European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejpe.v11i5.5568 Volume 11 | Issue 5 | 2024

JOURNEY OF CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER FROM EARLY CHILDHOOD TO ADULTHOOD

Murat Yalçın Beşiktaş[i],
Mustafa Serdar Terekli
Fenerbahçe University,
Sport Sciences Faculty,
Turkey

Abstract:
A meticulously crafted program for physical education and sports implementation holds promise as an effective strategy for mitigating certain risks associated with Autism Spectrum Disorder (ASD). Consequently, it stands to enhance not only physical fitness but also psychomotor, cognitive, and emotional development in affected children. It is widely acknowledged that physical education and sports exert a positive influence on various aspects of children's development, encompassing both physical and mental domains. Heightened engagement in physical activities correlates with improved physical health, cognitive prowess, and social and behavioral competencies. Moreover, empirical evidence suggests that structured exercise regimens contribute to enhancements in muscle and cardiovascular endurance, alongside bolstering physical strength and flexibility. This literature review endeavors to delve into the nexus between health and skill cultivation in children and adolescents grappling with ASD, elucidating potential interventions and the manifold benefits that accrue from participation in physical education and sports activities. The review conducted a systematic examination of pertinent literature across diverse databases, including PubMed, Medline, Google Scholar, and Ulakbim-Tübitak, encompassing original articles within the study's purview. Thus, it is posited that well-designed sports programs and physical education curricula hold promise in ameliorating ASD symptoms and augmenting the overall quality of life for affected children.

Keywords: physical activity, physical education, autism spectrum disorders

1. Introduction

Autism spectrum disorders (ASD), characterized by substantial deficits in behavior and communication, represent complex neurodevelopmental conditions that typically

[i] Correspondence: email yalcin.besiktas@yahoo.com

manifest in early childhood and endure throughout the lifespan (American Psychiatric Association, 2013).

The concept of "ASD" is formed by the combination of the prefix "auto," meaning self or own in Greek, with the suffix "-ism," which denotes action, state, or hypothesis. The concept of ASD was first mentioned by Swiss psychiatrist Eugen Bleuler in an article published in the American Journal of Psychiatry in 1911.

Bleuler used this term to describe individuals who completely isolate themselves from the external environment, referring to introverted persons (Kudaıbergenova, 2018). Bleuler used this concept to refer to individuals who completely isolated themselves from the external environment, describing them as introverted (Kudaibergenova, 2018, p. 8). The first description related to ASD is based on the story of a 12-year-old boy mentioned in a work by Martin Luther King, Jr., who lived in the 1700s. According to this story, Luther wished for the drowning death of a child whom he believed to have a body without a soul, possessed by a demon (Wing, 1997). In 1798, there was mention of a child named Victor living in the forests of Aveyron in France who was described as having autism spectrum disorder (ASD). At that time, a medical student named Jean Marc Gaspard Itard attempted to improve the child's social adjustment and communication through a behavioral approach based on imitation and social conformity. In this context, ASD was first addressed in the 1700s in France by Jean Itard and in England by Jon Halsam, who described them as distinct individuals (Wolff, 2004).

In the early days, autism was associated with severe psychiatric disorders that began in childhood. It was described as a form of childhood schizophrenia because of its similarity to schizophrenia in adults. The term "autism" was used by Austrian child psychiatrist Hans Asperger during a German-language lecture on child psychology in 1938 at Vienna University Hospital, referring to Bleuler's concept of autistic psychopaths. Asperger referred to children with normal intelligence but behavioral characteristics of social isolation. He defined the condition of these children as Asperger Syndrome (Mengi, 2018). In a study on autism conducted in 1970, Rutter highlighted the social inadequacies of individuals with autism, while Lewis drew attention to their preference for loneliness and their deficiencies in communication skills. These studies presented descriptions of autistic children under four headings. The first is the onset of autism before the age of 30 months. The second is inadequate language development in individuals with autism. The third is a deficiency primarily in social development rather than intellectual development. The fourth is characterized by repetitive play skills, maintaining routine habits, and exhibiting extreme responses or indifference to changes in their environment (Rutter, 1970).

As previously discussed, structured physical education and tailored sports programs offer valuable avenues for enhancing communication skills and fostering social integration among children and adolescents diagnosed with ASD, empowering them to navigate diverse environments and engage in community interactions. It is widely acknowledged that well-designed physical education classes and sports initiatives play a pivotal role in enhancing the physical, emotional, and psychological well-being of

individuals with ASD. However, there remains a dearth of specialized technical guidance specifically tailored to the realm of physical education and sports for this population. For instance, there is a paucity of detailed information concerning specific intervention techniques, pedagogical approaches, and programmatic strategies that could effectively support the health needs of individuals with ASD. The proliferation of such research endeavors and the dissemination of diverse implementation experiences are paramount for children and adolescents with ASD. Engagement in structured physical activities holds the potential to yield numerous health benefits akin to those observed in the general population (Sowa, Meulenbroek, 2012). Participation in such activities can foster the development of various physiological systems, mitigate the risk of obesity, bolster motor skill proficiency, and significantly enhance socialization. Furthermore, physical activity has been shown to alleviate common symptoms of anxiety and depression among individuals with ASD while bolstering their sense of self-efficacy.

