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Improving Motor Skills Through Circuits In Autism Spectrum Disorder: A Case Study

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Abstract
Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by behavioral manifestations, deficits in communication and social interaction, and may present a restricted repertoire. The present study aimed to evaluate the influence of circuit exercises on the motor skills of a child with Autism Spectrum Disorder (ASD), in the school context. This research is characterized as quantitative, descriptive and comparative. A female child from a school in the city of São Miguel do Oeste/SC, aged 6, took part in the present study. This study investigated the impact of 12 motor circuit sessions, carried out over four weeks. To analyze motor skills, the classification protocol proposed by Rosa Neto (2015) was used. After the intervention, a notable progress equivalent to 7 months was observed in the General Motor Quotient (MQ), resulting in an increase in the classification from Inferior, indicating moderate risk, to Low Normal, now placing it in the mild risk group. Furthermore, the results of the tests applied, MQ1, MQ2, MQ3, MQ4, MQ6, showed positive advances, as evaluated. This study highlights the importance of implementing motor circuits as a teaching resource in School Physical Education classes for children with ASD, promoting a notable improvement in motor performance and contributing to their overall well-being.

Keywords: *Autism. Physical education. Motricity. Circuits. Development scale.*

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I. Introduction

The aim of school physical education is the all-round development of children and adolescents, because it helps to develop cognitive, affective, social and motor aspects, and, in addition, the school provides a space for learning about principles and values that they will use for the rest of their lives. In view of this, when Physical Education classes are planned, they should be thought of beyond sports practice, with the aim of helping students to become more capable individuals in terms of coordinative interaction, body awareness and spatial perception (TELES, 2014).

Schoolchildren are building their knowledge base and for their full development they must use the widest variety of stimuli, be they physical, emotional, sensory, cognitive and social. For students with Autism Spectrum

Disorder (ASD), functional alterations are noticeable in the neural structures responsible for memory, learning, semantic processing, emotional processing, motor planning and motor coordination, which can lead to damage to the psychomotor development of this specific group (BUSTO, 2022).

Children with ASD have retrograde motor skills, making their assessment a challenge, and they also have lower than normal motor standards. These motor deficits manifest themselves early in the child's life, directly affecting aspects of laterality, fine and global motor skills, balance, body schema, spatial orientation and temporal orientation (DOS ANJOS et al., 2017).

There is a range of activities to stimulate child development, both in typical children and those with ASD, encompassing practices to improve fine motor skills, such as fitting games and painting, and global motor skills, through circuits with obstacles and games with music. In addition, activities are suggested to strengthen balance, body awareness, spatial and temporal orientation, and laterality, through games, sensory activities and classification exercises (ROSA NETO et al., 2013).

Stimulation during childhood development, which is crucial for acquiring motor skills, is often associated with games. However, in the case of children with ASD, this process can be complex and challenging, considering the restrictions these individuals face. This can lead to reduced engagement in play activities, diminishing the importance of play in their development. The playful approach is considered not only a physical activity, but also a mental one, playing a vital role in the integral development of children, providing an integrated and harmonious approach to learning (VIEIRA, COSTA, SANTOS, 2020).

In this sense, taking into account the aforementioned information and the scientific relevance of the subject, this study aimed to evaluate the influence of circuit exercises on the motor skills of a child with ASD, in the school context.

II. Method

Population And Sample

This research was characterized as quantitative, descriptive and comparative. This study included one female child, aged 6, from a school in the city of São Miguel do Oeste. In order to analyze this scenario, the sample was selected for convenience and intentionally, with voluntary participation, subject to parental authorization.

In order to find out more about the sample, we asked the mother a few questions, in which she revealed a history without gestational complications, reaching motor and language development milestones within the expected range for the age group. However, from an early age, she exhibited peculiarities, such as an early interest in letters and numbers, a tendency not to interact with other children, repetitive and restricted behaviors, as well as walking on tiptoe. These are signs that are often associated with ASD. In addition, the child shows considerable food selectivity, a common trait among individuals with ASD, resulting in limitations in the variety of foods consumed.

