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Dance Movement Therapy as a Psychomotor Intervention for Children with Autism Spectrum Disorder

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Abstract

The aim of the present study was to investigate the effect of one-year dance therapy on psychomotor development in children with autism spectrum disorder (ASD). Fourteen male children (age = 10.29 ± 1.50 years) participated in this study. They were randomly assigned to an experimental group (n = 7, age = 10.29 ± 1.50 years), who were engaged in dance therapy training, or a control group (n = 7, age = 10.29 ± 1.50 years). General motor coordination, Draw-a-person, and the gesture imitation tests were used to assess subjective and objective scores, intelligence quotient (IQ), and the simple gestures of the hands and arms, respectively. Of note, both experimental and control groups were also subdivided according to their ASD degree: mild (n = 4) and moderate (n = 3) ASD. The findings revealed that dance therapy training significantly enhanced general motor coordination, namely objective scores, compared with the control group ($p = 0.01$). For the imitation of gestures, dance therapy was associated with higher simple gestures of the hands ($p = 0.003$) and arms ($p < 0.001$) scores compared to the control group. Conversely, the post-subjective scores of motor coordination and post-IQ values did not significantly differ between the overall experimental and control groups ($p = 0.11$ and $p = 0.56$, respectively). Moreover, a greater effect of dance therapy on subjective scores in children with mild ASD compared with those with moderate ASD ($p = 0.03$) was observed. The practice of dance therapy is an appropriate psychomotor therapy to develop visuospatial and motor execution in children with mild and moderate ASD, with a greater effect in children with mild ASD for subjective scores of motor coordination.

Keywords: *autism, therapy, coordination, imitation, intelligence quotient*

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Introduction

Sporting activities are considered a privileged way of learning at the sensorimotor, communication, and socialization levels for people with autism spectrum disorder (ASD) (Massion, 2006). Numerous studies have been conducted on this topic, including a study by Dugas and Moretton (2012) on the evolution of young people with ASD who have participated in various sporting activities, such as swimming, climbing, and basketball. This intervention has been proven effective; however, children with ASD face different degrees of constraint when participating in sporting activities, the most important of which is paying attention to the trainer or the educator, particularly when playing in teams (Vernazza-Martin et al., 2005). Additionally, children with ASD lack intrinsic or extrinsic motivation for performing any motor action (Schmitz et al., 2003).

With regard to these difficulties, it is recommended that instructors or caregivers of children with ASD follow a specific set of pedagogical procedures. These facilitate the integration of children with ASD into their environment and provide them with the required care. First, the trainer or the educator is invited to identify the particular needs of each child (Rogers et al., 2005). Children with ASD are often dependent during various periods. The trainer or the educator is encouraged to establish a trust-based relationship between the child with ASD and the people around them (Baron et al., 1998). Several studies have reported that sports in the social life of individuals with ASD can represent an overlapping area of intervention, with children suffering from the same problem to different degrees. To address this disorder, choosing a convenient sporting activity is vital for achieving the desired goals (Dugas and Moretton, 2012).

Dance movement therapy can be defined as "a psychotherapeutic use of the movement as a process to promote the physical, psychic and social integration of an individual" (Vaysse et al., 2003). It has been widely practiced in England, the USA, and Australia for 50 years. It harmonizes the physical and cognitive aspects of one's personality and promotes self-expression. This form of therapy offers opportunities to establish connections among sensory perceptions, representations, and the child's environment (Bartenieff and Lewis, 2013). According to Blos (1993), psychomotor development is organized as an integrative system with four levels (tonic, sensory, affective, and representative). Dance is a vehicle for leading all these movements in an adaptable and playful way. Moreover, dance engages the body in action as an entity to be felt, lived, and appropriated or reappropriated (Biotteau et al., 2015). The bodily movements of dance, as a practice, generally reflect the dimensions of time, structure, and organization. Undoubtedly, to dance is to put one's body into action for a certain duration by following a set of movements (Louppe, 2010).

Dance as a mediation is considered therapeutic only when it is part of a package of therapeutic interventions (Albaret, 2015). Referring to Larousse, "a package is a set of means implemented for a specific intervention". It is possible to distinguish some specific ways of dancing. The first way is related to the group parameter, by which situations or exercises allow the subject to interact with an individual or a group of individuals to test their relationships with oneself, the other, and the group. The second is the spatial parameter, which concerns the different spatial forms of use, specifically, the capacity of the circle, the frontality of the line, or the investment of the different levels of space. Notably, symbolization and creativity are other parameters embodied in mediating objects such as fabric, sticks, balloons, and music (Lesage, 2006).