2. Literature Review

2.1 The Impact of Well-Designed Physical Education on the Development of Children with Autism Spectrum Disorder

Each of these positive impacts highlighted here is seen as a separate source of motivation to sustain ongoing efforts in this field. The idea that sporting activities aimed at physical, mental, and social support, typically carried out by healthy individuals without physical or mental disabilities, can also be undertaken by individuals with disabilities was not taken seriously for many years. It was only after World War I and World War II, with an increase in the number of individuals with physical and mental disabilities seeking rehabilitation, that this notion began to gain consideration. Initially, only the physical aspects of rehabilitation were addressed, but with a shift in the perception of rehabilitation, the goals to be achieved also changed. Today, the aim for the treatment of a disabled individual extends beyond achieving physical independence to fostering a life of overall freedom, where one can continue their life without relying on others, transitioning from being a consumer to contributing to production. There are two main objectives to incorporating sporting activities within the rehabilitation plan for individuals with disabilities:

- Conducting organized, well-planned, beneficial training sessions
- Creating variations in rehabilitation plans within healthcare institutions to alleviate monotony and enhance individual motivation.

In individuals with disabilities, it has been found that both of these goals can be achieved through sports activities. When examining the relationship between individuals with ASD and sports, their participation in mental, social, and physical activities is often low due to difficulties in self-expression. Therefore, reducing repetitive behaviors significantly benefits the progression of more complex abilities. Advancements in abilities provide a foundation for adding complex skills by extending to other physical movements. Sporting activities, which are crucial for improving the lifestyle of

individuals with ASD, are often overlooked. Enhancing body awareness through sporting activities plays a significant role in advancing adaptation to the environment and interacting with other children in common ways among individuals with ASD.

Autism Spectrum Disorder (ASD) presents a lifelong challenge, impacting learning development and cognitive abilities, often necessitating continuous support for daily functioning. ASD's spectrum nature entails a range of manifestations, demanding varying levels of assistance, from extensive to minimal. Those profoundly affected by ASD may require lifelong aid, which can be hindered by difficulties in interpersonal relationships, leading to feelings of isolation and diminished self-esteem (Steiner, Keryesz, 2015). Consequently, individuals with ASD often engage in lower levels of physical activity compared to their neurotypical peers, resulting in a sedentary lifestyle and reduced capacity for vigorous physical exercise.

The number of children with Autism Spectrum Disorder (ASD) is increasing every year (Buurke *et al*., 2016). "*In autism, the child not only lacks the development they should display but also begins to lose the skills they have acquired. The prevalence of autism was 1 in 150 in the early 2000s globally, but according to data reported in 2020, it has risen to 1 in 36. Unfortunately, this represents a significant increase, indicating a visible acceleration in the likelihood of autism occurrence. Given that mechanisms beyond genetic factors remain unclear, early diagnosis through screening is the only solution for autism. Autism is not a preventable condition*." Findings related to autism can sometimes be very apparent while other times they can be subtle. "A child who develops normally up to the age of 24 months suddenly regresses and loses acquired habits. The child, who may have started forming sentences by the age of 24 months, can suddenly stop speaking. Signs of Autism Spectrum Disorder (ASD) include: not making eye contact by 6 months, not responding when called by name at 9 months, not adapting through play by 12 months, inability to point to a location by 18 months, not expressing emotions like pity or sadness by 24 months, not playing with other children by 36 months, and not engaging in role-playing games (like pretending to be a doctor) by 48 months. Studies have demonstrated that children diagnosed with autism spectrum disorder (ASD) often encounter delays in their physical development, exhibit deficiencies in motor skills, and may present with lower scores in assessments of physical fitness (Reid, Collier, 2002). Consequently, the engagement of children with ASD in group activities and team sports presents notable challenges for both these individuals and educators alike. It is paramount to establish inclusive environments wherein all children, including those with ASD, can actively participate and receive education tailored to their needs. Within a well-structured physical education curriculum, it is imperative to cater to the diverse interests of all students, with special attention given to addressing the unique requirements of children with ASD. Through the provision of personalized instruction tailored to these requirements, the likelihood of participation in physical education activities by children with ASD can be enhanced, thereby fostering the development of their motor skills and capabilities through increased involvement. A comprehensive physical education curriculum should encompass a spectrum of student abilities and proficiencies. The overarching objective of such programs is to ensure the

full engagement of every student in physical activities. However, adaptations in instructional approaches and the implementation of educational interventions must be meticulously crafted to effectively address the specific needs of children with ASD.

Educators should possess comprehensive knowledge regarding the historical performance of students to gain insights into their capabilities. Subsequently, they ought to provide physical activities that afford students the autonomy to select their level of engagement commensurate with their skill sets. For instance, instructors may establish diverse activity stations encompassing tasks such as shooting, throwing, hitting, or dribbling a ball, thereby enabling each student, including those diagnosed with autism spectrum disorder (ASD), to choose an activity aligned with their preferences and abilities. Additionally, instructors may permit students to determine the number of repetitions performed during physical exercises; for example, a student with ASD might undertake five push-ups while peers complete ten. The greater the range of options afforded within the instructional framework, the higher the likelihood of success for students with ASD within the realm of physical education.

In recent years, physical activity and exercise interventions have been shown to benefit in reducing repetitive behaviors, improving physical fitness, enhancing communication and social interaction, and improving balance and motor skills. Ansari *et al.* (2020) evaluated the effects of karate and aquatic-based training on the physical capacities and motor skills of individuals with ASD (Ansari *et al.*, 2020). Swimming-based exercise interventions are potentially safe and recreational activities for children with disabilities, including autism (Stan, 2012). The properties of water, such as buoyancy and hydrostatic pressure, provide sensory inputs, create a fun environment, and offer simple movements that can enhance well-being, communication skills, and sensory and social behaviors in autism, but there is limited information on the effects of swimming on balance control in children with ASD. Only two studies have assessed the impact of swimming on static and dynamic balance in children and adolescents with ASD. Yılmaz *et al.* (2004) reported that swimming could significantly improve static balance duration in children with ASD. Additionally, Bumin *et al.* examined the effects of hydrotherapy on an 11-year-old girl with Rett syndrome and reported improvements in walking balance after an 8-week hydrotherapy program (Bumin *et al.*, 2003).

