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Original article

Proposal for a system of exercises for the development of basic motor skills in students with autism spectrum disorder

[*Propuesta de un sistema de ejercicios para el desarrollo de habilidades motrices básicas en educandos con trastorno de espectro autista*]

[*Proposta de um sistema de exercícios para o desenvolvimento de habilidades motoras básicas em alunos com TEA (Transtorno do Espectro Autista)*]

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ABSTRACT

Introduction: Currently, motor development is understood as the progressive acquisition of basic and complex motor skills, resulting from the interaction between biological, environmental, and social factors.

Objective: To design a system of physical exercises to foster the development of basic motor skills in children aged 5 to 7 with autism spectrum disorder (ASD) who are in the first or second grade of primary education.

Methods: The study was structured in three stages: a theoretical analysis of conceptual and methodological frameworks regarding motor development in ASD; an assessment of the current status of basic motor skills in a sample of 29 children; and the design of an inclusive, contextualized system. Theoretical, empirical, and statistical methods were employed, ensuring validity and reliability. The results showed a predominance of an intermediate level of motor development, with greater difficulties observed in locomotion and stability, and relatively better performance in manipulation.

Results: Methodological triangulation confirmed that curricular and methodological limitations directly impact motor performance, which justifies the need for a structured, progressive, and adapted system of exercises.

Conclusion: The proposal is conceived as an open and flexible model, grounded in systems theory and the principles of inclusive physical education. It is aimed at the functional compensation of motor limitations, while promoting autonomy, socialization, and the school inclusion of children with ASD.

Keywords: autism spectrum disorder, basic motor skills, inclusive Physical Education, exercise system, motor development, school inclusion.

RESUMEN

Introducción: en la actualidad, el desarrollo motor se concibe como la adquisición progresiva de habilidades motrices básicas y complejas, resultado de la interacción entre factores biológicos, ambientales y sociales.

Objetivo: diseñar un sistema de ejercicios físicos para favorecer el desarrollo de las habilidades motrices básicas en educandos con trastorno del espectro autista de 5 a 7 años, que cursan el primer y segundo grado de la enseñanza primaria.

Métodos: el estudio se estructuró en tres etapas: análisis teórico de referentes conceptuales y metodológicos sobre el desarrollo motor en el trastorno del espectro

autista, diagnóstico del estado actual de las habilidades motrices básicas en una muestra de 29 niños y diseño de un sistema inclusivo y contextualizado. Se emplearon métodos teóricos, empíricos y estadísticos, garantizando validez y confiabilidad. Los resultados evidenciaron un predominio del nivel medio en el desarrollo motriz, con mayores dificultades en locomoción y estabilidad, y un desempeño relativamente más favorable en manipulación.

Resultados: la triangulación metodológica confirmó que las limitaciones curriculares y metodológicas repercuten directamente en el desempeño motriz, lo que fundamenta la pertinencia de un sistema de ejercicios estructurado, progresivo y adaptado.

Conclusión: la propuesta se concibe como un modelo abierto y flexible, fundamentado en la teoría de los sistemas y en principios de la educación física inclusiva, orientado a la compensación funcional de limitaciones motrices y favorecer la autonomía, la socialización y la inclusión escolar de los niños con trastorno del espectro autista.

Palabras clave: trastorno del espectro autista, habilidades motrices básicas, educación física inclusiva, sistema de ejercicios, desarrollo motor, inclusión escolar.

RESUMO

Introdução: Atualmente, o desenvolvimento motor é concebido como a aquisição progressiva de habilidades motoras básicas e complexas, resultante da interação entre fatores biológicos, ambientais e sociais.

Objetivo: Elaborar um sistema de exercícios físicos para favorecer o desenvolvimento de habilidades motoras básicas em educandos com Transtorno do Espectro Autista, de 5 a 7 anos, que cursam o primeiro e o segundo ano do ensino fundamental.

Métodos: O estudo estruturou-se em três etapas: análise teórica de referenciais conceituais e metodológicos sobre o desenvolvimento motor no TEA; diagnóstico do estado atual das habilidades motoras básicas em uma amostra de 29 crianças; e elaboração de um sistema inclusivo e contextualizado. Foram empregados métodos teóricos, empíricos e estatísticos, garantindo validade e confiabilidade. Os resultados evidenciaram um predomínio do nível médio no desenvolvimento motor, com maiores

dificuldades em locomoção e estabilidade, e um desempenho relativamente mais favorável em manipulação.