Various experiments have highlighted the importance of dance therapy for children with ASD. A study of the effects of dancing was carried out with a group of nine children with ASD who pursued dance classes for 2 h every 15 days. They were accompanied by a dance teacher, an occupational therapist, and a psychologist. After one year of practice, children's gestural and technical improvements could be observed, although researchers noted some difficulties at the levels of segmentation, coordination, and amplitude (Xia and Grant, 2009). In this respect, Peterson et al. (2015) reported that dancing helps foster the relational abilities of children with ASD through the involvement of various disorders that hinder their relationships with others. Another experiment, described by Seal and Bonvillian (1979), was performed in a sample of three teenagers with ASD. The goal was to evaluate the relationship between the dance teacher and the children after their participation in different dance sessions. This research reported a change in the interactions between the children with ASD and the dance teacher, as well as among the group members.

With respect to the beneficial effects of dance therapy for children with ASD in terms of the unification of body image, symbolization of gestures, and integration in group performance (Henze et al., 1998; Scharoun et al., 2014), the precise effects of dance therapy in children with different degrees of ASD still have to be thoroughly assessed. Moreover, the existing body of scholarly research highlights the benefits of dance movement-based therapies in ASD (Aithal et al., 2021; Chen et al., 2022; Cui & Wang, 2024; Takahashi et al., 2019), yet few studies systematically examine their impact on both motor and cognitive domains. Understanding these effects could provide evidence-based support for integrating dance therapy into therapeutic and educational programs, offering a non-pharmacological approach to improving functional outcomes in children with ASD. Therefore, the aim of the present research was to evaluate the effect of dance therapy on children with mild and moderate ASD and the degree-specific effects. We hypothesized that dance therapy would help develop motor coordination, intellectual maturity, and body schema compared to the control group, with greater improvements expected in children with mild ASD. This study was prompted by the need to understand the potential contributions of dance movement therapy to children with ASD, given their documented difficulties in perception, motor coordination, communication, and socialization. It examined whether participation in dance therapy had supported improvements in their ability to navigate social environments. The investigation also considered whether the intervention had enhanced bodily awareness and self-regulation, thereby enabling greater control in interactions with space and objects. Particular attention was paid to whether the therapeutic effects had differed between children with mild and moderate forms of ASD.

Methods

Participants

Fourteen male children (age = 10.29 ± 1.50 years) participated in this study. They were a representative sub-sample of patients of the Errahma Center of the Ibn Sina Association, Sfax, Tunisia. They were randomly assigned to an experimental group (n = 7, age = 10.29 ± 1.50 years) (Tables 1 and 2) or

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a control group (n = 7, age = 10.29 ± 1.50 years) using stratified randomization to ensure balance between groups based on ASD severity (mild = 4 vs. moderate = 3). Within each stratum (mild/moderate ASD), allocation to groups was determined by a computer-generated randomization sequence (blocked 1:1 ratio), ensuring equal distribution of subjects based on ASD severity. To prevent selection bias, allocation was concealed using sealed opaque envelopes, and an independent researcher managed the randomization process to maintain blinding (Figure 1). Participants were included if they met the following criteria: (a) suffering from mild and moderate ASD, (b) no history of chronic disease, (c) absence of interaction disorders and motor difficulties, and (d) abstinence from physical activities 48 h prior to the testing sessions. Participants not meeting these criteria were excluded from the study. The investigation adhered to the guidelines outlined in the Declaration of Helsinki. All participants were informed about the study's objectives and provided written, informed consent for their inclusion.