Children with motor disabilities and balance disorders are more prone to falling during daily activities and may experience greater disruptions in the development of communication and interaction skills. Therefore, children diagnosed with ASD should be able to participate in well-structured physical education classes alongside their peers, and their physical and social development should be analyzed using pre-test and post-test methods.

It is imperative for instructors in such educational settings to possess a deep understanding of these individuals and to employ a pedagogical approach that progresses incrementally from simpler to more complex activities, utilizing age-appropriate tasks. Specifically, to structure instruction according to age cohorts and deliver suitable activities, the physical education teacher must discern the motor skills

requisite for engagement in physical pursuits alongside typically developing peers (e.g., executing a ball roll for volleyball, basketball, or soccer). A significant developmental hurdle for children diagnosed with ASD lies in their distinctive learning patterns vis-à-vis behavioral, social, and communicative domains. Equipping children diagnosed with ASD with age-appropriate motor skills constitutes an efficacious strategy for their integration into meticulously designed physical education or targeted sports programs (Davis & Burton, 1991). Age-appropriate motor skills may be categorized based on variables such as motor skills commonly employed in local community physical endeavors, requisites outlined in the school's physical education syllabus, and recreational pastimes enjoyed by neurotypical peers (Block, 2000). From these variables, the most frequently identified and preferred skills can subsequently be delineated as targeted motor competencies for the physical education regimen. For instance, a meticulously structured swimming regimen amalgamating the Halliwick technique with an aquatic exercise scheme has been devised. This methodology is underpinned by mechanical principles aimed at facilitating aquatic mobility for individuals with disabilities (Kolachahi *et al.*, 2020). Each training session may encompass a 5-minute warm-up phase (comprising walking, running, jumping, and limb movements), a 15-minute orientation session (encompassing sagittal, transverse, and longitudinal rotations), a 20-minute foundational swimming skills segment (focusing on breathing techniques, swimming strokes, and stroke refinement), a 15-minute period of unstructured swimming (involving group activities and interaction with pool toys), and a 5-minute cooldown phase, culminating in an engaging and enjoyable 60-minute program. Table 1 illustrates a 60-minute aquatic exercise regimen protocol tailored for children and adolescents diagnosed with ASD.

An alternative investigation implemented an individualized strategy toward physical engagement, involving ten children diagnosed with ASD who partook in weekly swimming sessions and aquatic exercises over a duration of one week. This intervention yielded notable improvements in social interaction, alongside enhancements in bodily mobility and aquatic proficiencies (Pan, 2020:14-15). Notably, these benefits endured even following a subsequent ten-week interval, signifying a sustained favorable reaction to physical education interventions.

Table 1: 60 Minutes for Children Diagnosed with ASD. Water Exercise Program Protocol

Activity Program	Length (min)	Contents	Goal
Warm-up	5	Walking clockwise and counter clockwise, running in place, jumping jacks, blowing bubbles and reciprocal arm and leg movements	Warm-up and Water adjustment
Orientation training	15	Sagittal, transversal and longitudinal rotation	Water orientation
Basic swimming skills	20	Breathing, Floating and Stroke skills	Swimming skills
Free swim	15	Group activities: Ball toss and catch, cross through hula-hoop, red light/green light, allowed to play pool toys, noodles, and kickboards	Communication and Social interaction
Cool down	5	The same as warm up	

Source: Ansari *et al.*, 2021:3182.

Matheson *et al.* (2019) conducted an inquiry into the effects of instructing physical activities and imparting dietary education tailored to children diagnosed with ASD. In a separate investigation, Pan *et al.* (2016) evaluated the impacts of table tennis-based activities on both the physical and cognitive domains among children diagnosed with ASD (Pan *et al.*, 2016). Additionally, Toscana *et al.* (2019) scrutinized the ramifications of strength, balance, and coordination exercises on the quality of life and cardiometabolic health indicators, such as insulin resistance syndrome, in children diagnosed with ASD (Toscana *et al.*, 2017). These collective studies suggest that individuals demonstrate improvements in their physical aptitudes through personalized exercise modalities, consequently fostering enhancements in behavioral and social competencies beyond training sessions. Hence, interventions incorporating alternative sports, animal interactions, and nature immersion emerge as viable strategies for enhancing the quality of life among children diagnosed with ASD. Within this framework, therapeutic horseback riding and equine-assisted activities have demonstrated efficacy in augmenting physical control, motor proficiencies, deliberate movements, and other skill sets among individuals with ASD.

Must *et al.* (2023) reported positive outcomes from a program integrating parental involvement and interventions focusing on physical activity and nutritional education. The study underscored the significance of addressing selective eating habits in children with ASD to mitigate the risk of obesity. Over a 16-week period, home-based activities involving parental participation, such as walking and gymnastics, resulted in weight reduction for both parents and children. Notably, the study revealed that the physical activity levels of children with ASD either remained stable or increased, with two participants transitioning from a precarious weight category to a healthier range. Remarkably, as families embraced healthier lifestyles, including increased vegetable

consumption and the integration of physical activity into their daily routines, parents also experienced weight loss.

