

The role of physical education and exercise for children with Autism Spectrum Disorder and the effects on socialization, communication, behavior, fitness, and quality of life

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Abstract

Autism spectrum disorder (ASD) is often characterized by motor debilities and inabilities. Studies also show that children with ASD exhibit reduced skills and difficulty in increasing physical fitness compared to children of the typical population, during physical activity, with multiple health effects. On their health sports and exercise are useful as they reduce these motor inabilities, increase physical fitness, reduce the time of sedentary life, and provide a form of socialization to the child which also helps in other areas. However, international literature has yielded limited but useful results, exercises and sports activities require further exploration for children with ASD as it is observed that family, educators, and other experts find difficulties in adapting physical activity so that it achieves positive effects in areas such as communication, socialization, behavior, and fitness required for the daily activities of children, with the aim of improving quality of life. The purpose of the research was to review the international and domestic literature in order to find out about the efficacy and physical education of children with ASD. Also, the gathering of information on the characteristics of this population as well as controlling the impact of physical education and exercise in the fields of socialization, behavior, communication, fitness, and quality of life. We used specific databases with a lot of encouraging findings in all areas to investigate our cases. Specifically, all of the domains tested were in accordance with research data from low to moderate positive effects following children's participation in exercise programs in the areas of socialization, behavior, communication, fitness, and quality of life. However, the limited literature and the gaps in the various surveys lead us to conclude that further research is needed in order to have a comprehensive picture of the above situation.

Keywords: *physical exercise, autism spectrum disorder (ASD), socialization, communication, behavior, physical condition, quality of life.*

Introduction

Our research focuses on key areas related to autism spectrum disorders and whether physical education has a positive impact on socialization, behavior, communication, fitness, and how it can help children, in daily life and living to achieve a better quality of life. In order to write this paper looking for material that will shed light on certain aspects of the autism spectrum, which relates to physical education, we have extracted material for a series of sports and activities involving students and children with ASD. with positive effects on physical status, socialization, behavior, communication, and quality of life [1,2,3,4].

The purpose of this work is to synthesize the complexity of barriers faced by students and children with ASD. However, each child is different with symptoms varying as results [5]. Kinematically children and pupils with ASD have difficulty in perceiving their body and their limbs in space which causes difficulties in controlling their body and their movement [6]. It is essential that exercise starts from an early age as the challenge for better results increases.

Child health and proper treatment of disorders result in reduced motor skills and a positive effect on proper posture and performance in large core muscle groups, which assist in daily movement [7]. However, it is important to note that the deficits created by the pupil's young age often persist for the rest of his or her life, as a structured exercise program is not pursued, with the aim of engaging the child in the long term and in adulthood [8,9]. With our research, we will try to compose a puzzle of the positive effects of physical education on the separate and multifaceted areas of children with ASD.

Purpose and necessity

The purpose of the research is to review the international literature and to find out the efficacy of physical education in students and children with ASD. The primary requirement was to collect information on the nature of the disorder and the individual difficulties encountered by these children, and in addition to check the efficacy and impact of physical

education and exercise in the areas of socialization, behavior, communication, of fitness in everyday life.

According to research from the last decade, there seems to be unanimity in the positive effect of exercise. The findings of the study [10], show that customized physical education appears to be effective in reducing the stereotypical behavior of a child with ASD and in developing their motor, social, and communication skills. However, what is troubling is the need for further research into the way and structure of customized exercise programs as well as the small samples included in surveys with children with ASD [10]. It would also be necessary for subsequent research to use semi-structured interviews to further examine the deeper thoughts and beliefs of all participants that cannot be expressed solely by the use of questionnaires. Combining a qualitative and quantitative approach with the use of a larger sample of children with ASD could help to further identify, influence, to exercise behavioral and communication skills as well as other characteristics of children with ASD [10].

Another step for researchers to make clearer interpretations of the effects of physical activity interventions on students and young people with ASD is to use real experimental designs to ensure that participants are at a comparable level before applying an intervention procedure. In addition, a comparable control group consisting of individuals with ASD with similar symptoms and reactions to stimuli as much possible [11] should be used. Future research should also focus on interventions aimed at enhancing self-service skills and skills related to access to society by adults and children with ASD [12]. Also, functional living skills are skills needed so that a person can be independent in society.

As people with ASD grow older and reach old age, the difference between functional living skills and that of their peers' increases, so following the study [13] it would be useful to analyze the data on generalization and maintenance conditions in future studies to determine the long-term effects. Visual stimuli and the presence of music in future research should also be explored in order to determine whether this intervention will continue to produce positive results when investigated with additional participants [13].