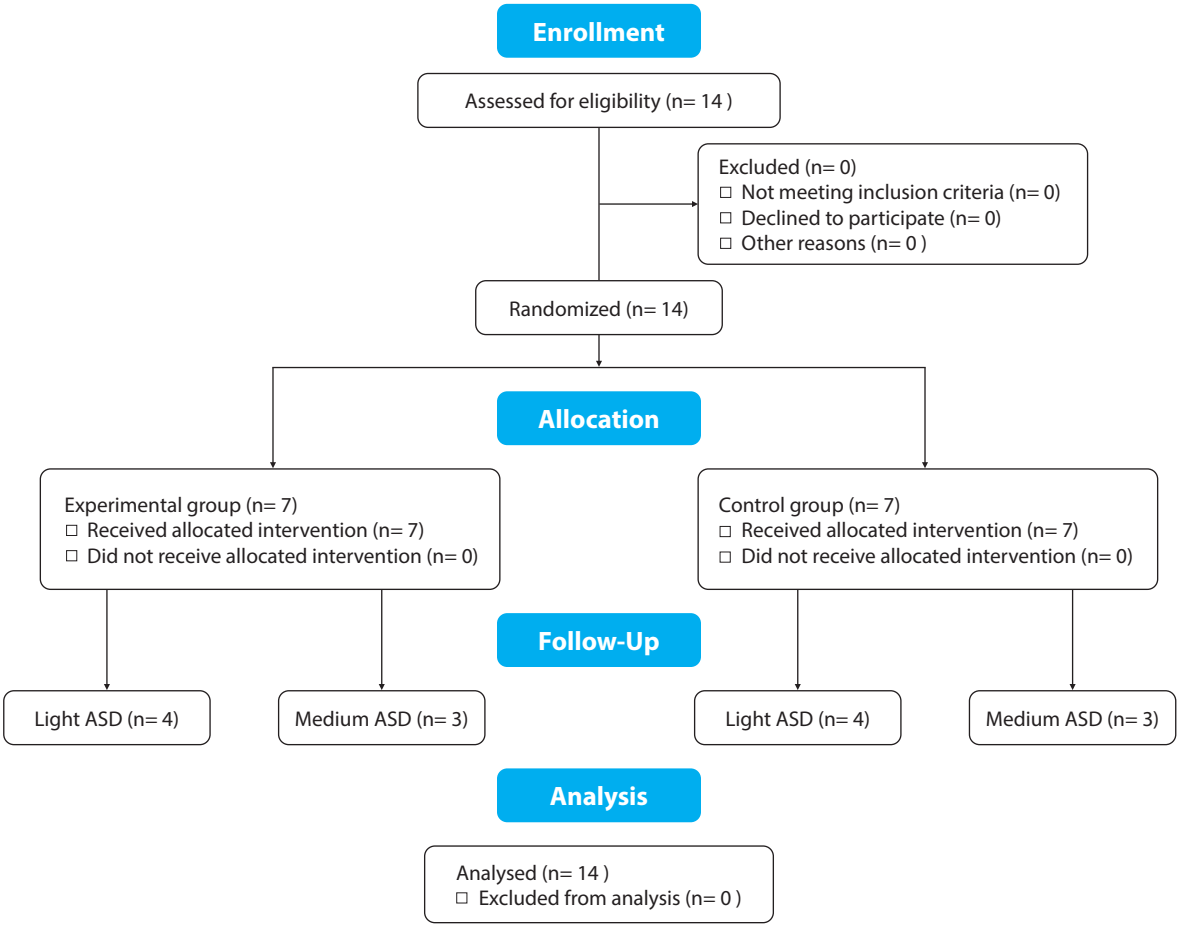

Figure 1. CONSORT diagram showing the flow of participants through each stage of a randomized trial.

Table 1. Characteristics of the experimental group suffering from moderate ASD.

Participant	Age (years)	Gender	Clinical Features
A	10	Boy	• Agitation • Absence of imitation in gestural communication • Fairly rigid movements
M	9	Boy	• Difficulties in movement due to obesity • Requires support to maintain balance (coordination disorder)
N	11	Boy	• Hyperactivity • Scarcity of facial expression • Absence of language

Table 2. Characteristics of the experimental group suffering from mild ASD.

Children (N = 4)	Age (years)	Gender	Clinical Features
D	12	Boy	• Leader of the group and a model for his friends • Understands verbal instructions (comprehension preserved) • Capable of outputting simple verbal exchanges (absence of interaction disorders)
F	12	Boy	• Capable of outputting simple verbal exchanges (absence of interaction disorders) • Prefers relaxation music • Slightly uncoordinated actions
H	10	Boy	• Laughs excessively (emotional regulation disorder) • No motor difficulties • Capable of outputting simple verbal exchanges (absence of interaction disorders)
B	8	Boy	• Agitated • Slack body posture