In a study by Tse *et al.* (2019), it was demonstrated that participation in a structured bicycle riding program enhanced executive functions among children with ASD, notably improving planning, working memory, cognitive flexibility, and control. A control group engaged in exercise using stationary bikes, while another group did not partake in bicycle riding activities. Notably, the non-bicycling group did not exhibit similar positive outcomes compared to the bicycling group. The distinctive impact of outdoor cycling on motor functions suggests its unique efficacy (Tse *et al.*, 2021). These findings underscore the efficacy of personalized exercise modalities in enhancing physical capabilities, thereby fostering improvements in behavioral and social skills beyond structured training sessions. Such insights underscore the substantial benefits of diverse sports and physical activities rooted in movement culture and physical education classes for children and adolescents with ASD. To promote skill generalization, it is imperative to teach age-appropriate motor skills in varied environments, facilitating the transfer of acquired skills across settings. Many students diagnosed with ASD encounter challenges in generalizing skills across different environments and instructors. This implies that while a student may successfully execute a motor skill like rolling a ball to knock down bowling pins in a gymnasium, they may struggle to apply the same skill in an actual bowling alley. To address this issue and enhance skill transferability across diverse contexts and instructors, it is vital to provide instruction in various settings, including gymnasiums, outdoor spaces during recess, and community settings.

Table 2: General Teaching Strategies for Students with Autism

Adapting Curriculum: Selecting Appropriate Content
• When planning lessons and curricula, ensure inclusivity by considering the diverse needs and interests of all students including those with autism spectrum disorder (ASD). • Incorporate explicit instruction on play skills such as turn-taking, recognizing the challenges students with autism face in social interactions. • Recognize that team sports may pose difficulties for students with ASD due to their social interaction challenges. Instead of focusing solely on team-based activities, prioritize skill instruction and small-group activities related to the sport. • Highlight individual and dual sports as well as lifelong leisure activities as alternative options. Consider offering activities like swimming, weight training, roller skating, ice skating, cross-country skiing, or canoeing, which provide opportunities for individual engagement without excessive social demands while still incorporating social elements.
Methods of Instruction, or How You Teach
• Establish a consistent class structure: Begin with a warm-up, followed by skill practice, a game, equipment cleanup, and a cool-down period. • When providing instructions, keep them brief and clear. Utilize modeling or demonstrations to enhance understanding. • Break down lessons into manageable steps to facilitate learning. • Actively engage with your students during activities. • Leverage the visual strengths of students with autism by incorporating station task cards or photo activity cards.

• Integrate instructional videos like Yo-Yo Man or Yoga for Kids into your teaching approach. • Provide advance notice of any changes to the routine or upcoming transitions: "In two minutes, we will tidy up our equipment." Utilize warnings and timers to help students anticipate what comes next.
Environment, or Where and With What You Teach
• Reduce or remove unnecessary equipment and distractions from the gym environment. Store unused mats, conceal dividing curtains behind a "mat wall," or relocate unused nets to the equipment room. • Consider factors such as floor glare, large spaces, fluorescent or mercury vapor lights, and acoustics, which may pose challenges for students with autism. Modify the environment where possible and seek ways to minimize distractions or sensory overload. Consult parents or special education teachers for suggestions, such as providing sunglasses, a personal CD player, or adjusting lighting. • Foster a positive climate and environment conducive to learning. • Offer instruction in diverse settings, including indoor and outdoor venues, tennis courts, community spaces, parks, and recreational facilities. • Allow students to choose from a selection of equipment, promoting autonomy and engagement.

Source: Zhang & Grıffın 2007:35

Autism Spectrum Disorder (ASD) encompasses a range of neurodevelopmental conditions marked by notable difficulties in social interaction, communication, and repetitive behaviors and interests. Given the hallmark symptoms of ASD, individuals affected by this condition commonly encounter distinct obstacles compared to their typically developing counterparts. These hurdles are evident in challenges related to effectively communicating with peers, adapting to daily routines, achieving behavioral and emotional regulation, forming age-appropriate relationships, and comprehending social cues. Moreover, individuals with ASD frequently exhibit delays or impairments in motor development, adding another layer of complexity to their condition.

The intersection of social, behavioral, and motor skill challenges has the potential to detrimentally affect the long-term mental, physiological, and psychological well-being of individuals. Many adolescents with Autism Spectrum Disorder (ASD) already contend with social, physical, and mental health issues, which can be further compounded by factors such as obesity and its associated health conditions like high blood pressure, diabetes, depression, and low self-esteem. While extensive research has shed light on the variability in how ASD impacts social and behavioral skills, there remains a dearth of information concerning its effects on motor skill proficiency. Motor skill proficiency encompasses the mastery of physical skills and movement patterns essential for enjoyable engagement in physical activities, thereby underpinning the development of a healthy lifestyle. Given the enduring health and economic implications of ASD, comprehending the factors influencing motor skill proficiency in adolescents with ASD is paramount for devising strategies to enhance their well-being. Notably, motor skill impairments are prevalent among individuals with ASD, with significant delays or impairments often observed during elementary school years, serving as indicators of motor skill deficits commonly associated with ASD (Chu *et al.*, 2020).

From the perspective of performance and talent development, students with Autism Spectrum Disorder (ASD) encounter numerous challenges, particularly as they may not possess the cognitive or social readiness to navigate competitive situations effectively. These students may struggle to perceive themselves as integral team members, feel misunderstood in communication exchanges, and find it difficult to synchronize their pace and strategic approach with that of their peers. Moreover, participating in group activities can heighten stress levels for students with ASD due to the unpredictability of events and outcomes. Consequently, activities that do not necessitate team dynamics, such as fitness routines, badminton, or golf, are often more appealing to these students. Similarly, activities involving frequent changes in tasks or physical contact may evoke distress in individuals with ASD.

