



Manuela Valentini

Associate Professor in Methods and didactics of motor activities, University of Urbino "Carlo Bo", Italy manuela.valentini@uniurb.it

Giulia Delbene

Kindergarten Teacher and Physical Education Teacher, Special Education Teacher, University of Urbino "Carlo Bo", Italy
g.delbene@campus.uniurb.it

Effects of motor activity on manifestation of Autism Spectrum Disorder in preschool age children: systematic review

Effetti dell'attività motoria sul Disturbo dello Spettro Autistico in età prescolare: systematic review

Sezione Monografica

ABSTRACT

The objective of the review is to evaluate research that has tested the effect of physical activity and sports programs on children with Autism Spectrum Disorder (ASD) in preschool age (3-6 years). 26 research were considered, conducted at school, during free time and focused on the primary and secondary effects of motor activity interventions. The results showed that they are beneficial: a) to develop motor skills and improve the physical condition of children with ASD; b) to encourage interaction with peers and adults of reference, thus increasing the dimension of social communication; c) to allow them to improve attention span, stimulate working memory and reduce stereotyped and repetitive behaviours.

Keywords: Autism Spectrum Disorder, ASD, physical activity, preschool age

OPEN ACCESS Double blind peer review

How to cite this article: Valentini M., Delbene G. (2022). Effects of motor activity on manifestation of Autism Spectrum Disorder in preschool age children: systematic review. *Italian Journal of Special Education for Inclusion*, X, 2, 197-210. <https://doi.org/10.7346/sipes-02-2022-19>

Corresponding Author: Manuela Valentini | manuela.valentini@uniurb.it

Received: 02/08/2022 | **Accepted:** 18/12/2022 | **Published:** 31/12/2022

Italian Journal of Special Education for Inclusion | © Pensa MultiMedia Editore srl
ISSN 2282-6041 (on line) | DOI: 10.7346/sipes-02-2022-19

* Although the article is the product of a joint ideation and drafting, the "Introduction" paragraph is by M. Valentini, the paragraph "1. Methodology" and "2. Results" by G. Delbene, while "3. Discussion" and "Conclusions" are the result of the work of both authors



Introduction

Autism Spectrum Disorder (ASD) is generally detected in early childhood (Christensen et al., 2016) and the current incidence is high, with 1 out of 59 children having this condition (Baio, 2018). Among the non-diagnostic characteristics of autism, we recall the presence of an impairment in motor skills, so that 83% of children with ASD show problems in performing age-appropriate movements (Ruggeri et al., 2020). Research shows an abnormal motor learning model and reduced confidence in the execution of gestures that affect social and communication skills as well as motor skills (Peña de Moraes et al., 2017). Furthermore, even though it is now well known how important it is for the health of the entire population to carry out physical activity from the earliest years of life - meaning for childhood, activities such as playing, structured exercise and sports practice (Biino, 2020) - the levels of the same in children with ASD appear to be lower than those of peers with normotypic development (Hillier et al., 2020). The situation is even more compromised due to Covid-19, since rapid social changes have occurred in the last 2 years that have somehow impacted children with special educational needs and their families, especially with a loss in terms of routine, network, support structures and specialist inputs (Asbury et al., 2021). In fact, even the school has had to reorganize itself and especially in the first phase of readjustment the Special Educational Needs were forgotten (Venuti et al., 2020).

The intervention models studied and proposed today for this disability are used immediately in the pre-school period and are mostly behavioural and educational approaches (Medavarapu et al., 2019) that aim at broad aspects, such as difficulties at communicative and relational level (Sefen et al., 2020). In any case, it is good to consider the experience gained over the decades and rely on evidence to make the intervention more and more effective, calibrating and correcting their own actions if necessary (Cottini and Vivanti, 2022); in this regard, research confirms that physical exercise is among the emerging approaches for autism (Cottini, 2020). As well as Zeng and collaborators (2017) carried out a systematic review of the literature on the benefits of motor activity in preschool for normotypic subjects, confirming improvements in motor and cognitive skills (specifically in areas such as attention, memory, behaviour and school performance), positive outcomes have also been highlighted for individuals with autism, taking into account a much larger age sample: a 2010 study (Lang et al., 2010), for example, has analyzed 18 experiments involving adults and children on which improvements were recorded in the areas of behaviour, school performance and physical fitness and more recently this result was confirmed thanks to the research of Ruggeri and colleagues (2020).

The objective of this systematic review, however, is to specifically investigate the effects that motor activity has on autism spectrum disorder in preschool age, for which we wanted to consider protocols / research / articles that take into account experiments both at school and in children's free time, contexts that increasingly have to travel in synchrony and harmony, especially at this age. The final intent is to obtain greater clarity on this type of approach, especially in terms of scientific results obtained over the last decade, compared to a very important period of life such as that of second childhood, whose trend can strongly affect the development of the Person and their quality of life.

1. Methodology

For this systematic review of the literature, after establishing the objective and the inclusion and exclusion criteria, several steps were carried out for the final selection of the articles considered suitable. The survey was conducted in the months of April-May 2022 through the following steps:

- Definition of keywords and their inclusion in search engines;
- Analysis of the title and abstract of the articles found and initial data collection;
- Merging all results and removing duplicates;
- In-depth reading of the articles and further manual research of suitable trials;
- Design and creation of grids with the main and most significant information of each selected study.



Specifically, the EBSCOhost search platform was used through which it was possible to access various databases such as SPORTDiscus with Full Text, APA PsycArticles, APA PsycInfo, ERIC, MEDLINE and Academic Search Index. In addition, the PubMed search engine was consulted, while ScienceDirect, ResearchGate and ACADEMIA were considered in the last phase of manual search. Thanks to the «advanced search» tool, the keywords referring to the parameters established through the combination of the Boolean operators AND and OR were entered and a time frame for the publication of the studies was outlined between 2012 and 2022.