The study was conducted from December 2015 to November 2016 in the sports hall of the Errahma Center. Each Monday, a session from 11:00 to 12:00 was scheduled for the experimental "moderate" ASD and control groups. The second experimental group, categorized as "mild", participated in the session from 12:00 to 13:00. During the first visit, one week prior to the beginning of the experiment, all the subjects were invited to the laboratory to familiarize themselves with the procedure and tests involved to minimize their learning effects during the test. The reception of weekly information regarding the evolution and the characteristics of each child was guaranteed. This approach ensured that the children could adapt to the context of the experiment, thus facilitating their examination. Each child's scores were recorded on a grid, noting the capacities in question. Thereafter, participants were subjected to the same tests at the second and third visits, one day before and after one of the two interventions (experimental or control group). The participants of the experimental groups engaged in dance therapy training, specifically the "opening ritual" and "therapeutic touch". The participants in the control group matched the dance therapy group in duration, frequency, and group size and performed various adapted physical activities, including conventional gross motor activities (e.g., obstacle courses, ball games, and balance exercises) and cooperative games (e.g., parachute activities), but were intentionally excluded from rhythmic movement, music-based interventions, and expressive dance components. Activities were adapted for autism-related needs using visual task cards, noise-reducing headphones, and consistent routines.

Psychomotor test evaluation

The development of children with ASD in different areas, namely, sensory and motor areas, usually occurs through individualized interventions by either specialists or psychomotor therapists (Feinberg and Beyer, 1998). In the present study, tests were used to assess children's abilities in areas of development in which an interest was noticed before and after each intervention.

The Charlop Atwell's motor coordination scale

This test measures general motor coordination both quantitatively and qualitatively (Schopler et al., 1995). The test lasts approximately 15 min. The six items are divided into four categories: the coordination between the upper limbs and the lower ones are grouped into the categories of "puppet" and "prehistoric animal". These two items also measure the ability to learn motor tasks quickly and accurately. The coordination of the two simultaneous actions with the "U-turn jump" and "whirling" as a dynamic balance is represented by "successive jumps on one foot and static equilibrium on tiptoes". This task was not originally standardized or validated for the age group of the children being tested. The children received an objective and a subjective score for each item (Charlop and Atwell, 1980), which are the sum of the six items. The objective score measured if the children performed the item as instructed and modeled by the individual administering the scale, and the subjective score measured how fluid or natural the children looked while performing the item (Charlop and Atwell, 1980).

The gesture imitation test

This test was used to evaluate the implementation of the children's body schema (Bergès and Lézine, 1963). Two sets of 10 simple and complex gestures involving the arms, hands, and fingers were proposed to the children without any verbal intervention (Bergès and Lézine, 1963). However, we used only simple gestures of arms (10 items) and hands (10 items) due to the difficulty of complex gestures in children with ASD. The test did not include any specific material except for illustrations of the gestures.

The test lasted approximately 10 minutes. In the original version, items were rated as 1 or 0, according to the success criteria (immediate, mirror, after trial, "piece to piece") or failure (global errors, incomplete answers, outliers) (Bergès and Lézine, 1963).

Draw-a-person test

This test was used to assess intellectual maturity (Goodenough, 1929). It allows the psychometrician to evaluate the idea that children possess a diagrammatic understanding of their body. Children were asked to draw themselves, a man, or a woman as best as they could. The raw score was assigned according to the number of drawing elements, with a maximum of 52 points. After that, each score was recorded and converted to the intelligence quotient (IQ) (Naglieri, 1988). Of note, Naglieri's DAP-IQ system represents a detailed and objective checklist to minimize subjective interpretation (Lichtenberger

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& Kaufman, 2013; Matto & Naglieri, 2005), with a high inter-rater reliability (0.84–0.88; Motta et al., 1993).

Dance therapy training program

The first part of the program was based on body awareness, self-awareness, and openness-to-space work (Lesage, 2006). At the beginning of each training session, ten minutes were spent listening to music while singing. This was called "the opening ritual". Each child learned to sing a few words and, in turn, attempted to repeat them. The same song was played frequently through the end of the year. After the opening ritual, relaxing music was chosen for the next exercise. The children with ASD lay on the ground. Light balloons were thrown over different parts of the children's bodies (first on the upper part and then the lower parts). In psychomotricity, this approach is termed "therapeutic touch" (Albaret, 2015). The children focused on their feelings. The touch-based demonstration of the exercise is important with such interventions because children with ASD cannot be guided verbally (Baron-Cohen et al., 1998). Subsequently, the light balloons were replaced with heavier ones. The same exercise was repeated while insisting that the children noticed the sensations moving from their center downward and upward (Lesage, 2006). The sessions encouraged the children to work on their own; each child picked up the balloon and tried to touch different parts of the partner's body (Butté, 2016). For the second group, the children were well rested. They could even close their eyes. In the second stage, fabrics were used to rub parts of their bodies (Biotteau et al., 2015). The children continued lying on the floor while the relaxing music was played. To make the session more dynamic, the children also participated on their own. The aim was to induce them to come into contact with their comrades (Morin et al., 2013). At first, it was difficult to combine these two actions simultaneously. For this reason, the work was split into two parts (Massion, 2006): The first part concerned how to hold the hoops by spreading the hands up, and the second part was based on how to close and then open the body from the bottom up. The children were amused by this process, and their pleasure was obvious, especially when the circle was opened and closed (Schopler, 1987). Motility games were proposed as a second part of the training program to promote the development of general motor skills.