The structured, organized, and consistent nature preferred by students with ASD means they have a low tolerance for changes, and their interactions with teachers may differ as a result. Teachers often need to provide explicit instructions and explanations, altering the dynamics of their relationships with students with ASD. Additionally, these students may not benefit from observational learning to the same extent as their peers, necessitating a reflexive interaction approach in physical education. This approach revolves around mastering physical movements with precision and accumulating specific physical skills, aligning with valued practices in physical education. However, the barriers presented challenge the acquisition and adoption of these valued practices by students with ASD, leading to varied forms of engagement. Individuals struggling with coordination, fitness, or gross motor skills may find the nature of physical education daunting. Therefore, any discussion on inclusion in physical education must acknowledge the traditional practices and valued rituals of the subject while considering the experiences of students who may not fully engage in interactive activities. This is particularly pertinent for children with ASD, as they often find collaborative practices stressful and overwhelming, impeding their social interaction and communication abilities. Expanding on these insights, this article delves into the lived experiences of students in physical education by providing a platform for them to share their perspectives. By amplifying the voices of students with ASD, this approach seeks to elucidate their unique experiences and challenges. However, effective engagement with autistic children necessitates creativity, sensitivity, and a theoretical framework that prioritizes their voices and experiences. Despite the complexities involved, empowering students with ASD to express their views is typically well-received, with many expressing satisfaction in being heard (Lamb, Firbank, Aldous, 2016).

Autism Spectrum Disorder (ASD) encompasses a range of neurodevelopmental disorders that manifest in early childhood and have seen a notable increase in prevalence in recent times, affecting approximately 2.5% of the population. Alongside challenges in social interaction and communication, individuals with ASD commonly exhibit restricted interests, repetitive behaviors, and stereotypical patterns. Moreover, they often encounter difficulties at the motor level, such as diminished motor coordination, impaired self-monitoring, and reduced Postural Control in bipedal stance compared to their typically

developing counterparts. Postural Control, essential for maintaining postural orientation and balance, plays a pivotal role in adapting to environmental demands and executing motor tasks effectively, making it a critical skill for ensuring balance quality across all populations. However, children with ASD frequently exhibit deficiencies in postural control, with abnormal postural development emerging as one of the earliest observable impairments in this population. These deficits persist throughout their developmental trajectory. Given the implications for fall risk mitigation, it becomes imperative to foster the development of postural control in individuals with ASD from an early age. Doing so not only addresses immediate concerns but also lays the foundation for long-term balance enhancement and injury prevention strategies.

Physical activity serves as a valuable avenue not only for enhancing social skills but also for fostering the motor development of children with ASD. Regrettably, this population often encounters limited opportunities to engage in programs that promote physical activity, potentially exacerbating the adverse effects of non-participation on early childhood development. Therefore, it is imperative to prioritize access to exercise opportunities for individuals with ASD to mitigate these negative consequences.

However, ensuring meaningful engagement in physical education programs necessitates the implementation of effective interventions tailored to the unique characteristics of individuals with ASD. Numerous studies have investigated the efficacy of specific intervention programs aimed at promoting physical activity in children with ASD. For instance, a recent meta-analysis underscored a spectrum of positive outcomes associated with sports programs or physical activity interventions for children with ASD. These outcomes encompass not only advancements in motor proficiency but also improvements in social skills. Consequently, active participation in sports and exercise programs holds the potential to substantially enhance the quality of life for individuals with ASD.

Physical inactivity stands as a formidable risk factor for global mortality, with its prevalence escalating steadily across all age cohorts in recent times. This trend is alarming, given that physical inactivity serves as a pivotal determinant in the onset of non-communicable diseases such as cardiovascular ailments, cancer, and diabetes, while also exacerbating respiratory conditions. Moreover, its association with the burgeoning obesity epidemic, which has witnessed a nearly threefold increase in prevalence over recent decades, underscores its multifaceted health implications. Among the demographic segments particularly vulnerable to the perils of physical inactivity are children, with approximately 80% of youths failing to meet the recommended daily threshold of 60 minutes of moderate to high-intensity physical activity. Within this cohort, individuals diagnosed with Autism Spectrum Disorder (ASD) face an elevated risk of sedentary behavior compared to their neurotypical counterparts. This heightened susceptibility to inactivity stems from the unique characteristics inherent to ASD, which impose constraints on individuals' engagement in physical endeavors.

Autism Spectrum Disorder (ASD) presents a constellation of challenges, including difficulties in communication, social interaction, and the presence of restricted, repetitive,

and stereotyped behaviors and interests. Motor difficulties and cognitive impairments are also prevalent among individuals with ASD. Recent data from the Centers for Disease Control and Prevention suggest that ASD affects approximately one in 59 children, underlining its significance as a prevalent neurodevelopmental disorder. The socio-communicative, behavioral, and motor impairments inherent to ASD, compounded by societal attitudes, often hinder opportunities for participation in physical activity and sports among affected individuals. Consequently, young people with ASD frequently exhibit increased sedentary behavior, predisposing them to various health conditions. Barriers related to social and communication skills may impede engagement in collaborative activities such as team sports or group games, while limited motor development often steers individuals with ASD towards solitary pursuits, exacerbating their social challenges. Furthermore, difficulties in adapting to changes in routine can further impede their physical activity levels by causing distress in response to novel stimuli.