Key words

- autism (or ASD or autism spectrum disorder);
- physical activity (or exercise or fitness);
- pre-schoolers (or preschool children or toddlers or early childhood or kindergarten).

The information relating to the various experiments was collected within a grid including: Bibliographic indicators - name of the authors, title, year of publication, geographical area, search engine; Characteristics of the studies - purpose and results obtained, sample and its characteristics (age, number of participants and gender), setting, research design and data analysis methods.

Exclusion criteria

The excluded works:

- In languages other than English;
- With a population that does not include preschool children;
- Which also examine other disabilities in addition to autism.

Inclusion criteria

The Included trials:

- Of activities conducted not only at school, but also in free time.

Consideration and mitigation of the risks of bias

- Publication bias: scientific publications with significant and less significant results were chosen;
- Time lag bias: scientific publications between 2012 and 2022, wide time range;
- Language bias: scientific publications selected by the main search engines and disseminated in scientific journals of the sector.

The studies conducted in this field of investigation mainly involve a small sample of participants, for this reason those with a population of less than 10 participants were also included, up to a minimum of 5. Nevertheless, all publications were subjected to peer review and these results will be considered in the final reflections of the review.

The selection of the articles was performed without a funder.

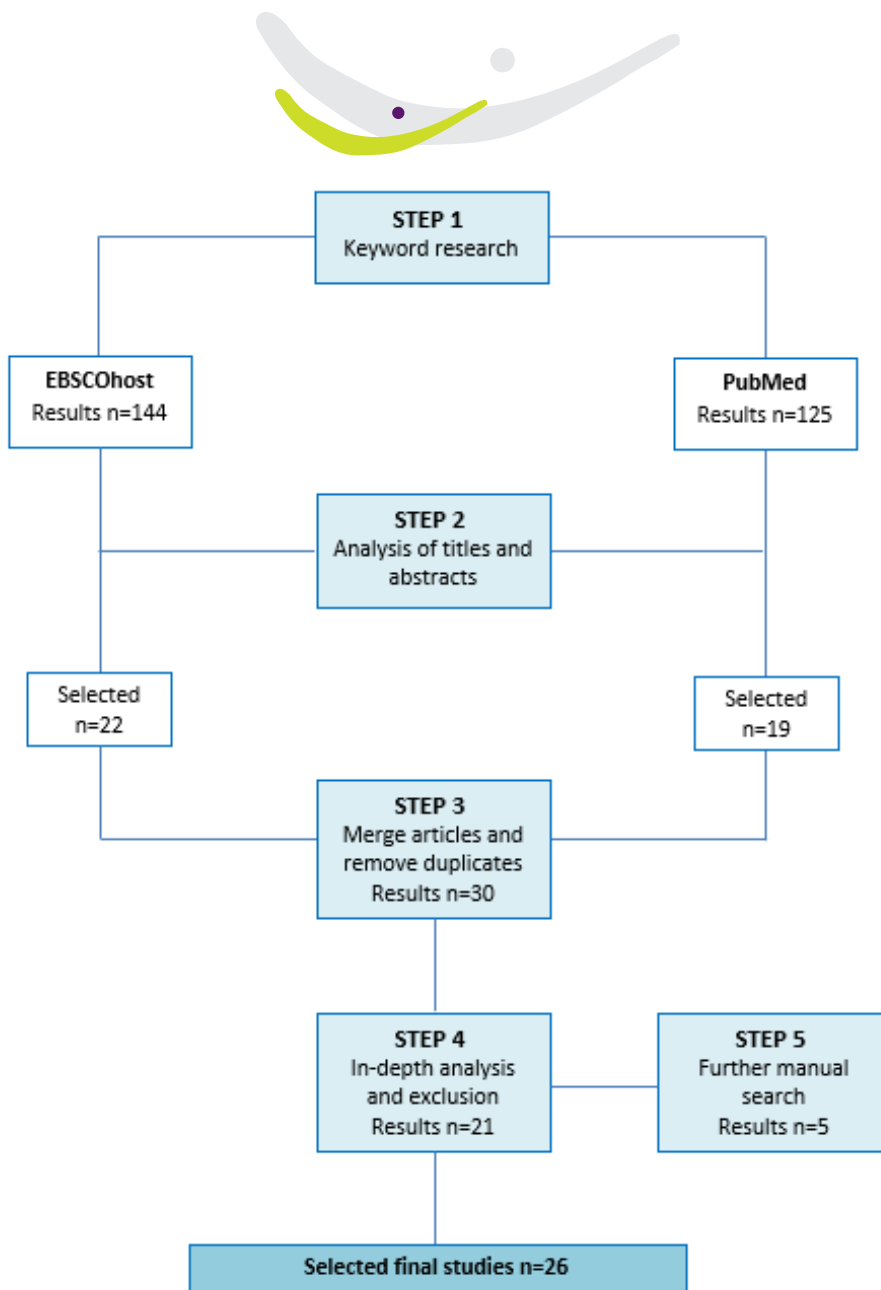


Figure 1 - Flow chart of the research phases (source: own elaboration)

2. Results

Thanks to the first phase of keyword insertion in search engines, a total of 269 studies were found ($n = 269$), of which an initial analysis of titles and abstracts was made, and it led to the exclusion of 228 articles ($n = 228$). Of the 41 considered valid for further study, 11 duplicates were removed ($n = 11$) and after a subsequent reading on the basis of the inclusion and exclusion criteria 21 articles were identified ($n = 21$) to which 5 others were added thanks to a subsequent and final manual search step ($n = 5$).

For the review work, a total of 26 studies ($n = 26$) were included, grouped into two tables: in the first one there are 10 experiments conducted on a sample exclusively of the reference age of the Kindergarten (3-6 years), while in the second there are 16 studies that include preschool children within samples larger than their age, which however fall within the period of childhood. This is because the path is taken into consideration in its evolutionary continuity.



