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Chapter

Motor Proficiency of Children with Typically Developing Children and Children with Autism Spectrum Disorder

Carla Lourenço, Dulce Esteves and Mariana Pinheiro

Abstract

Children with autism spectrum disorder (ASD) frequently present difficulties in communication, social interaction, and motor abilities. Physical activity presents several major benefits for children with and can be considered a non-pharmacological therapy to improve both motor and social skills. This chapter aims to compare motor proficiency of children with ASD and neurotypical children. Twenty Portuguese children participated in this study, half diagnosed with ASD (6.9 ± 1.97 years) and half typically developed (7 ± 1.83 years). Children's age ranged from 4 to 10 years (6.95 ± 1.85 years), with a prevalence of males (60%). Motor proficiency was evaluated using the Bruininks-Oseretsky test of motor proficiency (BOT-2). Children with ASD scored significantly lower on different items of motor proficiency (fine manual precision, manual dexterity, coordination of the upper limbs, balance, and motor proficiency profile). We conclude that, due to the deficits found, supervised physical exercise preferentially in small groups combining children with and without ASD is highly recommended.

Keywords: children with autism Spectrum disorder, motor proficiency, physical exercise

1. Introduction

Autism spectrum disorder (ASD) consists of neurological disorders affecting children's communication, social, and language development [1]. Diagnostic and statistical manual of mental disorders (5th ed.) and is typically characterized by core impairments in social communication functioning and rigid repetitive behavior styles [2]. Seven decades have passed since Leo Kanner's classic description of the syndrome early infantile autism [3], and over time, the concept has undergone several changes, namely those introduced by Volkmar & McPartland [4], that suggested an alternative classification system of ASD that incorporates both etiological factors (e.g. neurobiological and genetic) and clinical symptoms.

1.1 Motor impairments in children with ASD

Currently, ASD refers to neurodevelopmental disorders that generate deficits in communication and socialization, restricted interests, and repetitive behaviors [5]. Children with ASD usually present a dysfunctional sensory profile [6, 7] that might create difficulty attending to and processing sensory stimuli [8, 9] and consequently to motor impairments. In fact, the motor functioning in individuals with ASD and detected a pronounced motor impairment among those subjects [10]. Several other authors [2, 11–14] also confirm the existence of motor deficits in children with the condition. That motor deficits can be divided into two categories: the basic motor control (coordination, gait, posture and muscle tone) and motor performance deficits [15]. However, the specific motor deficits associated with ASD cannot be generalized nor simplified and are more evident in the most demanding activities [16]. Also, children on the spectrum demonstrate poor motor performance, and this becomes more persistent with an increase in age [17].

The motor impairments in ASD affect a variety of domains [12], such as balance [18], movement planning [19], gait and postural stability [20], and fine and gross motor coordination [2, 21].

1.2 Motor development in children with ASD

Face to this evidence, it is important to consider interventions to help improve motor skill in children with ASD.

Motor development is defined as the acquisition of fundamental motor skills, allowing different postures, locomotion, and manipulation of objects [22]. Researchers suggest that motor skill acquisition accompanies intellectual development and physical fitness which may be linked to a positive effect in the cognitive development in children [23]. When a child's development occurs according to the established developmental stages, it is considered typical development. However, when there are changes in the developmental trajectory, we have to consider them as early warning signs/red flags for different pathologies [24].

Although this topic has been persistent in different investigations, an approach focusing on the motor proficiency profile in children with ASD has not been sufficiently developed [25]. Understanding motor proficiency in children with the condition is necessary in order to assess their onset of motor skill development and acquisition. Motor proficiency profile is described as the “index or sum of the best performance or performance observed in a wide variety of situations or motor tasks and which tends to increase with age” ([26], p. 10). It is positively linked with physical activity participation and inversely to the children's sedentary lifestyle [27]. Evaluating the motor proficiency profile allows us to better understand each child's motor capacity, as well as to analyze different motor aspects in an isolated approach and a better evaluation of the fundamental fine and gross motor skills [28].

1.3 Exercise interventions in children with ASD

In addition to motor deficits, children with ASD tend to be physically inactive and to have sedentary behaviors [29], which has serious consequences for their health status and sustainable lifestyle.

One of the approaches to improve motor deficits is the use of physical activity-based intervention. In fact, it was reported that physical activity programs may provide benefits for children with ASD [30–32] and can be an excellent non-pharmacological therapy to reduce the challenges they face. The effects of physical activity interventions such as swimming [33, 34], walking/hiking [35, 36], running [37–39], and hippotherapy [40–42] have been supported by previous research and suggested that an improvement of motor proficiency in children on the spectrum branches from the participation in physical activity intervention [27]. Therefore, the engagement in physical activity interventions is a key modifiable factor in ensuring an active life across the lifespan. Creating an active routine during early years may lead autistic subjects to continue certain physical activities into adulthood, improving not only many health-related outcomes but also their quality of life [43]. Additionally, physical activity engagement has been shown to have some positive effects on the social functioning of young individuals on the autism spectrum, as well as a significant impact on their muscular strength and endurance [44]. Besides, motor skill development through exercise interventions is a critical step toward ensuring continued engagement in physical activity [45] as well as in leading positive trajectories for health outcomes [46].

Regarding the type of motor intervention, there is currently a wide variety of treatments and therapies targeted at autistic populations [47, 48]. Nevertheless, many of those current intervention models have only been designed to focus on the core characteristics of autism. Apart from modifying present intervention models for the physical activity setting [49], few interventions have been designed to target the motor domain [50]. Even fewer still are interventions targeting motor skill development for autistic populations [51].