Resultados: A triangulação metodológica confirmou que as limitações curriculares e metodológicas repercutem diretamente no desempenho motor, o que fundamenta a pertinência de um sistema de exercícios estruturado, progressivo e adaptado.

Conclusão: A proposta é concebida como um modelo aberto e flexível, fundamentado na teoria dos sistemas e em princípios da educação física inclusiva, voltado para a compensação funcional de limitações motoras e para favorecer a autonomia, a socialização e a inclusão escolar de crianças com transtorno do espectro autista.

Palavras-chave: transtorno do espectro autista, habilidades motoras básicas, Educação Física inclusiva, sistema de exercícios, desenvolvimento motor, inclusão escolar.

INTRODUCTION

The study of motor development has been a focus of attention since the late 19th century, with pioneering contributions highlighting the importance of reflexes, motor skills, and communication in the early stages of child development. Later, authors such as Gesell (1940) consolidated developmental theories that established norms for child development, while Piaget (1952) and Vygotsky (1978) emphasized the relationship between movement, thought, and the social environment. This background laid the foundation for understanding motor skills as a dynamic and multifactorial process that accompanies human beings throughout the entire lifespan.

Currently, motor development is conceived as the progressive acquisition of basic and complex motor skills, resulting from the interaction between biological, environmental, and social factors (Haywood & Getchell, 2024; Villera, 2024). These skills are organized into dimensions such as gross motor skills, fine motor skills, visuomotor coordination, motor planning, postural regulation, and balance, all of which are essential for autonomy, social adaptation, and overall well-being.

In the case of students with autism spectrum disorder (ASD), these dimensions acquire particular relevance, since the motor impairments present in those who suffer from it can constitute early markers of risk and are correlated with difficulties in socialization and communication (Lloyd *et al.,* 2013; MacDonald *et al.,* 2013). Recent research (Bhat, 2021; Skaletski *et al.,* 2024) confirms that children with ASD present motor clumsiness, balance problems and deficits in visuomotor integration, which directly impacts their autonomy and social participation.

Motor development, in addition to its impact on physical health, influences academic performance and social inclusion. Typical motor milestones such as running, jumping, maintaining balance, and manipulating objects form the basis of basic motor skills (BMS), which are classified as locomotor, non-locomotor, and manipulative. In children with ASD, difficulties in these areas limit participation in group games and school activities, leading to exclusion and affecting the development of social relationships (Staples & Reid, 2010; Whyatt & Craig, 2012).

From this perspective, addressing motor development in students with ASD is not a peripheral objective, but a central necessity to counteract patterns of inactivity, dependency, and social isolation. In this context, adapted motor intervention becomes a priority area of action, capable of transforming limitations into potential and promoting educational inclusion. Therefore, this research aims to design a system of physical exercises for the development of basic motor skills in students with ASD aged 5 to 7 years.

MATERIALS AND METHODS

The research was conducted at the "Enrique Galarraga" Special School for Autism, located in the municipality of Guanabacoa, Havana, a national leader in specialized educational care for students diagnosed with ASD. A purposive sample of 29 first and second grade students, aged between 5 and 7 years, was selected, who met the following

inclusion criteria: school age within the established range, presence of motor impairments, confirmed diagnosis of ASD, regular attendance at school activities, and institutional and family consent to participate in the study.

Method and techniques used in the research:

The historical-logical method to analyze the evolution of conceptions about motor development in students with ASD and to support the proposal from a scientific perspective.

The analysis-synthesis facilitated the integration of the theoretical and methodological references that support the research.

The inductive-deductive method made it possible to derive general conclusions from the data obtained in the diagnosis and apply them to the design of the exercise system.

Documentary analysis for the review of the official programs and methodological guidelines for Physical Education in the first and second grades, of the Ministry of Education.

Observation using the Ministry of Education's physical education exploration guide, organized by observable and measurable dimensions and indicators.