Also, one of the most important areas for future research may include evaluating the various processes used to perform or maintain the exercise. Still, ASD encompasses a wide range of mental functioning and symptoms, so study participants are predominantly diagnosed with autism and limited to those with Asperger's syndrome [13].

Future research investigating the effects of exercise across the spectrum of disorders would be beneficial and would help all those involved to better handle the incidents [5]. Finally, research aimed at identifying the mechanism by which exercise positively influences behaviors is necessary. Understanding this mechanism could lead to improvements in the use of exercise for the treatment of various behaviors and could help all involved in developing more effective programs for people with ASD [5]. Of course, future research is needed to consider interventions that will identify appropriate environmental modifications or adjustments to support children with ASD in their daily functioning [14].

Methodology

The process of authoring the research began in August 2018 with the review of literature playing a leading role in the study of the areas of socialization, communication, behavior, fitness, and quality of life in the lives of children with ASD. All of these areas were examined on the basis of the role of physical education and exercise separately to see if there were any effects. The sources for the final analysis included all the studies published in the last 15 years, specifically between 2003 and 2018. According to the literature, we focused on the above areas because of the nature of the deficits and wanting to see if there are sources that demonstrate the positive impact of physical education on students and children with ASD.

The sample of the study was mainly focused on children and students with ASD, from 3-18 years of age, which is why it is essential that intervention programs start at the youngest possible age but continue during adulthood of children. Based on our surveys we identified a variety of exercise activities that promoted the areas mentioned above. Overall,

the investigations we encountered and the effects of exercise on the above areas varied according to the level of symptoms of ASD. Any research that did not address any of the above areas and at the same time the age limit that we set to exceeded the predetermined, were not included for the conclusions.

Specifically, for each area of research, we will mention the number of articles we used: for socialization, we collected 8 articles, for communication, we based on 7, for behavior on 9, for fitness on 16 articles, and finally for quality of life in the daily lives of children with ASD at 5. First of all, I started the search engine bibliography using the list of keywords I had created. If the title of the article was relevant to the context of the study, I saved the title and the citation of the article. In the second stage, I began to independently review the article summaries and keyword lists of each article stored so that if the summary did not provide sufficient information about the criteria I had set, it was excluded from the study. In the third stage, I independently undertook the rest of the articles in full text for further consideration, if the articles did not meet the criteria we had set, they were excluded from the study. The bibliography used was derived from: The University of Nicosia electronic library, PubMed and Medline database, EBSCOhost, ProQuest, Scopus, SPORTDiscus, ERIC as well as books related to the fields of this research. All the articles we collected and counted on were in English with a small number of books, making the exception for the Greek language. By reviewing the summaries of each survey, we identified the studies related to the search fields we had set. Studies that did not explicitly refer to participants with ASD of any functionality were excluded from the review.

Comparison between typical developmental children and children with Autism Spectrum Disorder

The evidence for the importance of daily physical exercise with an impact on the health of children and adolescents is increasing [15]. Increased levels of fitness enhance cardiopulmonary function [16].

The literature reports that children and adolescents should participate in moderate to vigorous exercise programs for 60 minutes or more per day for most of the week [15, 17]. In addition, fitness patterns remain from childhood to adolescence and from adolescence to adulthood [17]. Consequently, significant research efforts have been made to fully understand the physical fitness of the young as a changing lifestyle behavior. However, there is little information on the physical fitness and physical difficulty of young people with ASD [17].

ASD is characterized by limited interests, impaired social interaction and communication skills in relation to the children of the typical population [18]. Researchers have observed differences in the motor skills of school-aged children with ASD compared to standard growth children [4]. These parameters of social, behavioral and motor impairments appear to interfere with various physical education programs and, as a result, endanger children and youth with activities, thus maintaining low levels of fitness [17].

Obesity has become a major concern for children's health around the world, including the population with ASD. Although the prevalence of obesity in these children may not have exceeded the National Survey of Children's Health's 2003-2004 norms, statistics suggest that young people with ASD are 40% more likely to be overweight and obese than their peers. Those with typical development [19]. A recent study evaluated the status of the Body Mass Index (BMI) for children with ASD and compared it with that of the general population using data from the National Health and Nutrition Examination Survey (NHANES) 2007-2008. This research has shown that the prevalence of obesity in children with ASD may vary with age [17]. Although the factors affecting obesity in children with ASD include dietary habits, medications, reduced opportunities for exercise, and increased interest in a sedentary life, the positive effect of Physical Education cannot be overlooked.