Author (Year) Country Search engine	Setting Sample Age	Activities Duration Type of study	Focus	Results
Tan et al. (2013) Cina ResearchGate	Free time 12 children 2-6 years	Triathlon 8 meetings Pilot study	Identify the effects of physical activity on attention and quality of life in ASD children	Improvement of attention span and physical condition of ASD children
Bremer et al. (2015) USA PubMed	Free time 9 children 4 years	Motor skills intervention 12h of instruction Experimental design	Evaluate the effectiveness of the intervention on motor skills, adaptive behaviour and social skills in ASD	Motor skills improved significantly, no results on adaptive behaviour and social skills
Ketcheson et al. (2017) USA PubMed	Summer program 20 children 4-6 years	Intensive motor intervention 8 weeks Pilot study	Evaluate the effectiveness of an intervention on motor skills and physical activity levels; any results in ASD socialization	Increased motor competence and positive results in communication and social domains
Cai et al. (2020) China SPORTDiscus	Free time 59 children 3-6 years	Mini-basketball 12 weeks Quasi-experimental design	Effects of the sports program on physical fitness and social communication in ASD children	Improvement of physical fitness and social communication
Wang et al. (2020) China PubMed	Free time 33 children 3-6 years	Mini-basketball 12 weeks Quasi-experimental design	Effects of the sports program on executive functions and the main characteristics of the ASD	Improvement of executive functions, social communication and repetitive behaviours
Elliott et al. (2021) USA MEDLINE	Free time 9 children 4 years	Motor skills intervention 12 weeks Qualitative research	Secondary effects of motor activity on ASD children and understand any benefits on family well-being	Positive results on motor skills and secondary effects such as social skills, listening skills, etc ... Benefits for the child have extended to the family
Litchke et al. (2021) USA SPORTDiscus	School 29 children 3-4 years	Yoga and drums program 5 weeks Quasi-experimental design	Compare the schedule with the normal physical activity performed at school with ASD children and related effects	The program can benefit problem solving, memory, relationship building and the expression of positive emotions
Ketcheson et al. (2021) USA PubMed	Summer program 20 children 4-6 years	Motor skills intervention 8 weeks Experimental design	Assess any improvements in motor skills and whether these are related to the language skills possessed in ASD	Motor programs improve motor skills when language is supported



Schmidt et al. (2021) USA MEDLINE	School 5 children 3-5 years	WE PLAY-Autism program 5 days Experimental design	Effects of the program on the physical commitment of the teacher and on the levels of physical activity in ASD children	More active teachers and improved levels of moderate to vigorous physical activity
Yang et al. (2021) China PubMed	Free time 30 children 3-6 years	Mini-basketball 12 weeks Quasi-experimental design	Effects of the sports program on social communication and executive control in ASD children	Significant improvement in the sub-dimensions of social cognition and social communication

Source: own elaboration

Table 1 - Selected studies relating exclusively to preschool children

Author (Year) Country Search engine	Setting Sample Age	Activities Duration Type of study	Focus	Results
Bahrami et al. (2012) Iran MEDLINE	Free time 30 children 5-16 years	Martial arts 14 weeks Experimental design	Effects of Kata techniques on stereotypical behaviours of the ASD	Reduction of stereotyped behaviours
Movahedi et al. (2013) Iran ScienceDirect	Free time 30 children 5-16 years	Martial arts 14 weeks Experimental design	Effects of Kata techniques on social interaction in ASD children and teenagers	Significantly improved social dysfunctions
Chan et al. (2015) China PubMed	Free time 66 children 5-17 years	Nei Gong exercise 4 weeks Experimental design	Effects of the program on learning and memory in ASD children and adolescents	Significantly improved memory strategies
Lourenço et al. (2015a) Portugal ACADEMIA	Free time 17 children 4-11 years	Trampoline 20 weeks Quasi-experimental design	Effects of the program on motor competence and body mass index on ASD children and adolescents	Improvement in motor competence eg. balance and coordination, no results on BMI
Lourenço et al. (2015b) Portugal ResearchGate	Free time 16 children 4-10 years	Trampoline 32 weeks Experimental design	Effects of the program on lower limb strength and motor ability in ASD children and adolescents	Significant improvement in both lower limb strength and fine motor skills
Sarol & Çimen (2015) Turkey ResearchGate	Free time 59 children 4-18 years	ARPA program 8 weeks Quasi-experimental design	Effects of adapted motor activity on ASD	Positive contribution in physical and emotional development; possible improvement in the quality of life
Bahrami et al. (2016) Iran PubMed	Free time 30 children 5-16 years	Martial arts 14 weeks Experimental design	Effects of karate on the communication of ASD children and teens	Communication deficit effectively reduced



Bremer & Lloyd (2016) USA APA PsycInfo	Special school 5 children 3-7 years	Motor skills intervention 12 weeks Pilot study	Demonstrate the impact of the program on motor skills and its effectiveness in ASD children	Improvements in locomotor and object control skills, in social skills; reduction of problem behaviours
Hayward et al. (2016) USA Academic Search Index	Free time 18 children 5-19 years	Adaptive soccer 6 weeks Pilot study	Effectiveness of the program on ASD children and adolescents	Effective program with improvement in skills related to football and physical activity
Henderson et al. (2016) USA ResearchGate	Free time 37 children 5-12 years	PE program 6 months Pre-post-test design	Effects of the program on motor skills in ASD children	Improvement on 10 of the 12 skills that have been worked on
Zachor et al. (2016) Israel APA PsycInfo	Special schools 51 children 3-7 years	Outdoor education 13 weeks Experimental design	Examine the effectiveness of an outdoor adventures program in ASD children	Development of social communication skills and acquisition of new motor skills
Alaniz et al. (2017) USA PubMed	Free time 7 children 3-7 years	Swimming 24 sessions Pre-post-test design	Examine the effectiveness of a group aquatic therapy program on water safety and social skills in ASD	Improved water safety, no results on social skills
Najafabadi et al. (2017) Iran PubMed	Free time 28 children 5-12 years	SPARK program 12 weeks Quasi-experimental design	Effectiveness of the ex. group on motor and behavioural skills in ASD children	Significant improvement in static and dynamic balance, bilateral coordination and social interaction
Zhao & Chen (2018) China PubMed	Special school 41 children 5-8 years	Physical activity program 12 weeks Quasi-experimental design	Effects of the program on social interaction and communication in ASD children	Improvements in social skills, communication, timely response and frequency of expression
Zanobini & Solari (2019) Italy PubMed	Free time 33 children 3-8 years	Swimming 5 months Quasi-experimental design	Effects of the program on interpersonal skills, mannerisms, and aquatic skills in ASD	Improvement in interpersonal skills, a tendency to improve even in autonomy and negative behaviours; improvement in aquatic skills
Howells et al. (2020) Australia MEDLINE	Free time 61 children 5-12 years	Soccer 12 sessions Pilot study	Effects of the program on social, behavioural and communication functioning in ASD	Decrease in anxiety and social problems, no results on socialization and communication