Surveys and interviews conducted with teachers and methodologists of special education.

The motor pretest allowed us to know the level of development of the basic motor skills of the sample.

The measurement was carried out to check the current state of development of basic motor skills in students with ASD.

Empirical distributions of absolute and relative frequencies: allowed the information to be organized systematically.

Methodological triangulation: used to integrate (documentary analysis, surveys, interviews and observation) the results of the different techniques applied, guaranteeing greater reliability in the characterization of the current state.

Systemic structural functional: to conceive the exercise system as an organized set of interdependent subsystems.

RESULTS AND DISCUSSION

With the aim of comprehensively understanding the current state of basic motor skill development in students with autism spectrum disorder (ASD), the research organized its results into three fundamental dimensions: curricular (Martínez, 2004), methodological (Hernández, 2018), and motor (González et al., 2020). This structure allowed for a comparison between what is stated in official Physical Education programs, what teachers apply in their pedagogical practice, and what is evidenced in the children's actual performance.

Presenting these dimensions offers a comprehensive view of the problem, revealing both the limitations of the curriculum and teaching practices, as well as the deficiencies detected in motor performance. A detailed analysis of each dimension follows (Tables 1 and 2).

Table 1. *- Summary of the dimensions analyzed in the diagnosis*

Dimension	Applied method	Main finding	Limitations detected
Curriculum	Documentary analysis (Physical Education Programs, first and second grade).	HMB recognition as essential content.	Disconnect between declaration and inclusive practice. Absence of specific adaptations for ASD Homogeneous progression.

			Evaluation without differentiated indicators.
Methodological	Survey of teachers (n=8) and interviews with methodologists (n=2).	Consensus on the importance of HMBs Use of visual aids and play activities.	Heterogeneity in definitions of ASD. Unsystematic practices. Absence of motor diagnosis protocols in 37.5% of teachers.
Motor	Physical Education exploration guide (observation of 29 children).	Predominance of the medium level (65.5%); manipulation with better performance (average 0.9).	Locomotion and stability at the lower limit of the average level (averages 0.9 – 1.0); no child reached a high level.

Individual results

Table 2. *Student results by indicators*

Child	Locomotion	Handling	Stability	Overall average	Level
Child 1	0.8	0.9	0.7	0.8	Low
Child 2	1.1	1.0	0.9	1.0	Half
Child 3	1.2	1.1	1.0	1.1	Half
Child 4	0.7	0.8	0.6	0.7	Low
Child 5	1.1	1.0	0.9	1.0	Half
Child 6	1.2	1.1	1.0	1.1	Half
Child 7	0.8	0.9	0.7	0.8	Low
Child 8	1.0	0.9	0.8	0.9	Half
Child 9	1.1	1.0	0.9	1.0	Half
Child 10	0.9	0.8	0.7	0.8	Low
Child 11	1.0	0.9	0.8	0.9	Half
Child 12	1.1	1.0	0.9	1.0	Half
Child 13	0.9	0.8	0.7	0.8	Low
Child 14	1.0	0.9	0.8	0.9	Half
Child 15	1.1	1.0	0.9	1.0	Half
Child 16	0.9	0.8	0.7	0.8	Low
Child 17	1.0	0.9	0.8	0.9	Half
Child 18	1.1	1.0	0.9	1.0	Half
Child 19	0.9	0.8	0.7	0.8	Low
Child 20	1.0	0.9	0.8	0.9	Half
Child 21	1.1	1.0	0.9	1.0	Half
Child 22	0.9	0.8	0.7	0.8	Low
Child 23	1.0	0.9	0.8	0.9	Half
Child 24	1.1	1.0	0.9	1.0	Half
Child 25	0.9	0.8	0.7	0.8	Low

Child 26	1.0	0.9	0.8	0.9	Half
Child 27	1.1	1.0	0.9	1.0	Half
Child 28	0.9	0.8	0.7	0.8	Low
Child 29	1.0	0.9	0.8	0.9	Half

The results table by dimension shows that most children have average scores at the middle level, although with variations across dimensions, demonstrating the lack of homogeneous motor development within the group. It was observed that some students show relatively more favorable performance in the manipulation indicator, while the lowest scores are concentrated in locomotion and stability, reflecting difficulties in balance control, coordination of movements, and postural stability.