Another survey [20] examined fitness status and determinant factors in children with ASD and found that fitness was lower in the obese group than in the normal-weight group and that age was associated with a decrease in physical

activity in children with ASD. [21] comparing the physical activity of these children, with typical developmental children, aged 3 to 11 years. The results showed that children with ASD and children with typical development received similar levels of physical activity over a week (7 consecutive days), demonstrating that children with ASD spent less time engaging in moderate activity than children with typical development on working days. Only 23% of participants with ASD reached the criteria for at least 60 minutes of daily activity. [22] there were no differences in daily activity levels during and after school hours between children with ASD and those with formal developmental disabilities, aged 5 to 12 years. Also, there were no differences between the days of the week for levels of physical activity, children with ASD and those with typical development. Still 67% of children with ASD participated in at least 60 minutes of physical activity per day.

Memari et al [20] examined the type of physical activity in children with ASD aged 7 to 14 years and found that activity levels on weekdays and weekends did not differ significantly. However, young people with ASD were significantly less active at school than those who spent time outside of school. In 2014, Pan investigated the type of physical activity in children and adolescents with ASD aged 10 to 19 years and found no differences in activity in terms of weekday variability and participants' functional level. The results also showed that physical activity decreased with increasing age and only 47% of young people with ASD met the recommended 60-minute limit of daily exercise [4].

Macdonald et al [23] evaluated the moderate to intense physical activity of a group of 72 children and young people with ASD aged 9 to 18 years and concluded that both children (9-11 years) and older age groups (12-18 years) responded to a minimum of 60 minutes of daily physical activity. The results of their study also revealed reductions in physical activity as young people age. As physical activity decreases in young people with ASD, the need to understand the importance of exercise in this population has become of great importance in the development, implementation, and evaluation of physical education interventions.

The level of physical activity is considered a behavioral factor and affects physical fitness, which is often divided into aerobic status (cardiopulmonary endurance test), musculoskeletal function (muscle strength and endurance test), flexibility (range of motion test) and body composition (test for degree of body elasticity) [24]. However, there is limited data on the levels of physical activity and physical fitness of youth with ASD, and there are not enough studies to investigate this relationship [17].

Borremans et al [25] compared the level of physical activity, in relation to fitness, of children and adolescents with and without Asperger's Syndrome, and found that children and adolescents with Asperger's Syndrome were less physically active and rated lower for their physical status. compared to adolescents with typical development. Tyler et al [26] examined the profiles of physical activity and young people's abilities (ages 9-18) with and without ASD and observed that youths with ASD were significantly less exposed to physical activity, as well as having fewer adjustments to power compared with their peers with typical development. However, this youth exhibited similar aerobic ability, body composition, and flexibility compared to their peers with typical development. Unfortunately, this study did not investigate the relationship between physical activity and physical fitness.

In the study of Pan et al [17], fitness was measured in participants with and without ASD, and significant differences were observed between the two groups in terms of walking for 20 meters, isometric postural flexibility, abdominal muscle exercises, and sit-and-reach testing test, indicating that participants with ASD have lower levels of cardiovascular endurance, also lower abdominal muscle strength and endurance, and lower levels of body flexibility compared to children with typical development. However, there were no significant differences in body composition between groups. In the same study [17] examined the relationship between physical activity and physical status in children with and without ASD. Participants with ASD showed a low correlation between physical activity and cardiovascular endurance, which was also seen in abdominal muscle strength and endurance. A low correlation was also ob-

served between moderate and high physical activity of the trunk muscles for strength and endurance. A moderate correlation was observed between moderate and high physical activity, abdominal muscles, strength, and endurance. There were no significant correlations between physical activity and flexibility, as well as between physical activity and body composition, for participants without ASD. Low correlations were observed between physical activity of children with ASD who reached the required thresholds and those with standard growth participants who did not reach the threshold. They also had significantly lower cardiovascular endurance and lower levels of flexibility than participants with standard growth who achieved the thresholds [17].

Effects of physical education and exercise on socialization - communication - behavior in children with ASD

The impact of the swimming program on behavioral and social skills for the study [27] has shown results that have been associated with reduced antisocial behavior problems and an increase in socialization skills. Therefore, the findings of the study by Ketcheson et al. [9] will be supported by previous research [27, 28], where changes in motor skills appear to have a positive impact on the social sector. Also, the analysis of the results of the research [11] showed that social functioning in young people with ASD was moderately affected by physical activity interventions, as in previous studies [29]. Concerning behavior: participation in physical activity has been identified as an approach to reduce stereotypical behavior (30, 31).