Source: own elaboration

Table 2 - Selected studies that include preschool children within more or less large samples with respect to age



3. Discussion

Following a careful analysis of the selected studies, it is possible to gather some initial information. First, most surveys were conducted in the United States ($n = 10$) and China ($n = 6$); among the remaining ones some belong to Iran ($n = 4$), others come from European Union countries ($n = 3$), very few from Australia ($n = 1$), from Turkey ($n = 1$) and from Israel ($n = 1$); 8 of these are recent and were published between 2020 and 2021, an indication of an increasingly emerging interest in this issue. In addition, a further interesting aspect is that of the 26 research, 19 were developed in free time, mainly in afternoon programs of physical activity or sports and only 5 refer to school interventions (mostly special schools), probably because it was easier creating a working group as numerous as possible involving children with autism.

Since most of the motor activity-based trials have aspired to improvements in the motor skills and physical condition of children with ASD, but also in secondary aspects such as communication and social skills, executive functions, adaptation, etc., the results will be discussed separately.

Anyway the articles show how the various motor activities presented in the research, adapted to the psychomotor characteristics of children with ASD and beyond, (for example: mini-basketball, triathlon, trampoline, football, swimming, martial arts, yoga) facilitate the improvement of various aspects such as: basic motor patterns, body pattern perception/knowledge/consciousness, lateralization, general and special coordination skills, conditional skills, locomotor skills, physical condition, expressiveness, executive functions, moderate to vigorous physical activity levels, object control; they also facilitate the acquisition of new motor tasks. It demonstrates how much physical exercise contributes to fostering social inclusion, communication skills and transferability. In «doing movement» with targeted, personalized activities, proposed in a playful way, from the results that emerged, there is a reduction in stereotyped, repetitive behaviours, improving social dysfunctions, working memory, autonomy, anxiety management, social communication, listening, relationships, emotions and problem solving. It is important to underline that even where the experiments have shown variables of sufficient effectiveness between motor activity and ASD, the constant is that in any case the impact of movement in the little ones is fundamental in toto.

3.1 Primary effects of motor activity interventions

All research investigating the effect of motor activity on motor skills and physical condition of children with autism has obtained positive responses (Bremer & Llyoid, 2016; Bremer et al., 2015; Cai et al., 2020; Elliot et al., 2021; Hayward et al., 2016; Henderson et al., 2016; Ketcheson et al., 2016; Ketcheson et al., 2021; Lourenço et al., 2015a; Lourenço et al., 2015b; Najafabadi et al., 2021 al., 2018; Schmidt et al., 2021).

For example, Bremer and colleagues involved 9 4-year-old children with ASD, divided into experimental group and control group: they proposed to the first one 12 basic motor activity interventions (1 hour per week); each session was managed ensuring the 1: 1 or 1: 2 ratio by the expert and eventual assistants and was scanned into seven activities: warm-up, review of previously learned, teaching and practice of new skills, obstacle course and tidying up. Basic movement patterns such as running, jumping, throwing, grabbing, kicking, etc. were taught, and instructions were given using an image exchange communication system. The tests showed a notable improvement in locomotor skills, as well as in the manipulation of objects. A very similar study (Bremer & Llyoid, 2016) was conducted in a Canadian school, within a transition class (lasting 1 year), i.e. made up of autistic or similar students aged 3 to 7 who undergo additional training before taking part in inclusive classes. In this case, it was a question of 5 students who faced a program like the one mentioned above, again lasting 12 weeks, but with 3 meetings of 45 minutes each. The pupils benefited from the experience as they demonstrated overall improvements in motor skills, in particular in jumping, rolling and grabbing, all of which can be generalized to moments of play and sport in which children of this age usually participate. Also in the school environment, Schmidt and collaborators (2021) proposed a program to promote physical activity for kindergartens called «Wellness Enhancing



Physical Activity for Young Children» (acronym WE PLAY), adapted in WE PLAY-AUTISM, created with the intent to facilitate more physically active behaviour by teachers and increase the level of moderate to vigorous physical activity of students with autism. This program was designed for inclusive schools, in which students with disabilities are inside the class groups, and consists of several steps: training the teacher so that he or she can understand not only the importance of physical activity, but also know what strategies to adopt to favour it by reducing barriers; videos and cards with supporting images; self-assessment for the teacher; equipment package, etc. Two of the three teachers involved expressed an attitude that was more engaging and facilitated the movement of the students and three of the latter, belonging to three different sections of the same school, improved the level of physical activity. These data require further exploration but express the potential of the program.