Statistical analyses

Descriptive statistical analyses were performed by calculating the means and standard deviations for each parameter under study. The normality of the data distribution was assessed using the Shapiro–Wilk test, which was selected due to its suitability for small sample sizes, as utilized in this investigation. Depending on the normality of the data, two-way analysis of variance (ANOVA) was conducted. If the data violated normality assumptions, the Friedman test was applied as a non-parametric alternative, to determine differences (a) between pre- and post-test measurements and (b) among various groups. When necessary, p-values were adjusted for multiple comparisons using the Bonferroni correction method. Effect sizes (ES) were calculated based on partial eta squared values, with values <0.06 considered small, >0.14 large, and between 0.06 and 0.14 considered medium (Lovakov and Agadullina, 2021). The magnitude of the ES was interpreted using standard guidelines: values <0.06 were considered small, while values >0.14 were considered large. All statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS, version 24.0; IBM, Armonk, NY, USA). Results with p-values <0.05 were considered statistically significant.

Results

Measurement of general motor coordination: Charlop Atwell Scale

For objective scores, a significant main effect of time was observed ($F(1,12) = 33.57$, $p < 0.001$, ES = 0.73, 95% Confidence Interval [CI] = 3.92-8.64), as well as a significant main effect of intervention ($F(1,12) = 8.47$, $p = 0.013$, ES = 0.41, 95% CI = 1.22-8.49). Additionally, a significant time × intervention interaction effect was identified ($F(1,12) = 27.74$, $p < 0.001$, ES = 0.69). Post-hoc analysis revealed that post-objective scores were significantly higher in the experimental compared to the control groups ($p = 0.013$). Furthermore, objective scores in the mild ASD experimental group were significantly higher than in the moderate control group ($p = 0.031$) (Table 3).

For the subjective scores, no significant effects of intervention ($F(1,12) = 2.83$, $p = 0.11$, ES = 0.19, 95% CI = -1.25-9.82) could be found, while a significant effect of time ($F(1,12) = 73.83$, $p < 0.001$, ES = 0.86, 95% CI = 7.03-11.81) was observed, with higher subjective scores post-intervention compared to pre-intervention (Table 3). Additionally, a significant time × intervention interaction effect was reported ($F(1,12) = 37.44$, $p < 0.001$, ES = 0.75). Post-hoc comparisons revealed no significant differences between the experimental and control groups ($p = 0.11$). More in detail, subjective scores were higher in the mild ASD experimental group than the moderate ASD experimental group ($p = 0.03$) and moderate ASD control group ($p = 0.002$).

Imitation of gestures test

Regarding the imitation of gestures, analyses revealed a significant effect of intervention on the simple gesture of hands ($F(1,12) = 13.78$, $p = 0.003$, ES = 0.53, 95% CI = 1.09-4.19), with higher scores in the experimental group compared to the control group ($p = 0.003$). Additionally, the simple gestures of arms differed significantly between experimental and control groups ($F(1,12) = 22.38$, $p < 0.001$, ES = 0.65, 95% CI = 1.81-4.90). Furthermore, higher post-simple gesture of hands scores in the mild ASD experimental group than in the mild and moderate ASD control groups (both, $p = 0.02$) (Table 1). Imitation of the simple gesture of arms scores were lower in the mild ASD control groups compared with the mild and moderate ASD experimental groups ($p = 0.02$, $p = 0.03$, respectively) (Table 3).