The support the child needs is provided by a multidisciplinary team made up of a physiotherapist, psychologist and psycho-pedagogue, who collaborate synergistically to address the child's various needs, as well as interacting with the school, seeking to offer a supportive and understanding environment to optimize the child's development and well-being.

Motor Development Analysis

To achieve the research objectives, the Motor and Psychomotor Development Scale developed by Rosa Neto (2015) was used. The study covered all the elements of the Motor Assessment Manual, divided into motor coordination, proprioception, perception and laterality.

Motor coordination involves fine motor skills, precise movements of the hands and fingers, and global motor skills, broad motor skills with large muscle groups. Proprioception involves balance and body schema, perception with spatial organization and temporal organization and finally laterality, which are fundamental aspects of motor control. They enable body stability, mental representation of one's own body, understanding of space and time and the ability to use one side of the body effectively (ROSA NETO, 2015).

Data Collection

The study involved the initial stage of communication with the school institution, in which an approach was made to obtain the necessary authorization to carry out the research. At the same time, a direct dialog was established with the child's guardian, detailing in detail the objectives and procedures of the research project. This process of contacting both the school and the guardians was essential to ensure transparency, consent and clarification about the nature and importance of the study, establishing a solid basis for the development of the proposed activities.

Once the sample had been selected, the TCLE and TA were handed over for the guardians and the child to sign and return a copy authorizing their participation. In the second moment, they were introduced to the place

where the intervention took place, so that the child would feel confident in carrying out the evaluation activities that were proposed. The data collected was recorded on a data collection form and the results were classified in accordance with Rosa Neto's proposal.

Intervention And Teaching Action Protocol

In the teaching action, 12 sessions of three different circuits were developed, which took place over four weeks, lasting 45 minutes each session, with three-minute breaks at the end of each plan based on and adapted by Neto et al. (2013), as described in Table 1. The intervention protocol was carried out in two stages, the pre-test, before the teaching action, and the post-test, after the action, which were applied in accordance with Rosa Neto's Evaluation Manual (2015).

Table 1 - Intervention circuits

Circuit A	Station 1 - Coordinating ladder At this station, the children climbed a staircase, alternately jumping from one step to the next. The aim was to improve motor coordination and balance while walking up and down the stairs. Station 2 - Zig-Zag cones At the second station, the children walked along a zig-zag path between cones. This helped develop agility and the ability to change direction quickly. Station 3 - Straight line At the third station, the child followed a straight line drawn on the floor, staying on it without moving off. This helped improve balance and concentration. Station 4 - Obstacles with Steps The fourth station consists of obstacles with Steps. The child ran over these obstacles, encouraging the development of strength and coordination when climbing up and down them. Station 5 - Jumping over the "X" At the fifth and final station, the child performed jumps in an "X" shape using only one foot at a time. The aim was to improve leg strength and stability during the jump.
Circuit B	Station 1 - Coordinating ladder At this stage, the children found a coordinating ladder with drawings of feet, indicating which foot they should use to get up the steps. This helped to develop motor coordination and a sense of movement and laterality. Station 2 - Zig Zag cones In the second stage, the child faced cones arranged in a row and zig-zagged past them. This helped improve agility and the ability to change direction quickly. Station 3 - Jumping Obstacles (Steps) The third stage consisted of three separately placed Steps. The child had to jump over them in a controlled manner, thus improving leg strength and motor coordination. Station 4 - Chinese cones and colored balls In the final stage, the child found five colored balls and five Chinese cones. The aim is to balance and arrange the balls on top of the Chinese cones carefully and precisely. This will improve their fine motor coordination, concentration and cognitive skills.
Circuit C	Station 1 - Tunnel At the first station, the child had to go through a tunnel. This activity helps to improve the child's broad motor coordination and spatial awareness. Station 2 - Jumping on the hula hoops The second station consisted of jumping with both feet onto three hula hoops arranged on the floor in rows. This task is designed to develop motor coordination and jumping skills. Station 3 - Long jump At the third station, the child faced the challenge of jumping from a distance of 1 meter, with lines marked out by the teacher. This helps to improve leg strength and jumping accuracy. Station 4 - Rope Walking and Throwing The fourth and final station features an "S" shaped rope that the child has to walk on. At the end of the rope is a ball which the child has to throw into a sixth. This activity improves balance and fine motor skills.