Other experiments focused on the possible benefits of sports activities on children with autism, including that of Cai and collaborators (2020), who verified the results obtained on physical fitness thanks to 12 weeks of mini-basketball training, in 59 children aged 3 to 6. The experimental group ($n = 30$) performed 5 sessions of 40 minutes per week and end-of-course tests highlighted an increase in speed-agility and muscle strength. About the latter, increases were also achieved thanks to a trampoline sports program (Lourenço et al., 2015b). In this case, the authors took a larger age sample (4-10 years) and the 16 participants with ASD were placed in the experimental and control groups, respectively. Those who carried out the activity, at the end of 32 weeks of training, showed a considerable increase in the strength of the lower limbs, but also in motor skills such as coordination, balance and speed. The same researchers developed a similar experiment (Lourenço et al., 2015a) of shorter duration (20 weeks), in which motor skills and body mass index were assessed: they were found to increase balance and coordination, while for the BMI no statistically significant data were found. An adapted football program, on the other hand, has shown its effectiveness in increasing football-related skills, including kicking accuracy and greater agility (Hayward et al., 2016).

A study in free time was also carried out on the correspondence in motor skills alone in a centre for individuals with autism spectrum disorder (Henderson et al., 2016). The sample took into consideration the age group 5-10 years (of which 7 children were in the range 5-6 years) and the children were placed in groups of 10, with the participation in 20 physical activity lessons lasting 40 minutes each; thanks to the comparison of the pre and post-tests, improvements emerged in 10 of the 12 motor skills analyzed, especially in jumping and in controlling the object after the rebound. Also in free time, the Sports, Play and Active Recreation for Kids (SPRK) motor activity program was created for 28 children with autism aged 5 to 12, which favoured the static and dynamic balance and bilateral coordination of the participants. involved (Najafabadi et al., 2018). The coaches, qualified and supervised by a psychologist, have varied the proposal by alternating fitness activities such as aerobic dance, running games and rope jumping, with parts dedicated to skills thanks to different sports such as football, basketball, Frisbee, etc. Finally, there is the recent research by Ketcheson and colleagues (2021) which, thanks to an 8-week motor intervention on children aged 4-6 with ASD (reduced sample of 11 subjects), have shown how the customization of commands based on individual needs may be fundamental for a growth in motor skills; however, the generalization of these goals can be questioned for the small size of the group involved in the experiment.

3.2 Secondary effects of motor activity interventions

If some of the research have tried to understand the functionality of motor interventions mainly on motor skills, evaluating only in addition also aspects such as communication and social skills, others have exclusively focused their attention on secondary effects (Alaniz et al., 2017; Bahrami et al., 2012; Bahrami et al., 2016; Chan et al., 2015; Howells et al., 2020; Litchke et al., 2021; Mohavedi et al., 2013; Sarol & Cimen, 2015; Tan et al., 2013; Wang et al., 2020; Yang et al., 2021; Zachor et al., 2016; Zanobini & Solari, 2019; Zhao & Chen, 2018).



Regarding social interaction, Zhao and Chen (2018) structured a 12-week program of physical activity for 41 pupils aged 5 to 8 with autism attending a special school in China. The interventions of one hour each were organized into 4 parts, namely warm-up, exercises in small and large groups, relaxation and awarding of activities; instructors used the TEACCH model, but also a reward system to encourage students to participate and be active. The interaction was almost obligatory as they were asked to say hello, high five, pass the ball to teammates, etc., and these exchanges shared over the course of the various games positively influenced the overall scores in communication, especially in thanking and watching in someone's eyes when you speak. Another study conducted in special schools was also interested in evaluating the improvement of personal interactions encouraged through moments of outdoor adventure (Zachor et al., 2016): specifically, 51 children aged 3 to 7 with ASD participated in demanding physical activities that required cooperation and interaction with both peers and teachers. Each session included songs at the beginning and at the end and a moment of confrontation at the end in which to express one's feelings and preferences. The results supported the effectiveness of this intervention given the improvements in the experimental group in both communication and social motivation. Further experiments focused on the communicative dimension of autism spectrum disorder but using sport as a learning vehicle. For example, Yang and colleagues (2021) considered mini-basketball for 30 children with autism aged 3 to 6 (12-week program). Thanks to the second version of the Social Response Scale (SRS-2), the parents of the participants answered 65 questions after observing their child in specific performances in daily life. Although no significant effects emerged in the context of motivation and social awareness, others such as communication and social cognition were positively evaluated. Movahedi and collaborators (2013) and subsequently Bahrami and colleagues (2016) took advantage of the training sessions of Kata, which consists of martial arts exercises, to study possible connections. The children and young people concerned (30 for each study, with an age range varying from 5 to 16 years) were selected by institutes for young people with autism. The results obtained showed a reduction in the communication deficit in the experimental group compared to the control group, also following a follow-up conducted after one month (Bahrami et al., 2016) and a substantial improvement in social interaction (Movahedi et al., 2013). Two studies based respectively on a swimming program (Alaniz et al., 2017) and football (Howells, 2020), on the other hand, contradicted the previous results and underlined the presence of a non-response of intervention with respect to a possible strengthening of social function in young people with autism. Although swimming training has favoured greater safety in the water of autistic children and that of football a reduction of anxiety, according to the authors the communicative dimension has not suffered any effect. However, the first result was contradicted by a subsequent experimentation (Zanobini & Solari, 2019) which instead demonstrated how the individual sessions with the swimming teacher led to an increase in relational behaviours, for example greater eye contact, imitation and touch. However, this is a study with a small sample as the intervention was given to 12 children aged 3 to 8 years.