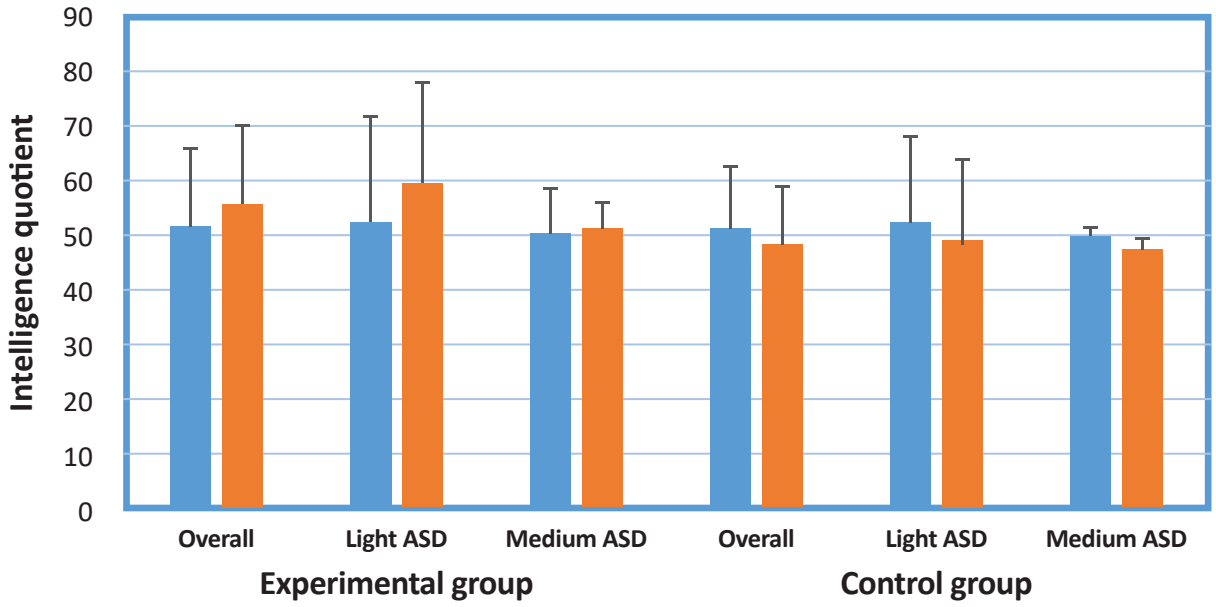
Table 3. Values of general motor coordination and imitation of gestures broken down according to each group.

Variable			Experimental group (Mean ± SD)			Control group (Mean ± SD)			Statistical Significance (Time × Intervention)
			Overall	Mild ASD	Moderate ASD	Overall	Mild ASD	Moderate ASD	
General motor coordination	Objective scores	Before	4.00 ± 2.58	4.5 ± 3.00	3.33 ± 2.30	4.85 ± 1.57	5.5 ± 1.91	4.00 ± 0.00	p < 0.001
		After	16.00 ± 6.42	19.00 ± 6.63	12.00 ± 4.00	5.42 ± 2.22	6.50 ± 2.51	4.00 ± 0.00	
	Subjective scores	Before	4.57 ± 3.10	6.50 ± 1.73	2.00 ± 2.64	7.00 ± 3.31	9.25 ± 1.89	4.00 ± 2.00	p < 0.001
		After	20.71 ± 7.67	25.25 ± 3.86	14.66 ± 7.63	9.71 ± 5.28	13.50 ± 3.31	4.66 ± 0.57	
Imitation of gestures	Simples gesture of hands	Before	2.28 ± 1.70	3.00 ± 1.63	1.33 ± 1.52	2.14 ± 0.89	2.25 ± 0.95	2.00 ± 1.00	p < 0.001
		After	6.28 ± 1.97	7.00 ± 1.41	5.33 ± 2.51	1.14 ± 0.89	1.25 ± 0.95	1.00 ± 1.00	
	Simples gesture of arms	Before	2.71 ± 1.70	2.75 ± 1.70	2.66 ± 2.08	1.85 ± 0.89	1.75 ± 0.95	2.00 ± 1.00	p < 0.001
		After	7.85 ± 1.67	7.75 ± 1.89	8.00 ± 1.73	2.00 ± 1.73	1.75 ± 1.25	2.33 ± 2.51	

Abbreviations: ASD: Autism Spectrum Disorder; SD: Standard deviation

Draw-a-person test

For the IQ, no significant effects of time ($F(1,12) = 0.36$, $p = 0.55$, ES = 0.03, 95% CI = -1.96-3.47) and intervention ($F(1,12) = 0.34$, $p = 0.56$, ES = 0.02, 95% CI = -10.54-18.35) were reported. A significant time × intervention interaction effect was observed ($F(1,12) = 8.13$, $p = 0.01$, ES = 0.40). Post-hoc comparisons indicated that post-IQ values did not differ between the experimental and control groups ($p = 0.56$). Finally, no significant difference was found between both mild and moderate ASD experimental and control groups ($p > 0.05$) (Figure 2).