Source: adapted from Neto et al. (2013).

Data Analysis

The classification protocol proposed by Rosa Neto (2015) was used to analyze the data obtained. The EDM calculation involves measuring the child's performance in relation to certain motor skills, taking into account their age in months. The calculation is based on a comparison between the child's chronological age (age in months) and motor age, which is the age at which the child achieves certain specific motor skills.

The process of determining a child's motor age involves converting the exact age into months and assessing motor skills through tests. Scores are assigned based on the achievement of these skills, adding up to obtain the total motor age. The difference between the Chronological Age (CI) and the Motor Age (MI) total indicates a possible delay in motor development. The Motor Quotient (QM), calculated using the formula QM = IM*IC/100, is used to quantify this development in relation to chronological age. This protocol is valuable for

identifying delays or advances in motor development, allowing follow-up over time to monitor progress and the effectiveness of interventions.

The process of determining a child's motor age involves assessing motor skills, with scores assigned based on the age at which the child is expected to achieve these skills. The sum of these scores results in the total MI, which is compared to the CI to identify possible delays in motor development. The calculated QM provides a quantitative measure.

III. Results And Discussion

The general analysis of the tests applied revealed comparative data on the performance of the children assessed in the pre-test and post-test, as shown in Table 1.

Table 1 - General analysis of the EDM tests applied

Component	Pre	Post
General Motor Age (GMI)	79 months	89 months
Chronological Age (CI)	81 months	82 months
General Motor Quotient (GMQ)	97 months	108 months
Age Positive (+)	-	7 months
Age Negative (-)	2 months	-

Source: authors (2024).

There was an improvement in the child's motor age, even considering the short assessment period. There was an advance of 7 months, reflecting a positive progression in their development. This progress shows a notable improvement in the child's motor development.

According to De Castro et al. (2022), intervention programs such as play activities, symbolic and creative games have a positive impact on the development of children with ASD. However, interventions started earlier result in more substantial benefits compared to those started later. In this context, guidance from the American Academy of Pediatrics (2014) emphasizes the importance of starting interventions as soon as ASD is suspected or confirmed, in order to maximize favorable results in the child's progress and development.

Further corroborating the research, the authors Fessia et al. (2018) show that the analyses carried out indicate that the regular and adequately guided practice of physical exercise favors the improvement of motor skills, as well as contributing to the promotion of positive psychological states and behavioral changes. However, the mechanisms underlying these transformations still lack a more precise definition.

It should also be noted that the difficulties in adapting to the proposed exercises may, to a large extent, derive from the fatigue resulting from the execution, which may result in an overall decrease in behavior. These considerations emphasize the need to deepen the understanding of the processes by which physical exercise influences both motor skills and psychological and behavioral aspects, which are crucial for designing more effective intervention strategies (FESSIA et al., 2018; DE CASTRO et al., 2022).

Analysis of the data in Table 2 referring to MI, calculated in months, reveals variability in the progress of the child assessed.

Table 2 - Pre and Post Motor Age test calculated in months

Motor Age (MA)	Pre	Post
Fine motor skills (MA1)	78 months	90 months
Global motor skills (MA2)	81 months	84 months
Balance (MA3)	78 months	84 months
Body schema (MA4)	93 months	120 months
Spatial organization (MA5)	72 months	72 months
Time organization (MA6)	72 months	84 months

Fonte: os autores (2024).

MA1 showed considerable progress, increasing his motor age from 78 months in the pre-test to 90 months in the post-test, representing a gain of 12 months. In contrast, MA2 and MA3 showed a decrease, with setbacks of 3 and 6 months, respectively, compared to the other elements assessed, which shows considerable progress.