It is also interesting to present some studies that have highlighted how motor activity can have implications on executive functions, attention, memory and problem-solving skills, which are almost always compromised in autistic subjects. Once again sports programs emerge, in this case of triathlon (Tan et al., 2013) and again mini-basketball (Wang et al., 2020): the first one was tested on a population of preschool age (2-6 years) through 8 sessions of physical activity with advantages on the duration of the attention span; the second one, again on an age sample from Kindergarten, with significant benefits in working memory and in the regulation of movements, but also on the communication deficit and on repetitive behaviours. On the latter, further research (Bahrami et al., 2012) affirmed that thanks to martial arts it is plausible to reduce stereotypies in children with autism and that even at the end of the intervention, one month after the end of the 14 weeks (56 sessions), this parameter remained reliable. Concerning the benefits on memory, Chan and colleagues (2015) demonstrated how engaging in a traditional activity such as the Nei Gong game, which involves mind-body action, is potentially valid for learning and for the implementation of mnemonic strategies in childhood. This description concludes by mentioning a very current experiment (Litchke et al., 2021) which proposes an alternative to normal physical activity in the classroom in a kindergarten. More precisely Drumtastic® and Kid Yoga Rocks represents a combination



of drums and yoga: with the 29 autistic students aged 3-4 years included in the research, 3 groups, one for each type of intervention were created and the third one as a control group without any activities planned for them. For the drum group they were arranged in a circle and for all of them large gymnastic balls, each inserted inside a bucket, and a pair of sticks. All sessions included games with the latter, but also rhythmic songs, choreography and moments of social interaction. The yoga part, on the other hand, included the execution of 31 poses, breathing techniques and chants. Compared to children who have not received any treatment, both drums and yoga have developed greater problem solving and memory skills and have favoured relationships building and the expression of positive emotions.

4. Conclusions

As a conclusion of this work, whose question was to understand the effects of motor activity on autism spectrum disorder in preschool age, we can only confirm the positive results of this type of intervention. The experiments included within the critical analysis were numerous and, although very heterogeneous in the choice of objectives, it was possible to group them and make an overall final evaluation.

As previously discussed, the researchers' interest was placed on the benefits of physical activity, sport and movement games on the motor skills of children with autism; other investigations have focused on further deficits present in this disorder, including that in communication and social relations, but also in executive functions, stereotypes and personal well-being. All the studies, except for a few that have only partially obtained the desired results, confirm the hypothesis that motor activity interventions are advantageous: a) to develop motor skills and improve the physical condition of children with ASD; b) to encourage interaction with peers and adults of reference, thus increasing the dimension of social communication; c) to allow them to improve attention span, stimulate working memory and reduce repetitive behaviours. The studies show that motor play, whether it is proposed in a school/educational environment or for recreational purposes in leisure programs, is by its nature a facilitator within the contexts presented for the achievement of the objectives indicated above. Whether it is activities carried out in the school gym/garden or in the play areas available to sports clubs and specialized centres for special educational needs, it is the movement proposal that makes the occurrence of some relational and communicative dynamics completely natural, as well as the acquisition of motor skills, which if not encouraged in most cases could remain deficient. Think, for example, of the visual and gestural exchange with the educators of reference or with the companions for passing the ball, the intention and attention towards a game objective such as a shot for the basket or on goal or a jump, the imitation and memorization of movements performed by a partner or by the coach are all expedients which motivate the autistic pupil to engage in the game/sport and which guarantee the activation of the processes highlighted in the surveys presented. These milestones achieved can truly change the quality of life of children with autism, but also of their families. In this regard, some parents have underlined how their children have generalized the learning obtained in the physical activity program in different environments of daily life such as home, school and extracurricular activities (Elliott et al., 2021). Greater safety was highlighted for one's physical abilities, from which new possibilities arise, such as choosing motor games as an alternative to electronic devices, going up and down stairs independently without the help of the railing, having the pleasure of playing in the park and with the ball; from the relational point of view a greater sociability and research of the group, as well as greater interaction and interdependence in the game between siblings. In fact, it is above all in group experiences that children with disabilities can get involved and experiment, share and consolidate their identity (D'Alonzo, 2017b). These aspects guide us to the concept of self-determination and to the possibility for these children, future adults, to become more autonomous, able to express personal interests and act according to their own decisions (Cottini, 2016).

Given the low levels of physical activity in preschool children - including those with autism - in childcare facilities (Fedewa et al., 2015, Schmidt et al., 2021), greater belief in the implementation of physical education intervention programs at school is needed, as well as to create continuity with leisure time projects



which, as we have understood, can really be useful for the physical health and well-being of children, respecting in this way the inclusive perspective. For this reason, the intervention of professionals, including teachers, should not be limited to the school environment alone, but rather open to an «educational-didactic proposal capable of promoting inclusion in the wider existential horizon of the person himself» (Gaspari, 2013, p. 347). Early intervention is fundamental in autism spectrum disorder (Bremer et al., 2015; Zachor et al., 2016) and physical activity programs could complement and become part of more commonly used services, which are not always sustainable in terms of costs.

It is good to say that the trials presented were conducted on small target populations and that the research should be further investigated. However, in the light of what has been argued above, what is hoped for with this research is a greater knowledge of these approaches and their possible benefits and above all, starting from the Kindergarten, through the collaboration between curricular teachers and specialized support teachers, to find the courage to innovate (D'Alonzo, 2017a) implementing a more widespread application of the same.