Overall results

The analysis of the overall averages by indicator shows that:

Manipulation: presents a higher average, located at the medium level, which indicates a more favorable performance in object handling actions and eye-hand coordination.

Locomotion and stability: they are located at the lower limit of the average level, reflecting greater difficulties in balance control, postural stability and coordination of movements.

These results confirm the existence of unequal motor development among the evaluated indicators, which justifies the need to design and implement pedagogical actions directed primarily at the most affected indicators (Table 3).

Level distribution

Table 3. *Distribution by levels of development*

Level	**Low**	**Half**	**High**
Amount	10	19	0

The table showing the distribution of developmental levels reveals a predominance of the average level, indicating that most students exhibit inconsistent motor skills, with partial mastery of the assessed abilities and a need for support during physical activities. The presence of students at the low level is also observed, revealing significant limitations in motor control. No students were recorded at the high level, confirming that basic motor skills are not yet consolidated in the studied sample.

Results organized by dimensions

The results, organized by thematic dimensions, revealed a complex picture:

Curricular dimension: the Physical Education program explicitly recognizes basic physical activities (BPAs) as essential content, but its treatment is general and homogeneous, without considering specific adaptations for functional diversity. This is contrasted by the general guidelines on methodological flexibility suggested in the documents, although these have not been translated into concrete operational guidelines.

Methodological dimension: Teachers agreed on the importance of basic motor skills (BMS) for the holistic development of children with autism spectrum disorder (ASD); however, their practices revealed a lack of systematicity and an absence of clear diagnostic and follow-up protocols. This heterogeneity contrasts with the discursive consensus on the relevance of BMS, highlighting divergences in the conceptualization of ASD and its relationship to motor skills.

Motor dimension: Empirical data confirmed the deficiencies suggested in the previous dimensions. A predominance of the average level was observed in the development of basic motor skills, with significant difficulties in locomotion and stability, and a relatively more favorable performance in manipulation. This finding reveals potential in eye-hand coordination, but also critical limitations in balance and movement that diverge from curricular guidelines.

It is precisely the systemic nature of the identified problem, where curriculum, teaching practice, and motor development mutually influence each other, that justifies adopting *General Systems Theory* (GST) as the structural framework for the proposal. Conceived from an open, dynamic, and inclusive perspective (Bertalanffy, 1968; Ramírez, 1999; Rosales, 2025), GST allows for the organization of motor intervention by applying the principles of wholeness, hierarchy, feedback, and equifinality to the design of exercises. These are conceived as interdependent subsystems that integrate sensory, cognitive, social, and motor dimensions, configuring a coherent and adaptive system capable of responding to the functional variability of students with ASD and of generating emergent properties in the form of new skills.

In addition, contributions are incorporated from the concept of exercise as a system (Martín, 2009) and from sports training theory (Matveev, 1983), which guarantee the progression, coherence, and pedagogical relevance of the activities. Physical exercise is conceived as a comprehensive, planned, and structured system that not only promotes motor development but also cognitive and socio-emotional processes, becoming an educational and therapeutic tool for inclusion (Bucher, 1968; World Health Organization, 2020).

The designed exercise system constitutes an organized and coherent set of activities that respond to current scientific principles and inclusive physical education criteria. In this sense, the Strategic Plan for Inclusive Education (Ministry of Education and Vocational Training, 2023) provides a regulatory framework that supports the need to adapt school practices to the diversity of learners, guaranteeing the participation of students with specific educational support needs, such as children with Autism Spectrum Disorder (ASD). Although it is a Spanish educational policy, its guidelines are relevant as an international reference for grounding the methodological proposal in the Cuban context, since they promote equity, inclusion, and attention to diversity in physical education. Thus, the exercise system not only addresses the basic motor needs of locomotion and stability but also aligns with global trends in inclusive education, offering teachers a viable methodological guide for Cuban school practice (Figure 1).