Yet, evidence suggests there are countless benefits of physical activity for autistic individuals [44, 52]. Physical activity has been shown to be beneficial in improving an autistic individual's motor proficiency [31], social skills [53], functional, cognitive and behavioral [52], among others. In the case of group physical activities, they can be an important contribution to the increase of mental health of these individuals [54].

Despite the demonstrated beneficial impacts of physical activity on the factors of quality of life for autistic individuals, this population remains more sedentary than the general population [55] and they face numerous obstacles to physical activity from early childhood through adolescence [56, 57] into adulthood [58–61]. In fact, a physical education class can be really challenging for these children, who may have difficulties in accessing instruction, meeting with stringent rules, in learning abstract content, as well as in collective games due to the speed and exchange of functions (defense and attack) [62].

Due to motor and/or social difficulties, the actors in the teaching process (parents and teachers) would sometimes reveal some difficulties in promoting motor activities, as well as difficulties in understanding how to evaluate children with ASD.

1.4 Motor proficiency of children with ASD and typically developing children

Perhaps more important than evaluating motor proficiency of children with ASD is to compare motor proficiency of children with ASD and neurotypical children, to quantify the differences found.

Previous research revealed that children with ASD performed poorer when compared to their typically developing peers [63, 64] in many areas, such as coordination of the upper and lower limbs in manual dexterity, balance, agility, and speed [65–67].

Lourenço, et al. [68] compared the motor proficiency profiles between children with ASD and their typically developing peers in Portugal, using the Bruininks-Oseretsky test of motor proficiency (BOT-2) [69]. Twenty Portuguese children participated in this study, half diagnosed with ASD (6.9 ± 1.97 years) and half typically developed (7 ± 1.83 years). Children's age ranged from 4 to 10 years (6.95 ± 1.85 years), with a prevalence of males (60%). Children with ASD scored significantly lower on fine manual precision ($p < 0.05$) and large effect sizes were found ($d > 0.8$). Children with ASD also performed poorer in item 1—drawing line through path (1.90 ± 0.87) and item 2—fold paper (4.00 ± 2.30).

No statistically significant difference was found between the two groups in fine motor integration subtests ($p > 0.05$). However, effect sizes showed moderate effect ($d > .5$) indicated children with ASD were less proficient, suggesting a trend for delays in motor integration tasks.

A significant difference was found between children with ASD and the typically developing children on manual dexterity ($p = 0.024$), and a large effect size was found ($d = 4.467$) with ASD children scoring significantly lower, revealing that children with ASD were delayed on manual dexterity.

Regarding coordination of the upper limbs (items 10 and 11), the first one did not present significant differences between the two groups whereas item 11 registered significant differences ($p = 0.044$) and a large effect size ($d = 1.664$). Portuguese children with ASD scored lower mean values in both items when compared to their typical developing peers.

No statistically significant differences were found regarding bilateral coordination, but typical developing displayed higher mean values than the children with ASD. They showed better results in item 6 than the other item in bilateral coordination subtest.

To what concerns balance, children with typical developing presented significantly higher mean values ($p = 0.028$) and a large effect size was found ($d = 4.221$). Similar results were found in speed and agility ($p = 0.043$; $d = 2.496$).

It is noteworthy that Portuguese children with ASD registered lower values of motor proficiency profile, translating into statistically significant differences (**Figure 1**).

Portuguese children with ASD (80%) were classified in well below the average or below average and only two children were in the average motor proficiency category. On the other hand, 90% typical developing children's motor proficiency was in the average or above average category.

The results revealed significant differences in fine motor proficiency on manual dexterity, showing the children with ASD had lower indices, similar to the results presented by Pan [63], that concluded that Adolescents with ASD demonstrated less proficient motor skills than adolescents without ASD.

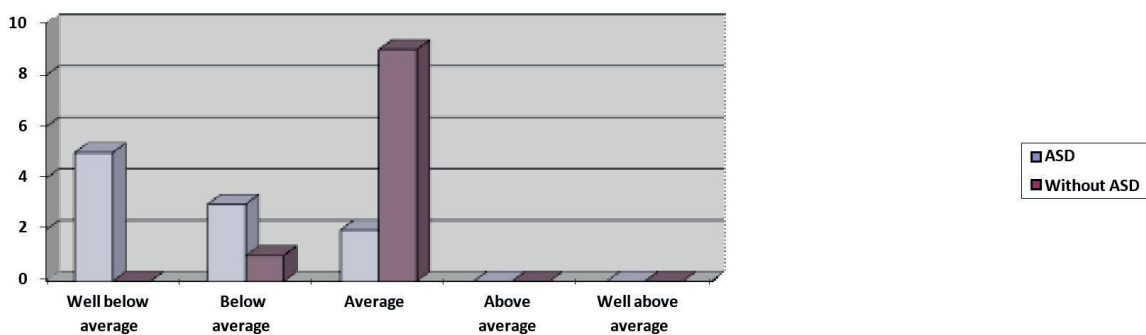


Figure 1. Classification of the motor proficiency profile of children with and without ASD.

The significant differences found in the coordination of the upper limbs may impair an object-control proficiency, such as kicking, catching, and overhand throwing, which are requirements to most sport activities and is a predictor of physical inactivity/no participation in sports activities.

As referred by Pan [63], “the lower level of motor proficiency and physical fitness in adolescents with ASD requires increased attention and immediate intervention,” suggesting the participation of typically developing peers as intervention agents, such as in-peer tutoring and peer-assisted learning, to teach students with ASD motor skills to encourage inclusion and increase enjoyment. Furthermore, group activities involving both students and their families, such as swimming, biking, and walking, are strongly recommended because of the limited duration of physical education in schools and the lack of active recess times in secondary schools [63].

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