MA4 evolved from 93 months in the pre-test to 120 months in the post-test, indicating a large difference of 27 months. MA5 remained stable, maintaining the same MA of 72 months in both tests. Finally, MA6 showed an increase in MA, from 72 months in the pre-test to 84 months in the post-test, representing progress of 12

months. This variability in results highlights the importance of individualized approaches to promote each child's motor development, taking into account their specific needs and progress.

According to the literature, in the studies by Rosa Neto et.al. (2013) no relevant results were obtained for Fine Motor Skills, being much lower, however after the motor interventions carried out in the present study, a significant improvement was seen, as well as in Global Motor Skills, which obtained a standard of normality after the sessions, a fact that further reveres the motor intervention program.

Corroborating this, Mesquita et.al (2019) carried out a study to observe the effects of physical activity on psychomotor factors, broad motor coordination and fine motor coordination in a 4-year-old child diagnosed with ASD. The Vitor Fonseca Psychomotor Battery (BPM) was used for assessment before and after the interventions, which lasted 7 months, with 3 weekly 40-minute sessions. After the intervention process and with the reapplication of the BPM, there were efficient improvements in broad motor coordination, but for fine motor coordination the interventions were not as efficient, with non-significant improvements.

Bearing in mind that MA3 is represented by balance, there was a 6-month improvement in MA. Melo et al. (2020) concluded that the child assessed in their study had very poor balance. However, although there were no statistically significant differences, it was possible to see improvements at the end of the program. These results were similar to those found in this study.

According to this study, MA4 is represented by Body Schema, and the child made significant progress over 27 months. In contrast, the study conducted by Do Santos and Mélo (2018), for this element, the child with ASD developed the exercise successfully, in which MA4 was the same as CA. In their study, the child assessed was 10 years old.

Thinking about Body Schema, in the study carried out by Sarabzadeh, Azari and Helalizadeh (2019), they obtained satisfactory results involving Tai Chi Chuan training in autistic individuals, in the aspects of balance, proprioception, body awareness, cognitive and behavioral, over 8 weeks of intervention. According to the results expressed in this study, it can be seen that IM5, which is represented by Spatial Organization, did not make any progress. Corroborating this situation, in the study by Garcia (2018), Spatial Organization, with interventions of motor skills training and recreational activities in the pre-intervention period, as well as in the post-intervention period, showed low rates of improvement.

According to the results expressed in the present study, MA6 is portrayed by Temporal Organization, in which an evolution of 12 months was obtained. With regard to Temporal Organization, the child was able to perform up to level three, resulting in a motor age of 6 years, in which there was no change. However, through the interventions carried out, it can be seen that psychomotricity can make a positive contribution, leading to improvements in Temporal Organization. In Physical Education classes, it is necessary to have a professional who motivates and assists in this process of evolution in order to positively increase psychomotor elements.

Also according to Vieira, da Costa and Santos (2020) who investigated the contribution of throwing games, kicking games, jumping, running, and games with music to the motor development of a child diagnosed with ASD, it can be said that with the 16-week interventions, with 3 sessions per week lasting 60 minutes, it was possible to see notable progress in all tasks and games, and that these activities had a positive influence on development.

The data in Table 3, which describes the General Motor Quotient (GMQ), shows a varied panorama of progress.

Table 3- General Motor Quotient pre- and post-test

Motor Quotient	**Pre**	**Post**
Fine motor skills	96 months	110 months
Global motor skills	100 months	102 months
Balance	96 months	102 months
Body schema	115 months	146 months
Spatial organization	89 months	88 months
Time organization	89 months	102 months

Fonte: os autores (2024).