Despite the obstacles faced by adolescents with ASD in engaging in physical sports activities, research highlights the myriad benefits of physical activity for this population. Physical activity promotes the development of social skills, fostering interaction, collaboration, and adaptation. It also mitigates stereotypical behaviors associated with ASD, improves motor deficiencies, and enhances basic motor skills. Additionally, physical activity contributes to the enhancement of executive function, addressing deficits commonly observed in students with ASD, including improvements in working memory and metacognition. Given the imperative nature of promoting physical activity for children with ASD, educational interventions must be tailored to accommodate their unique needs. Assessing the implementation of physical activity, both in terms of duration and intensity, is essential for identifying existing challenges and designing appropriate intervention strategies within the educational framework. Utilizing instruments that accurately capture physical activity levels while accommodating the specific characteristics of adolescents with ASD is recommended for effective assessment of activity patterns and informing targeted interventions (Lopez *et al.*, 2021).

Autism Spectrum Disorder (ASD) encompasses a diverse range of neurodevelopmental challenges, including impairments in social interaction, language, and communication. Globally, ASD affects approximately one in 132 individuals, with a higher prevalence observed in males compared to females. Recent interventions for individuals with ASD have shifted towards enhancing overall well-being and quality of life, emphasizing holistic approaches beyond symptom management. Quality of life serves as a comprehensive measure of subjective and objective well-being across multiple domains, including physical health, mental well-being, social relationships, development, and activities. Research indicates that individuals with ASD typically experience a lower quality of life compared to their neurotypical counterparts. Factors such as participation in school activities, adaptive behaviors, social interaction difficulties, behavior problems, and the severity of ASD symptoms are associated with variations in the quality of life among children with ASD. Despite the clear impact of

these factors on quality of life, limited studies have explored modifiable determinants that could positively influence the well-being of children with ASD. This knowledge gap impedes efforts to enhance the quality of life for individuals with ASD, highlighting the need for further research to identify and address these modifiable factors. By understanding and targeting such determinants, interventions can be developed to improve the overall quality of life for children with ASD, promoting their well-being and holistic development.

The lifestyle of children diagnosed with Autism Spectrum Disorder (ASD) significantly influences their overall well-being. Some empirical findings indicate that lifestyle interventions, such as consistent engagement in physical activity (PA), hold promise as potential enhancers of quality of life (QoL) among these children. Conversely, detrimental lifestyle habits such as prolonged sedentary behavior and inadequate sleep negatively impact the well-being of individuals with ASD. Historically, research has predominantly explored the individual effects of movement behaviors, including PA, sedentary behavior (SB), and sleep, on QoL. However, there is a recent paradigm shift among scholars advocating for a holistic approach. This approach involves examining the combined impact of PA, SB, and sleep on various outcomes associated with ASD (Kong *et al*., 2023).

Autism Spectrum Disorder (ASD) presents as a complex developmental condition marked by deficits in communication, social interaction, and repetitive behaviors. Among its multifaceted challenges, children with ASD often exhibit delays in motor skill development, although this aspect is not considered diagnostic per se. Interestingly, while delays in motor skills are also observed in children with other developmental disorders, those with ASD tend to experience more pronounced delays. This discrepancy has been evidenced through various assessment tools and analyses of motor skill performance, including standardized measures and observational methods.

Studies comparing the motor skills of children with ASD to those of peers with different developmental disorders have yielded mixed results, with some indicating significant differences and others suggesting comparability. However, a consensus emerges regarding the overall lower motor skill scores among children with ASD, particularly in the crucial developmental period spanning 18-35 months. For instance, Matson *et al.* (2010a) found that children diagnosed with ASD exhibited notably lower motor skill scores compared to counterparts affected by non-autism developmental disorders. Further research underscores the pervasive nature of motor skill delays in children with ASD, extending beyond specific skill domains. For instance, a notable proportion of autistic children aged 16-32 months displayed difficulties in fundamental motor tasks such as walking, with a subset experiencing concurrent delays in speech development. Interestingly, regional disparities in developmental milestones have also been documented, with studies reporting delayed motor development primarily in children from certain geographic regions. Given the challenges associated with timely diagnosis of ASD, particularly in resource-limited settings where late identification is common, there is growing interest in leveraging existing growth standards for early

screening purposes. While conventional growth charts are designed for typically developing populations, exploring their utility in identifying atypical developmental trajectories, including those characteristic of ASD, holds promise for enhancing early detection efforts. Foundational skills like sitting, standing, and walking, are imperative. Most existing studies in this realm have predominantly targeted older individuals, warranting increased attention to the timing and progression of motor skill acquisition in early childhood. Such insights are invaluable for optimizing therapeutic interventions and promoting holistic development in children affected by ASD.

Hence, this investigation delves into whether disparities exist in the attainment ages of pivotal developmental milestones—namely, sitting, standing, and unsupported walking—among individuals under suspicion of conditions such as autism, utilizing benchmarks established by the World Health Organization. The identification of such discrepancies could potentially underscore the utility of these benchmarks as a screening tool for early detection of autism spectrum disorders (ASD) and related conditions. Within this study, the achievement ages of significant milestones are scrutinized across children affected by diverse developmental disorders, including ASD. ASD, a pervasive developmental disorder characterized by communication deficits, social interaction impairments, and repetitive behaviors, is marked by notable delays in motor skill acquisition and function among affected children. Extensive prior research indicates that individuals with ASD tend to exhibit more pronounced motor skill delays compared to counterparts with different developmental disorders. To elucidate these differences, investigations have leveraged various standardized methodologies and tools, alongside analyses of observational data gleaned from homemade videos.