Discussion

The objective of the present study was to evaluate the effects of dance therapy on motor coordination, intellectual maturity, and body schema in children with mild and moderate ASD and the difference between them. This research found that one year of dance movement therapy significantly enhanced motor coordination, body schema, and IQ in children with ASD compared with the control group. The results of the post-test revealed significant motor progress at both objective and subjective levels. Nevertheless, this progress was less significant for the subjective scores of motor coordination in the group diagnosed with more severe autism, namely moderate ASD. These findings agree with those of Dawson (1997), who emphasized the importance of sports in the development of motor skills and the general functional development of people with autism. The motor stimulation provoked by this activity makes it possible to create relationships with others, as Birnbrauer and Leach (1997) noted, in interventions within a therapeutic environment. They stated that "to get in motion is already the beginning of a life of relationship... with the other, being either with or against him". In addition, in terms of relationships, this progress was noticed in the sessions during which grouping and exchanging between peers were pursued. The findings were confirmed by the dance movement therapy experiments described by Lesage (2006), through which the contributions of the dancing activity were learned at the motor and relational levels. Generally, dance therapy eliminates the restrict-

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ed images that always confine participants to the same register (Lesage, 2006). The majority of children had a positive experience (Lleixa et al., 2016), reflecting that "pleasure, and more particularly this relation of pleasure to the practice of physical and sporting activities, must be considered as the fundamental acquisition in physical education, conditioning all other acquisitions, their reinvestment, and, ultimately, their social utility".

From a neurodevelopmental standpoint, dance therapy leverages brain plasticity to strengthen neural pathways involved in motor planning, social cognition, and sensorimotor integration, which are often atypical in autism (Hildebrandt et al., 2016; Thaut et al., 2015). It also enhances cerebellar-prefrontal connectivity, which in turn improves coordination and balance (Hildebrandt et al., 2016). In addition, listening to music while dancing (e.g., rhythmic auditory cues) activates the basal ganglia, which supports motor timing and sequencing (Thaut et al., 2015). From a sensorimotor learning viewpoint, dance therapy provides multisensory input (auditory, kinesthetic, visual) to reinforce motor learning and body schema through embodied cognition. The dynamic systems theory posits that dance therapy promotes motor variability, enabling children to explore and adapt movements (Thelen & Smith, 1994), while proprioceptive feedback from dance steps further refines motor accuracy (Bhat et al., 2011).

The present data reported an evolution of children's imitative capacities after one year of dance movement therapy. The improvement of these capacities is necessary so that these children can manage and control their emotions and reactions, since they have problems with imitation and being imitated (Lainé et al., 2008). The games chosen in the current investigation promoted imitation (facing the mirror, a simple imitation). Schopler's system is helpful for achieving good results (Schopler, 1987). Nevertheless, these results were variable in accordance with the complexity of the test. This variability was demonstrated by the gesture imitation test results. The more complex the items were, the less improvement was achieved. This finding agrees with the findings of Vaivre-Douret et al. (2016), who mentioned that people with autism can imitate if they are offered simple tasks. They can also imitate if the execution of the movement is not too fast for them (Gepner and Mestre, 2002). Practitioners have affirmed that dance therapy is important for different parts of the body (Lesage, 2006). This step is essential for body coordination in children with ASD (Smolak, 2004). The current approach argues that different exercises, such as dance therapy, help children elaborate their body schema in a better way.

Dance therapy enhances body schema/imitation through multiple integrated mechanisms. Tactile cues in partner dance improve body boundary perception by addressing sensory integration deficits (Cascio et al., 2012), while slow, mindful approaches such as the Laban/Bartenieff movement foster interoceptive awareness (Mehling et al., 2018). The mirror neuron system (MNS) further contributes by synchronizing visual, proprioceptive, and tactile feedback during dance, strengthening body awareness (Koch et al., 2012). Collectively, these neurophysiological processes lead to measurable improvements in postural control and spatial orientation in children with autism (Scharoun et al., 2014), demonstrating dance's unique capacity to remodel body schema through multisensory integration and neural plasticity. In addition, predictable rhythmic patterns leverage predictive coding mechanisms to reduce cognitive load (Van der Kamp et al., 2008), permitting greater allocation of attentional resources to imitation. These effects are amplified through therapeutic social scaffolding, where modeled movements strengthen visuomotor coupling via MNS activation (Rizzolatti & Craighero, 2004), collectively establishing dance as a potent modality for addressing imitation impairments through synchronized bottom-up (sensorimotor) and top-down (cognitive) neural processes.