Bibliography

- Alaniz M. L., Rosenberg S. S., Beard N. R., & Rosario E. R. (2017). The Effectiveness of Aquatic Group Therapy for Improving Water Safety and Social Interactions in Children with Autism Spectrum Disorder: A Pilot Program. *Journal of autism and developmental disorders*, 47(12), 4006–4017. <https://doi.org/10.1007/s10803-017-3264-4>.
- Asbury K., Fox L., Deniz E., Code A., & Toseeb U. (2021). How is COVID-19 Affecting the Mental Health of Children with Special Educational Needs and Disabilities and Their Families? *Journal of autism and developmental disorders*, 51(5), 1772–1780. <https://doi.org/10.1007/s10803-020-04577-2>
- Bahrami F., Movahedi A., Marandi S. M., & Abedi A. (2012). Kata techniques training consistently decreases stereotypy in children with autism spectrum disorder. *Research in developmental disabilities*, 33(4), 1183–1193. <https://doi.org/10.1016/j.ridd.2012.01.018>
- Bahrami F., Movahedi A., Marandi S. M., & Sorensen C. (2016). The Effect of Karate Techniques Training on Communication Deficit of Children with Autism Spectrum Disorders. *Journal of autism and developmental disorders*, 46(3), 978–986. <https://doi.org/10.1007/s10803-015-2643-y>
- Baio J., Wiggins L., Christensen D. L., Maenner M. J., Daniels J., Warren Z., Kurzius-Spencer M., Zahorodny W., Robinson Rosenberg C., White T., Durkin M. S., Imm P., Nikolaou L., Yeargin-Allsopp M., Lee L. C., Harrington R., Lopez M., Fitzgerald R. T., Hewitt A., Pettygrove S., ... Dowling N. F. (2018). Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2014. *Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C.: 2002)*, 67(6), 1–23. <https://doi.org/10.15585/mmwr.ss6706a1>
- Biino V. (2020). L'attività fisica correlata alle funzioni esecutive: studi e applicazioni in ambito scolastico. *Ricercazione*, 12(1), 149-166.
- Bremer E., Balogh R., & Lloyd M. (2015). Effectiveness of a fundamental motor skill intervention for 4-year-old children with autism spectrum disorder: A pilot study. *Autism: the international journal of research and practice*, 19(8), 980–991. <https://doi.org/10.1177/1362361314557548>
- Bremer E., & Lloyd M. (2016). School-Based Fundamental-Motor-Skill Intervention for Children With Autism-Like Characteristics: An Exploratory Study. *Adapted physical activity quarterly: APAQ*, 33(1), 66–88. <https://doi.org/10.1123/APAQ.2015-0009>
- Cai K. L., Wang J. G., Liu Z. M., Zhu L. N., Xiong X., Klich S., Maszczyk A., & Chen A. G. (2020). Mini-Basketball Training Program Improves Physical Fitness and Social Communication in Preschool Children with Autism Spectrum Disorders. *Journal of human kinetics*, 73, 267–278. <https://doi.org/10.2478/hukin-2020-0007>
- Chan A. S., Han Y. M., Sze S. L., & Lau E. M. (2015). Neuroenhancement of Memory for Children with Autism by a Mind-Body Exercise. *Frontiers in psychology*, 6, 1893. <https://doi.org/10.3389/fpsyg.2015.01893>
- Christensen D. L., Baio J., Van Naarden Braun K., Bilder D., Charles J., Constantino J. N., Daniels J., Durkin M. S., Fitzgerald R. T., Kurzius-Spencer M., Lee L. C., Pettygrove S., Robinson C., Schulz E., Wells C., Wingate M. S., Zahorodny W., Yeargin-Allsopp M., & Centers for Disease Control and Prevention (CDC) (2016). Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years—Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. *Morbidity and mortality weekly report. Surveillance*



- summaries (Washington, D.C.: 2002), 65(3), 1–23. <https://doi.org/10.15585/mmwr.ss6503a1>
- Cottini L. (2016). *L'autodeterminazione nelle persone con disabilità. Percorsi educativi per svilupparla*. Trento: Le Guide, Erikson
- Cottini L. (2020). Gli interventi efficaci nei disturbi dello spettro autistico: uno sguardo alle principali linee guida. *Giornale Italiano dei Disturbi del Neurosviluppo*, 4(1), 33–68.
- Cottini L. & Vivanti G. (2022). *Autismo e didattica. Potenziare gli interventi in classe con materiali dedicati all'Area cognitivo-curricolare completati da attività per le abilità sociali, emotive e di comunicazione*. Firenze: Giunti EDU.
- d'Alonzo L. (2017a). Il coraggio nell'innovare per includere. La differenziazione didattica. *L'integrazione scolastica e sociale*, 16(4), 361–369.
- d'Alonzo L. (2017b). Pedagogical consultants for disability and marginalization. *Pedagogia Oggi*, 15(2), 145–157.
- Elliott L. K., Weiss J. A., & Lloyd M. (2021). Beyond the Motor Domain: Exploring the Secondary Effects of a Fundamental Motor Skill Intervention for Children With Autism Spectrum Disorder. *Adapted physical activity quarterly: APAQ*, 38(2), 195–214. <https://doi.org/10.1123/apaq.2020-0024>
- Gaspari P. (2013). Una cornice epistemologica per i Bisogni Educativi Speciali. *L'integrazione scolastica e sociale*, 12(4), 344–354.
- Gorbett Litchke L., Willemin T., Willemin A., Ekins C., & Owens D. P. (2021). Efficacy of Therapeutic Recreation-Based Drumtastic® and Kid Yoga Rocks in an Early Childhood Public School Setting. *Therapeutic Recreation Journal*, 55(1), 60–77.
- Hayward L. M., Fragala-Pinkham M., Johnson K., & Torres A. (2016). A Community-Based, Adaptive Soccer Program for Children with Autism: Design, Implementation, and Evaluation. *Palaestra*, 30(4), 44–50.
- Henderson H., Fuller A., Noren S., Montensen Stout V., & Williams D. (2016). The Effects of a Physical Education Program on the Motor Skill Performance of Children with Autism Spectrum Disorder. *Palaestra*, 30(3), 41–50.
- Hillier A., Buckingham A., & Schena D., 2nd (2020). Physical Activity Among Adults With Autism: Participation, Attitudes, and Barriers. *Perceptual and motor skills*, 127(5), 874–890. <https://doi.org/10.1177/0031512520927560>
- Howells K., Sivaratnam C., Lindor E., Hyde C., McGillivray J., Whitehouse A., & Rinehart N. (2020). Can Participation in a Community Organized Football Program Improve Social, Behavioural Functioning and Communication in Children with Autism Spectrum Disorder? A Pilot Study. *Journal of autism and developmental disorders*, 50(10), 3714–3727. <https://doi.org/10.1007/s10803-020-04423-5>
- Ketcheson L., Felzer-Kim I. T., & Hauck J. L. (2021). Promoting Adapted Physical Activity Regardless of Language Ability in Young Children With Autism Spectrum Disorder. *Research quarterly for exercise and sport*, 92(4), 813–823. <https://doi.org/10.1080/02701367.2020.1788205>
- Ketcheson L., Hauck J., & Ulrich D. (2017). The effects of an early motor skill intervention on motor skills, levels of physical activity, and socialization in young children with autism spectrum disorder: A pilot study. *Autism: the international journal of research and practice*, 21(4), 481–492. <https://doi.org/10.1177/1362361316650611>
- Lang R., Koegel L.K., Ashbaugh K., Regester A., Ence W., & Smith W. (2010). Physical exercise and individuals with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 4(4), 565–576.
- Lourenço C., Esteves D., Corredeira R., & Seabra A. (2015a). Children with Autism Spectrum Disorder and Trampoline Training. *Palaestra*, 29(4), 20.
- Lourenço C., Esteves D., Corredeira R., & Seabra A. (2015b). The Effect of a Trampoline-Based Training Program on the Muscle Strength of the Inferior Limbs and Motor Proficiency in Children with Autism Spectrum Disorders. *Journal of physical education and sport*, 15, 592.
- Medavarapu S., Marella L. L., Sangem A., & Kairam R. J. C. (2019). Where is the evidence? A narrative literature review of the treatment modalities for autism spectrum disorders. *Cureus* 11, 3901. doi: 10.7759/cureus.3901
- Movahedi A., Bahrami F., Marandi S. M., & Abedi A. (2013). Improvement in social dysfunction of children with autism spectrum disorder following long term Kata techniques training. *Research in autism spectrum disorders*, 7(9), 1054–1061.
- Najafabadi M. G., Sheikh M., Hemayattalab R., Memari A. H., Aderyani M. R., & Hafizi S. (2018). The effect of SPARK on social and motor skills of children with autism. *Pediatrics and neonatology*, 59(5), 481–487. <https://doi.org/10.1016/j.pedneo.2017.12.005>
- Peña de Moraes Í., Massetti T., Crocetta T. B., da Silva T. D., de Menezes L., Monteiro C., & Magalhães F. H. (2017). Motor learning characterization in people with autism spectrum disorder: A systematic review. *Dementia & neuropsychologia*, 11(3), 276–286. <https://doi.org/10.1590/1980-57642016dn11-030010>
- Ruggeri A., Dancel A., Johnson R., & Sargent B. (2020). The effect of motor and physical activity intervention on motor outcomes of children with autism spectrum disorder: A systematic review. *Autism: the international journal of research and practice*, 24(3), 544–568. <https://doi.org/10.1177/1362361319885215>
- Sarol H. & Çimen Z. (2015). The effects of adapted recreational physical activity on the life quality of individuals