The results of the study [32] reported positive behavior that was associated with an increase in academic participation after physical activity, suggesting that exercise may have a direct impact on school participation. A follow-up study supports the potential benefits of physical activity as an intervention to reduce unwanted behavior and increase appropriate school behavior [3]. For example, it is possible that reductions in challenging post-exercise behavior may be due to physical fatigue [3].

Previous reviews have been conducted on the impact of physical activity and exercise interventions on people with ASD [5, 33, 34, 29] that resulted in positive results. On the other hand, researchers from [8] found no reduction in stereotypical behaviors following the jogging intervention program. However, the other five studies found significant reductions [30, 35]. Only two of the studies used controlled trials to assess the impact of exercise on stereotyped behaviors [30,35]. Found statistically significant reductions in stereotypical behavior after the intervention and no significant change after intervention for 30 days[30].

An intervention in the background research of [28], showed that horse riding included a socio-functional measure that showed significant improvements in adaptive behavior, as well as communication, social and daily living skills, from the initial intervention to the post-intervention period [35]. However, these changes were not significant compared to the control period [35].

Participants in the study [36] showed reduced stereotypes in their behavior as a result of the 48-week exercise intervention program, confirming the positive effect of exercise on primary symptoms of ASD [28,17]. In his research, [27] noted significant behavioral improvements in social competence, as well as a reduction in unwanted behavior, from initial to final intervention. However, these changes were not significant compared to the control group. Finally, [37] found significant reductions in symptoms of unwanted behavior, from initial intervention to the final one with yoga and dancing, but did not include a control group in the design of their study.

For communication, [38] point out that by adhering to certain strategies in physical education programs, activities can become beneficial in resolving problems that children with ASD face during sports and physical activities. This creates a climate of willingness to engage in daily activities, to socialize, to communicate and to be active throughout their lives. The results of one study showed that the bathing process was effective in teaching basic bathing skills, as well as significant mention by parents of improving children's language skills through the program [39].

Effects of physical education and exercise on the physical condition of children with ASD

In deriving the results of the second research question concerning the role of physical education and exercise in the field of physical fitness for children with ASD, [40] in a sample of 10 children with ASD and co-existing mental retardation aged 14-18 years showed results showing exercise ability, measured by walking speed, body mass index and exercise frequency with improvements in all the measures for the intervention group. Evaluated a combined intervention, physical activity, and diet changes, for children with intellectual disabilities and ASD, who have been recognized as overweight or obese in New Zealand[41]. A 10-week program included healthy parenting training sessions and two-day exercise program sessions with children. The results of the study showed an improvement in the gait rate after the intervention. This study was characterized as the first combination of exercise and diet intervention in people with ASD [41].

Sam et al [42] analyzed eight studies examining the effects of socialization and physical activity on people with ASD. With findings from moderate to high impact on results. Sowa and Meulenbroek [29] examined the effects of exercise interventions categorized as group and individual in the areas of motor, social, and communication skills. The aggregated results showed an overall improvement of 37.5% and found that both motor skills and social skills individually yielded average results. The results of their research [11] showed a moderately positive overall effect on participants who participated in physical activity interventions, in particular, programs aimed at the development of motor skills, motor skills, social-related skills, muscular function strength, and endurance. Therefore, it was important to note that, in the context of muscular strength and endurance programs, the experimental groups outperformed the control groups [11].

Fragala-Pinkham et al [24] reported the positive effects caused by participants' physical fitness by increasing resistance to exercise activities. In addition, the analysis of exercise programs lasting up to 16 weeks showed a significant impact on the performance of the participants designated

as the experimental group [11]. Exercise provides a positive effect on related disorders with symptoms such as motor deficits [44], obesity and overweight [43,24,17], aggressive behaviors [3] and social interaction [28]. There was an increase in HDL-C and a decrease in LDL-C and total cholesterol as a result of exercise in children with ASD, but no differences were found for glucose and triglycerides from the exercise program by Toscano et al. [36].

Effects for quality of life of children with ASD and the effects of physical education and exercise

According to the third research question, reference is made to the effects of physical education and exercise on quality of life in the daily lives of children and pupils with ASD. Studies show that quality of life is lower when the severity of ASD is greater [45,46]. Saldana et al [47] state that a greater degree of autistic symptoms can affect the ability of people with ASD to self-serve and, moreover, may affect parents and caregivers who largely determine the quality of life on a daily basis. According to [4], physical education trainers through exercise programs succeed in enhancing the motor skills of students with ASD by encouraging them and leading them to more active lifestyles. This enables pupils and children with ASD to be able to participate in their daily activities and to meet the demands of daily living with greater comfort and independence as their body is prepared after engaging in physical education [4]. Functional fitness is an effective tool that helps them improve their fitness levels but at the same time, respond positively and complete daily living activities without the need for help, such as eating, bathing, dressing, toileting and walking [12].