Children's different developments in intellectual maturity and body image were interpreted through a draw-a-person test performed by the subjects examined before and after the intervention. Specifically, dance movement therapy was more beneficial in children with ASD than in the control group. For example, participant "A" from the moderate ASD group performed differently in the pretest. A closed figure of his drawn man, termed "round or ovoid", was observed. At this stage, according to the explanations of Brechet et al. (2009) about the round man, "this child does not have the capacity to coordinate in parts or in all. During this stage of the drawn man test, it can be concluded that the child focused on its entirety but forgot the parts". In the posttest, the drawing moved from "ovoid" to a "tadpole man or a man in detached pieces" (tadpole in English and Kopffüssler in German) (Brechet et al., 2009). This type of drawn man is usually composed of an "ovoid" shape containing facial elements around which radiating lines represent the limbs. For participant "D" of the second group, whose degree of autism was mild, there was a transition from a stage of sex differentiation (index: mustache) to the profile stage, or "the contour man" (participant draws what he sees). Notably, "the child began to draw starting from the contour; his drawing then resembles to the silhouette of a body" (Baldy, 2005). For the other children, a transition was also detected from one stage to another with associated changes in their IQ levels. According to Ajuriaguerra (1970), body image is based on tactile, kinesthetic, labyrinthine, and visual impressions. In this investigation, dance therapy, which included exercises such as body opening and closing, body awareness and openness to space, mobilized the internal experiences of the examined children. This experience provided the opportunity for the subjects to find themselves, share their emotions, and get in touch with the outside world. These results confirm those of Barnet-López's work (Benoit, 2006), which highlighted the importance of dance therapy in the construction of body image.

Dance therapy may enhance IQ and improve body image (assessed via the Draw-A-Person test) in children with ASD through neurodevelopmental and sensorimotor learning mechanisms. Neuroplastically, dance movement therapy strengthens white matter connectivity (Sihvonen et al., 2017), improves cerebellar function (Koziol et al., 2014), and activates MNS (Haboushaw et al., 2021), supporting cognitive gains in executive function and non-verbal IQ (Reinders et al., 2019). Sensorimotor frameworks suggest that dance therapy recalibrates proprioception (Mastrominico et al., 2018) and interoception (Shah et al., 2021), fostering body schema refinement, which may translate to more accurate/holistic human figure drawings (Koch et al., 2015; Priebe et al., 2022). Rhythmic entrainment (Thaut et al., 2015) and mirroring exercises (Behrends et al., 2012) further integrate motor and cognitive timing while enhancing self-other differentiation, collectively addressing core autism-related deficits in body awareness and IQ-linked skills (Berger et al., 2019).

Strengths and Limitations

This study provides valuable insights into the effects of adapted physical activity, namely dance therapy, on motor coordination and body schema in participants with ASD. One of the main strengths is the long training volume and the degree-specific effects. Additionally, the use of validated tools such as the

Charlop Atwell Scale, Draw-a-person, and imitation of gestures tests enhances the reliability of the findings. However, this study is not without limitations. The small sample size (n = 14), unequal gender distribution, and limited demographic diversity in participants affect the generalizability of the results to larger populations and may reduce the statistical power and the ability to draw conclusions about gender-specific effects. Furthermore, the sample consisted solely of mild and moderate ASD children, making it challenging to extend the findings to individuals with other neurodevelopmental disorders. Finally, the lack of a direct neurophysiological assessment of cognitive function, such as electroencephalography (EEG) or functional magnetic resonance imaging (fMRI), restricts the ability to elucidate the underlying mechanisms of the observed changes. Future investigations including cognitive and neurobiological data are essential to improve the current body of scholarly knowledge and help understand the underlying mechanisms of the effectiveness of dance therapy in children with mild and moderate ASD.

Conclusion

In summary, motor and relational skills can be developed in children with differing degrees of ASD. The practice of dance therapy not only helps reduce inappropriate behavior but also leads to social and life access. The observed motor and relational changes seemed to intervene only in the case of the organization of materials and human resources for running various sessions in favorable conditions, such as group stability, learning duration, accompaniment by psychologists, and room availability, which were guaranteed for weekly work. Children with ASD are disrupted at the motor, relational, and communicative levels. However, they can develop via an adapted and reassuring framework as well as through the relevant choice of activities to promote later social integration. The aim of this research was not to teach these children these techniques nor to help them achieve better performance. It was merely to help them find themselves, share moments of pleasure, and encourage them to discover their own bodies. The goal was not to help these people live like others but to live with others.

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Conflict of interest information

We have no conflicts of interest to disclose.

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