The initial MQ, represented by MQ1, showed remarkable progress, rising from 96 in the pre-test to 110 in the post-test, indicating an increase of 14 months. However, when considering MQ2 and MQ3, although they showed improvements, these were more modest, with advances of 2 and 6 months, respectively, in the period between the pre- and post-test. In contrast, MQ4 showed substantial progress, with a significant leap from 115 to 146, an increase of 31 units. However, there was a slight decrease in MQ5, from 89 to 88, indicating a propensity of 1 month. The sample maintained the same level of motor development in the two tests applied for this element in the pre and post, in which it started at 81 months of age and at the end was 82, explaining the drop. Finally, MQ6 showed growth, increasing from 89 to 102, resulting in progress of 13 months.

This individualized analysis of the results highlights the variation in the progress of the QMG of each assessment. While the child shows great improvements in MQ1 and MQ4, he shows more discreet changes in

MQ2 and MQ3, but a slight decrease in MQ5. These data reinforce the importance of adopting personalized approaches, taking into account the specific progress of each child in the context of the case study to promote their motor development.

In contrast to these findings, Diniz et al. (2020) observed that when drawing up a motor profile of children with ASD, significant challenges were identified in specific areas. These difficulties were mainly manifested in activities related to gross motor coordination, body schema and spatial-temporal organization. In addition, the children showed notable obstacles in fine and gross motor coordination, imitation, simultaneous coordination of lower and upper limbs, as well as in rhythmic tasks. The possible origin of this inferior performance may be associated with problems in the activation of motor planning. This perspective highlights the complexity of the motor profile in children with ASD, addressing specific areas that may require personalized interventions and strategies to promote motor development effectively.

Given these findings, the authors Diniz et al. (2020) recommend the inclusion of intervention strategies based on movement, which encompasses a variety of motor elements. In line with this perspective, the approach proposed in this study is aligned with the importance of promoting specific physical activities, such as circuits, which offer a variety of sensory stimuli. In addition, the proposal highlights the integration of visual elements, using images, with the aim of improving not only the motor skills, but also the social skills of children with ASD. Both approaches converge towards a comprehensive understanding of motor and social development, seeking to offer integral support for the progress of these individuals.

With regard to laterality, the results are shown in Table 4.

Table 4 - Pre and Post Test Results for Laterality

Laterality	Pre	Post
Hands - Eyes - Feet	Complete wreck	Complete wreck

Source: the authors (2024).

The results of the laterality assessment revealed important aspects of the child's motor development, showing a clear preference for the right-handed side. The tests applied, described in Rosa Neto's manual (2015), which involved kicking a ball, throwing a ball and using adapted binoculars to determine the dominance of the hands, feet and eyes, offered valuable insights into the child's motor choices.

According to Fernandes et al. (2020), the identification of laterality as a key behavioral indicator offers valuable direction for health professionals, including teachers, physiotherapists and occupational therapists, in interventional practice. By understanding the interconnection between laterality and the development of writing, manual dexterity and language, these professionals can implement bilateral motor intervention strategies. This approach not only improves motor skills related to laterality, but also promotes auditory and visual development.

Fernandes et al. (2020) further corroborate this, pointing out that taking the playful side into account in motor task tests is highlighted as a relevant practice to encourage the execution of activities. Given the diversity of ASD manifestations, defining specific movement analysis methods to guide intervention is challenging. However, it is possible to provide comprehensive guidelines for practice, recognizing the importance of individualization in motor intervention strategies and highlighting the relevance of playful aspects to optimize engagement.

IV. Conclusion

Analysis of the results made it possible to detect any deficiencies or deviations in development, guiding the implementation of targeted and more effective interventions for each situation. Based on this assumption, we can see that children with ASD need to be stimulated by Physical Education professionals and teachers who are more knowledgeable or seek to learn more about the autistic spectrum.

Therefore, through the activities carried out, we can see how physical exercise is of the utmost importance for the development of psychomotricity. School Physical Education therefore plays an extremely important role once the individual is able to internalize their actions, seeking to build structured moments in order to reduce their difficulties.

Recognizing the importance of psychomotor development as an integral part of the healthy growth and well-being of children with ASD, this research has contributed to understanding the beneficial effects that motor circuits have on motor skills. In this sense, the importance of implementing and using this didactic resource as an essential tool during school physical education classes is highlighted.

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