The results of the study by [36] based on 48 weeks of exercise and by examining the metabolic profile, features of the disorder and quality of life in children with ASD, found that intervention program compared to control group children showed significant positive effects on improvement of their metabolic health and reduction of ASD characteristics. As a result, parents' perceptions of the quality of life of their chil-

dren increased significantly for those involved in the intervention program, as opposed to those in the control group. Evidence of correlations between symptoms of ASD and health-related quality of life suggests that effective exercise interventions allow for the reduction of specific behavioral characteristics that in turn lead to gains in quality of life and health [48].

Discussion

The findings of the present study show that physical education and exercise appear to be effective in reducing the stereotypical behavior of the child as well as in developing their motor, social and communication skills, with a positive effect on their quality of life.

Exercise has improved the child's communication skills with ASD, which has strengthened collaboration with parents, teachers and expert groups. Improvements can be evident at home, at school, and in the wider community. In addition, exercise programs based on children's desires and needs appear to be pleasant and acceptable, allowing them to participate in the exercise.

It is very important to prepare the child appropriately for any exercise program in order to positively influence their psychology, reduce their anxiety, increase their self-esteem, and thus maximize their overall performance and behavior. These findings are consistent with those of [5], who reported additionally a limited bibliographic basis and requested additional high-quality research, in particular studies with strong experimental design, which could assist teachers, parents and those involved on a daily basis with the development of effective planning for stew with ASD. As researchers move forward with the design and conduct of research, to further establish conclusions, they need to close the gap between research and practice. It has been found that interventions that are too narrow, complex, difficult to implement or costly do not meet the perceived needs of children [49], thereby perpetuating the gap and hampering the process of converting empirically supported discoveries into regular educational practices.

Observing that part of the research is based on the influence of aquatic skills, aquatic programs of at least 10 weeks duration can improve aquatic skills in children with ASD, using learning methods such as the constant learning process and help from siblings and their peers. It seems that hydration and physical education programs are an alternative for parents and children with ASD as they can develop many areas of children that are lagging behind and creatively fill children's leisure time [50]. Concerning improvements to the physical state through aquatic activities, it is difficult to draw safe conclusions based on the results obtained from the few studies on this part. One reason is that the results had different effects on the studies, but also that none of the studies had a high level of evidence such as a randomized controlled trial [50]. But that leaves us with a positive outlook for future research that will shed light on such aspects.

It is clear both in this study and in the others that we have mentioned that further investigation is needed in order to have a clear and secure picture of the positive effects of exercise on children with ASD. However, there is a need to keep in mind that each child is unique, with different preferences and interests, giving us the opportunity to work on them and develop them as much as possible. There is a critical need to increase our knowledge of the health profile of children with ASD, including childhood and lifelong illnesses, as well as their prognosis. This will enable understanding of the effects of chronic diseases, risk analysis for chronic diseases and will guide the development of up-to-date primary health care services as well as effective interventions for each age group with relevant objectives.

For more frequent physical activity and lower levels of sedentary living, our study supports the notion that children with ASD could potentially benefit from lifestyle changes that promote increased physical activity over sedentary life, giving them a chance to get out from home, getting to know and interacting with other people, objects and places that will help them develop, areas that are lagging behind.

Conclusion

Future research should continue to identify the substance [51] of physical activity interventions aimed at developing the social field of pupils and children with ASD. A trained physical education trainer specializing in promoting a social interaction environment can be the key to success in developing social skills, so research should also be given greater weight to come up with new ideas for smooth socialization and social interaction and the avoidance of bias [11]. Conformity measures should also be collected so that we can have safe conclusions about the interventions that researchers will use.

Randomized control trials, comparable to the control group, will be crucial for the factors that contribute to positive results. The research community has identified the need for further research to determine the duration and intensity of physical activity [5, 31] in order to investigate the possibility that physical fatigue may lead to reducing unwanted behavior.

Future research should continue to adjust the structure, intensity, and quantity of early interventions, focusing on developing skills related to motor skills, seeking to examine the impact of participation in physical activity [11]. Curriculum teaching and assessment should be taken into account when it is appropriate to ensure that goal-oriented, structured and progressive interventions are implemented [52]. Recommendations for future research also include the application of aquatic programs at a higher weekly frequency, as well as the use of heart rate meters during aerobic exercise, to control heart rate [50].

Finally, future research should examine the viability of intervention effects on children and pupils with ASD in order to have an impact on their later life [11].

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DOI: 10.26386/obrela.v3i1.178

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