- with autism. *The Anthropologist*, 21(3), 522-527.
- Sefen J., Al-Salmi S., Shaikh Z., AlMulhem J. T., Rajab E., & Fredericks S. (2020). Beneficial Use and Potential Effectiveness of Physical Activity in Managing Autism Spectrum Disorder. *Frontiers in behavioral neuroscience*, 14, 587560. <https://doi.org/10.3389/fnbeh.2020.587560>
- Schmidt E. M., Hoffman J. A., Mulé C., & Briesch A. (2021). Effects of a teacher training program to promote physically active play among preschoolers with autism spectrum disorders. *Journal of school psychology*, 85, 57–79. <https://doi.org/10.1016/j.jsp.2021.01.003>
- Tan W.Z.B., Cohen L. & Pooley J. (2013). Physical activity: its implication on attention span and quality of life in children with Autism Spectrum Disorders. *Journal of Law and Social Sciences*, 2(2), 108-116.
- Venuti P., Cainelli S., Coco C. (2020). L'accompagnamento esperto dei consigli di classe per l'inclusione degli studenti con disturbi dello spettro autistico. Esperienze e riflessioni maturate nella scuola trentina ai tempi del Covid-19. *RicercaAzione*, 12(1), 235-239.
- Wang J. G., Cai K. L., Liu Z. M., Herold F., Zou L., Zhu L. N., Xiong X., & Chen A. G. (2020). Effects of Mini-Basketball Training Program on Executive Functions and Core Symptoms among Preschool Children with Autism Spectrum Disorders. *Brain sciences*, 10(5), 263. <https://doi.org/10.3390/brainsci10050263>
- Yang S., Liu Z., Xiong X., Cai K., Zhu L., Dong X., Wang J., Zhu H., Shi Y., & Chen A. (2021). Effects of Mini-Basketball Training Program on Social Communication Impairment and Executive Control Network in Preschool Children with Autism Spectrum Disorder. *International journal of environmental research and public health*, 18(10), 5132. <https://doi.org/10.3390/ijerph18105132>
- Zachor D. A., Vardi S., Baron-Eitan S., Brodai-Meir I., Ginossar N., & Ben-Itzhak E. (2017). The effectiveness of an outdoor adventure programme for young children with autism spectrum disorder: a controlled study. *Developmental medicine and child neurology*, 59(5), 550–556. <https://doi.org/10.1111/dmcn.13337>
- Zanobini M., & Solari S. (2019). Effectiveness of the Program «Acqua Mediatrice di Comunicazione» (Water as a Mediator of Communication) on Social Skills, Autistic Behaviors and Aquatic Skills in ASD Children. *Journal of autism and developmental disorders*, 49(10), 4134–4146. <https://doi.org/10.1007/s10803-019-04128-4>
- Zeng N., Ayyub M., Sun H., Wen X., Xiang P., & Gao Z. (2017). Effects of Physical Activity on Motor Skills and Cognitive Development in Early Childhood: A Systematic Review. *BioMed research international*, 2017, 2760716. <https://doi.org/10.1155/2017/2760716>
- Zhao M., & Chen S. (2018). The Effects of Structured Physical Activity Program on Social Interaction and Communication for Children with Autism. *BioMed research international*, 2018, 1825046. <https://doi.org/10.1155/2018/1825046>