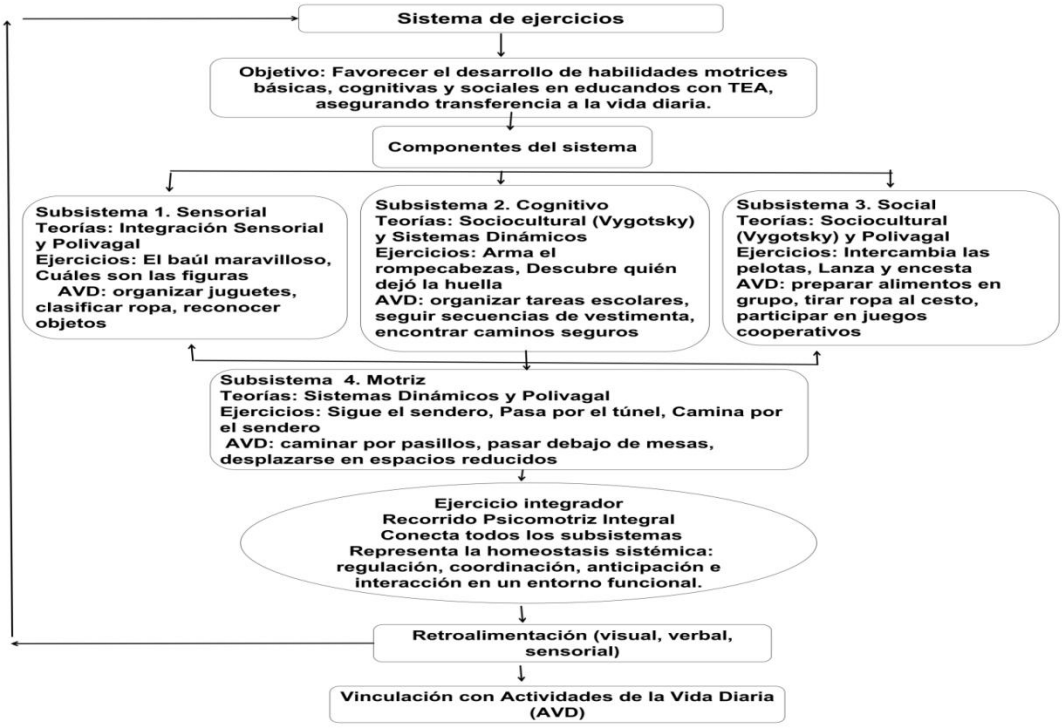


Figure 1. *Structure of the exercise system*

Theoretical basis for the preparation of the exercises

The development of the exercise system was based on validated references from physical education and training theory, adopting the systematic approach of exercise (Martín, 2015) to classify and organize movements according to their characteristics and purpose, ensuring coherence and pedagogical progression. Likewise, the theory of sports training (Matveev, 1983) contributed the concept of exercise as a pedagogical and biological system, structured in cycles and phases that ensure adaptation and progressive development.

In addition, the quality criteria for inclusive physical education from the (Ministry of Education and Vocational Training, 2023) reinforced the methodological relevance, highlighting that the activities must be safe, adaptive and transferable to daily life, guaranteeing inclusion and practical functionality in school children with ASD.

The applied methodological procedure allowed for the design of exercises as interdependent subsystems, with clear objectives, progressive sequences, and constant feedback. Each exercise was conceived with principles of comprehensiveness, functional variability, self-regulation, cultural contextualization, and transfer to daily life, ensuring that the system responds to the motor, cognitive, and social needs of students with ASD.

The system is composed of ten exercises, each designed as an interdependent subsystem:

- Exercise 1: The wonderful trunk: sensory exploration and manipulation.
- Exercise 2: Discover who left their mark: resistance and coordination.
- Exercise 3: Follow the path: dynamic balance and postural control.
- Exercise 4: Throw and score: eye-hand coordination and cooperation.
- Exercise 5: Assemble the puzzle: Integration of gross and fine motor skills with problem solving.
- Exercise 6: What are the shapes?: visual classification and rapid manipulation.
- Exercise 7: exchange the balls: bilateral coordination and controlled transport.
- Exercise 8: Go through the tunnel: Body awareness and spatial adaptation.
- Exercise 9: Walk along the path: motor flexibility and attention to patterns.
- Exercise 10: comprehensive psychomotor journey: synthesis of all skills in a complete journey.