These studies have shown that children with autism generally receive lower scores compared to children with other developmental disorders. For example, one study found that children with autism scored lower in overall motor skills compared to groups affected by other developmental disorders. This study aims to provide a tool for early screening of individuals suspected of being affected by disorders such as autism by determining the ages at which these milestones are achieved using the World Health Organization's standards. If these standards reveal differences in the ages at which these skills are achieved at specific periods, it suggests that they could be used as a tool in autism screening. This research aims to determine whether there is a difference in the ages at which individuals affected by developmental disorders such as ASD achieve fundamental skills. If such a difference is detected, it could mean that WHO standards could be utilized as an early screening tool. This is because, in developing countries, autism diagnosis is typically made after the age of three, which makes it difficult to directly attend to these individuals' acquisition of fundamental skills. Therefore, this study aims to determine when these skills are acquired, taking into account the significant role of therapeutic interventions at early ages in the development of these individuals. Most research conducted thus far has tended to focus on older age groups, and there is a need for greater awareness about when these individuals acquire these skills. Therefore, this study investigates whether WHO standards can be used to

determine the fundamental skills of individuals affected by disorders such as autism (Arabameri, Sotoodeh, 2015).

Globally, the prevalence of Autism Spectrum Disorder (ASD) is on the rise, and Hong Kong mirrors this trend. Data from 1986 to 2005 revealed an average ASD prevalence rate of 16.1 per 10,000 individuals under 15 years old in Hong Kong. However, subsequent years have witnessed a notable surge in new ASD cases among Hong Kong children, with reported figures showing a staggering 184% increase from 1997 to 2005 alone. ASD encompasses a spectrum of neurodevelopmental disorders characterized by deficits in social interaction and communication, repetitive behaviors, and narrow interests. Beyond these core symptoms, many individuals with ASD may also contend with cognitive-behavioral and perceptuomotor challenges, along with difficulties in motor function and maintaining static and dynamic balance. Owing to their social and behavioral impairments, children with ASD commonly exhibit reduced levels of physical activity, leading to a sedentary lifestyle and lower exercise tolerance compared to their neurotypical peers. Consequently, motor skill development in children with ASD often lags or is delayed, and unfortunately, ASD frequently coexists with developmental coordination disorder in this population. These deficits in motor control, coupled with insufficient engagement in physical activity, predispose individuals with ASD to chronic health conditions, with obesity being particularly prevalent among affected children.

The preceding five reviews have assessed the impact of physical activity or exercise on both children and adults, yielding promising findings. Beyond enhancing motor skills, interventions involving physical activity or exercise have demonstrated improvements across a spectrum of behavioral outcomes, encompassing reductions in stereotypical behaviors, advancements in socio-emotional functioning, cognitive enhancements, and heightened attention levels. Notably, more intensive forms of exercise have been shown to elicit more significant effects compared to lighter or less rigorous activities. However, studies employing a randomized controlled trial design or focusing specifically on younger children, particularly those aged 4 to 6 years, remain scarce. Among the current body of research, jogging and swimming emerge as the most frequently selected exercises serving as primary components of interventions. Additionally, various other exercise modalities have been explored, including horseback riding, martial arts, resistance training, yoga, and dance.

To foster the engagement of children diagnosed with Autism Spectrum Disorder (ASD) in physical activity, enhanced support for both these children and their families is imperative. This study implements a multidimensional training program, specifically tailored for the younger age cohort, encompassing components such as aerobic and resistance training, fundamental movement skills, speed, plyometric exercises, and agility development. The comprehensive design of the exercise regimen aims at fortifying the foundational physical capacities essential for various sports and exercise endeavors. By integrating diverse sports skills, the program seeks to mitigate the risk of overuse injuries inherent in singular exercise regimens over prolonged durations. Notably, to our knowledge, no published studies have explored exercise training programs specifically

tailored for young children diagnosed with ASD, incorporating multidimensional training elements. Hence, our interdisciplinary research team, comprising experts from pediatrics, psychology, sports science, and physical education, has developed the present play-based exercise program to afford more holistic support to children with ASD. Furthermore, to facilitate the sustainable implementation of the program within the community, we have adopted a train-the-trainer model. In alignment with this model, a cohort of frontline healthcare providers from community organizations underwent training, subsequently disseminating the program to children.

The training regimen employed in this study is meticulously tailored to suit the needs of children, presenting exercise activities in the guise of games. Each game is thoughtfully crafted to integrate elements that engage both their physical and cognitive faculties. Moreover, the games are structured with varying levels of difficulty, ensuring they can be adapted to suit the children's individual abilities, thereby fostering motivation for progression to more advanced levels over the course of the training. This study proposal posits that our exercise program will exert a positive impact on both the physical and psychological well-being of children diagnosed with Autism Spectrum Disorder (ASD). Additionally, the efficacy of the program will lend credence to the feasibility of the training model employed (Yu *et al.*, 2018).

The inadequacy of physical activity levels is a concerning issue for students with Autism Spectrum Disorder (ASD). It cannot be said that these students are any less capable of being physically active than anyone else. The problem lies in the lack of opportunities for them to engage in physical activity. It has been reported that students with ASD participate less in organized and recreational physical activities compared to their typically developing peers. This issue continues to escalate as they age. Adolescents with ASD are reported to have more limited or no participation in physical activity compared to younger children. The reasons why these individuals do not participate in physical activities are still unclear. Often, this lack of participation is due to the challenging nature of managing their behaviors and social issues, in addition to the absence of specialized services and expert professionals in physical activity and sports settings for these individuals. Failure to address this issue throughout their school years is likely to result in adults with ASD not achieving sufficient physical fitness and having restrictive and sedentary lifestyles. These restrictive lifestyles pose a serious problem, as individuals with Autism Spectrum Disorder (ASD) already have a high risk and prevalence of obesity. Obesity has documented negative effects on health and quality of life. The high prevalence of obesity poses an increased risk for Type II diabetes later in life. These health risk factors can lead to higher healthcare costs and long-term health issues in adults. Students with Autism Spectrum Disorder often spend much of their day in general education settings, participating in various activities and physical education classes. However, screening and manually tracking skill-related health/exercise can often be difficult or even impossible. It has always been a struggle for physical education educators to effectively serve all students diagnosed with Autism Spectrum Disorder. According to the Centers for Disease Control and Prevention in the United States, autism

not only affects an individual's ability to interact and learn but also affects their physical health.