General characteristics of the system

The designed exercise system is characterized by its comprehensiveness, functional variability, self-regulation and safety, cultural contextualization, transferability to activities of daily living, and progressive sequencing. These characteristics are derived from the application of the principles of General Systems Theory (Bertalanffy, 1968; Ramírez, 1999; Rosales, 2025) and complementary theories such as dynamic systems theory (Thelen & Smith, 2000), sensory integration theory (Ayres, 2005), polyvagal theory (Porges, 2022), and the sociocultural perspective (Vygotsky, 1978), which allow the exercises to be conceived as an open, dynamic, and adaptive system.

- Comprehensiveness: the exercises cover basic motor skills (balance, coordination, manipulation, walking, throwing) and associated cognitive processes (attention, memory, classification, planning).
- Functional variability: each exercise allows for multiple motor solutions, recognizing the diversity of sensorimotor profiles in children with ASD.
- Self-regulation and safety: opening and closing rituals, visual and sensory supports, and pedagogical co-regulation are incorporated to ensure a safe environment.
- Cultural contextualization: the exercises include family and community references, promoting connection with daily life and cultural identity.
- Transfer to ADLs: each exercise is explicitly linked to school, domestic or social routines, ensuring the practical functionality of the learning.
- Progressive sequentiality: the system progresses from simple sensory exploration and manipulation exercises (Exercise 1) to a comprehensive psychomotor journey (Exercise 10), consolidating learning within a framework of increasing complexity.

Official Physical Education programs recognize basic physical skills (BPS) as essential content, but lack specific guidelines for addressing functional diversity. This deficiency creates a gap between the curriculum's stated objectives and actual inclusive practice. The diagnostic results confirm that the pedagogical progression does not include differentiated adjustments for children with Autism Spectrum Disorder (ASD), which aligns with the findings of Staples & Reid (2010) and Whyatt & Craig (2012), who highlight that the lack of adaptations limits participation in group games and school activities. The absence of differentiated indicators in curriculum assessment reduces the capacity for monitoring and feedback, justifying the need for more precise and adapted methodological approaches.

Surveys and interviews revealed a consensus on the importance of basic motor skills (BMS) in the holistic development of children with autism spectrum disorder (ASD), but also highlighted conceptual gaps and heterogeneous practices. Although teachers

recognize the relationship between motor skills, socialization, and autonomy, their strategies lack systematicity and clear protocols. This finding aligns with the work of Lloyd *et al.* (2013), who emphasize that motor impairments affect communication and socialization. The need for regular assessments and adapted resources, such as visual aids and differentiated instructions, reinforces the relevance of a structured system of exercises that ensures progression, flexibility, and personalized attention.

The motor assessment revealed a predominance of intermediate skills, with greater difficulties in locomotion and stability, and relatively more favorable performance in manipulation. These results confirm the findings of Bhat (2021) and Skaletski *et al. (* 2024), who identified motor clumsiness and balance deficits in children with ASD. The absence of students at the advanced level reflects that basic motor skills are not yet consolidated, requiring specific interventions. While manipulation skills are more developed, they need further strengthening to ensure eye-hand coordination and its transfer to school and social activities.

Integration of results

Methodological triangulation confirmed that curricular and methodological limitations are directly reflected in students' motor performance. The convergence among the three dimensions confirms that the lack of specific guidance and systematic practice impacts the uneven development of basic motor skills. At the same time, the complementarity of the findings reveals potential in the manipulation and willingness of teachers to implement adapted systems, providing a favorable basis for intervention.

CONCLUSIONS

The functional diagnosis of basic motor skills in children with ASD aged 5 to 7 years shows uneven development: manipulation is the most favorable dimension, while locomotion and stability show significant limitations that condition autonomy and school inclusion.

Physical Education programs lack specific guidelines for functional diversity, which leads to heterogeneous and unsystematic teaching practices.

The proposal of an inclusive and progressive exercise system constitutes a viable response, capable of transforming these limitations into potentialities and promoting active participation, socialization and integral development of students with ASD.

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***Conflict of interest*:**

The authors declare no conflicts of interest.

***Authors' contribution*:**

The authors have participated in the writing of the work and analysis of the documents.

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