The number of studies investigating physical activity in individuals with disabilities has been steadily increasing. Many physical education and sports programs implemented for disabled children have focused on integrating the child into existing general education programs (Rocco & Kulinna, 2011). Successfully implemented inclusion programs have led to increased physical and social functionality for disabled children (Tyler, 2015). However, there are still many children with Autism Spectrum Disorder (ASD) who receive education in separate special education settings. Rocco and Kulinna (2011) note that children diagnosed with mild to moderate ASD could benefit from an inclusive physical education class that introduces them to learning in a more authentic physical context. As stated by APENS (quoted in Rocco, Kulinna, 2011), adapted physical education is an educational process that encourages children's movement abilities, patterns, and skills. It can be argued that adapted programs have similar objectives; however, APENS suggests that adapted programs are customized, structured, and designed to ensure students' highest level of success in physical education. These children can still benefit from health and motor skill-related advantages, which can lead to increased self-confidence and self-esteem (Rocco, Kulinna, 2011).

Providing an adapted PE program in a special education setting for children with autism can lead to many benefits, but the importance of changes in the daily routine should be considered. Guttormsen (2016) conducted semi-structured interviews in Norway with teachers who identified motor interventions as a theme of importance in reducing symptoms and behavioral problems in children with ASD. An adaptive physical education program is essentially a long-term motor intervention, where all skills and activities gained in the program can be transferred and applied outside of the physical education domain. Considering the change in routine, increased disappointment may occur due to the uncertainty of the child facing new activities and tasks.

Guttormsen (2016) also mentioned the possibility of educators overlooking behavioral issues that may arise during new interventions, as challenging behaviors could interfere with activities and limit the perspectives of parents and teachers regarding the potential effects of motor interventions. These challenges may lead to short-term problems, but APA programs are implemented with long-term goals and are beneficial for the child's future; therefore, the intervention should not be considered a failure even if immediate negative signs are evident. The results of a study on the implementation of a Daily Physical Activity (DPA) program by teachers in Canada support this assertion. A qualitative case study conducted in a special education setting for children with mild intellectual disabilities found that despite facing many obstacles and challenges during the 12-week program, teachers remained committed to changing children's behaviors, improving their skills, and enhancing the importance of the activity. Teachers believe that the program holds many benefits and positive effects for children,

and long-term data from multiple DPA programs in Canada have shown significant improvements in academic behavior and achievement for both disabled and non-disabled students (Watkinson & Bodkin, 2016). While this study is not directly related to children with OSB, it can serve as a reference for any motor intervention program facing similar challenges.

3. Recommendations and Conclusion

Children diagnosed with ASD can acquire motor skills through the implementation of appropriate teaching strategies and structured programs. An effective teaching strategy involves the systematic planning of instructional methods aimed at assisting children, including those with autism, in mastering motor skills accurately (refer to Table 1). The primary objective of employing these teaching strategies is to afford opportunities for successful acquisition of diverse motor skills. Facilitating such opportunities, especially for children diagnosed with ASD, holds paramount importance in enhancing their overall quality of life. It is imperative for physical education instructors in inclusive settings to possess the capability to execute well-crafted educational programs and exercise patience. Considering that physical activity entails lower costs and demands less effort compared to other therapeutic approaches, it is noteworthy that physical exercise curricula could serve as promising alternatives for coaches to foster the development of skills in children with ASD with minimal expenditure of resources and energy.

All sports and physical education teachers working or intending to work in this field should strive to use the communication features listed below in child-teacher relationships:

- Don't ask the student if they want to do something in the educational environment. The question "Do you want to do warm-up exercises?" can easily be answered with a simple "No." Just determine what needs to be done: For example, it's time for warm-up exercises.
- Give students short, concise, and understandable commands that tell them what they should do, not what they shouldn't do.
- After giving a command, wait at least one to seven seconds to avoid confusing the student. It may take some time for autistic students to understand the meaning of commands and act accordingly.
- Autistic students often exhibit a preference for literal interpretation of language, relying heavily on explicit instructions rather than grasping implicit meanings. In practical scenarios, such as during a basketball game, when a teacher issues a command like "defend," autistic students may struggle to comprehend the abstract concept behind the instruction. Consequently, they may face challenges in understanding how to execute the action or what specific actions are expected of them in that context. Therefore, it is vital for educators to provide clear and explicit instructions, accompanied by demonstrations or visual aids, to facilitate the understanding and participation of autistic students in various activities and tasks.

- Give commands in a low and calm voice.
- Always strive to remain patient and calm.
- Ensuring that students enjoy and find pleasure in what they are doing is an important source of motivation. Never lose sight of this and strive to sustain it, if not increase it.
- It's important to ensure that parents also see the progress made by children diagnosed with ASD in such well-designed physical education activities. When families witness such progress in their children, it will bring them much more hope for both themselves and their children, encouraging them to support their children's participation in such activities with enthusiasm.

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Author(s)

Murat Yalçın Beşiktaş, Fenerbahçe University, Sport Sciences Faculty, Department of Coaching Education.
Mustafa Serdar Terekli, Fenerbahçe University, Sport Sciences Faculty, Department of Physical Education Teaching.

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