THE EFFECTIVENESS OF A TRADITIONAL DANCE PROGRAM ON BALANCE OF PRIMARY EDUCATION STUDENTS WITH AUTISM SPECTRUM DISORDER

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Abstract

The purpose of this study was to investigate the effectiveness of a traditional dance program on the balance of primary school students with autism spectrum disorder (ASD). Nineteen primary school students with ASD were randomly assigned into one treatment and the control group. The treatment group consisted of 10 students(11.30±2.26 years old) who took part in a 4-week traditional dance training program (12 sessions), 3 times per week for 45 minutes per lesson, while the control group (9 students, 12±1.41 years old) attended their regular physical education lessons. Prior to and after the intervention, the participants were assessed for dynamic balance (walking forwards on balance beams of the Körperkoordinationstest Für Kinder, KTK test), functional balance (Timed Up and Go test), and static balance (single-leg-stance test). The findings indicated that the treatment group performed significantly better on dynamic balance and Timed Up and Go test. However, there were no significant differences regarding static balance (total excursion of the center of pressure). The results suggest that Greek traditional dances constitute an effective and enjoyable activity for the development of balance in primary school students with ASD.

Key words: *Autism Spectrum Disorder, traditional dance, postural control, primary school, physical education.*

Introduction

Autism Spectrum Disorder (ASD) is a group of complex neurodevelopmental disorders that widely affect a person's life. It is characterized by severe difficulties mainly in three areas, such as difficulties with social interactions, challenges in verbal and non-verbal communication and the appearance of repetitive and stereotyped behaviors and movements (American Psychiatric Association, 2013). Today, ASD is the most common developmental disorder. Although prevalence estimates vary in different studies, the ratio is 1:59 children worldwide to 1:166 in 2004 (Baio et al., 2018). According to research by Thomaidis et al. (2020), which assessed the frequency of diagnosis of ASD in children from all over Greece who were born in the years 2008 and 2009, the overall rate is estimated at 1.15% (1.83% in boys and 0.44% in girls) with a boy-girl ratio of 4.14:1. ASD is more common in boys than girls worldwide as well (Werling & Geschwind, 2013).

Individuals with ASD not only have limited social and communicative skills but also have motor disorders, such as poor ability of balance (Stins & Emck, 2018). Balance is the individual's ability to maintain or retain their center of mass within the body's support base so as to prevent falling and complete the required movements (Blackburnet al., 2000;Zhanget al., 2008;). It is composed of static and dynamic balance, which are considered to be relatively independent skills (Sell, 2012; Dehghani & Gunay 2015; Chatzihidiroglou et al., 2018). Several studies reported that children with ASD show reduced body posture control compared to typical developing children (McKinley et al., 2008; Kattenstroth et al., 2010; Granacher, et al., 2012; Paquet et al., 2016). Travers et al. (2013), examined postural stability in adolescents and adults with ASD. Results indicated significant impairment in postural stability in individuals with ASD, in comparison with typical development individuals. Moreover, Radonovich et al.(2013) found that the intensity and frequency of restricted, repetitive behaviors were significant predictors of greater postural sway area in individuals with ASD. Additionally, children with ASD compared with typically developing peers have increased postural sway when confronted with social stimuli and the rate of autistic symptoms was directly associated with an increase in postural sway in social tasks (Ghanouni et al., 2017). In their study, Lin et al. (2017) indicate that multiple sensory processing deficits in ASD contribute to postural control impairment in people with ASD. Moreover, a common feature of ASD is elevated anxiety (Ozsivadjian & Knott, 2011; Theocharidou et al., 2018; Wijnhoven et al.,2018). Anxiety, in turn, could alter basic sensory processing, thereby affecting the manner in which sensory input is used to regulate balance (Horslen & Carpenter, 2011).

Recent studies examined the effects of balance training programs on postural control of individuals with ASD. Wuang et al. (2010) showed the effectiveness of a 20-week Simulated Developmental Horse-Riding Program (SDHRP) on balance of children with ASD. Similar positive results were observed in balance of six children with ASD 5-12 years old after their participation in 12 weekly 45-min hippotherapy sessions (Ajzenman et al., 2013). In addition, improvement in balance of children with ASD was found after a

highly structured therapeutic skating intervention for 12 weeks (Casey et al., 2015), also, after a program of a 30-minute bicycle workout followed by 30 minutes of training in coordination and especially in balance, thrice-weekly for three weeks (Brand et al., 2015), as well as, after a trampoline-based training program lasting 32 weeks (Lourenco et al., 2015). Rafie et al. (2016) reported balance improvements in adolescents with ASD after a motor activity program. Similarly, a study indicated that a 12-week of SPARK program (Sports, Play and Active Recreation for Kids) was effective for improving motor skills including balance (dynamic and static) in children with ASD (Najafabadi, et al., 2017).In a recent study, Sarabzadeh et al. (2019) demonstrated that a six-week program of Tai Chi Chuan was effective in improving balance of nine children with ASD (Sarabzadeh et al., 2019). Finally, the study of Cheldavi et al.(2014), showed that a balance training program in multiple conditions (exercises of single leg stance, balance path) efficiently improved the postural control in children with ASD (average age: 7.70 ± 1.05).

Dancing is a multidimensional experience that dramatically contributes to a child's development. It educates children in a way that combines feelings and emotions with fundamental motor skills (Lykesas et al., 2020). Dance moves are therapeutic because they enhance mental and physical health, improve self-esteem, quality of life, enhance problem-solving skills and our sense of joy (Takahashi, 2015; Murcia et al.,2010; Bräuninger, 2012; Koch et al., 2014; Karkou et al., 2017; Lykesas, et al., 2019). Recent research suggests that in order to improve balance, content should include exercises that attract the interest and excitement of young children (Scharoun et al., 2014; Szatmari, et al., 2016; Walchliet al., 2018; Thomaidis, et al., 2020).

Dance provides learning experiences which enhances the range of children's behavior and their response to the world. The majority of dance moves require very good balance, and balance activities are indeed part of every dance class (Minget al., 2007; Maski et al., 2011; Scharoun et al., 2014; Chatzopoulos, 2019). Emck (2014) reported that a therapeutic intervention based on dance could be very promising in improving the ability of balance. A study by Arzoglou et al. (2013) showed that the neuromuscular coordination of adolescents with ASD improved after the implementation of a Greek traditional dance program, lasting 8 weeks. Moreover, the results of recent studies with adolescents with cerebral palsy and people who have suffered a stroke reported that programs of various dances (tango, ballet, jazz, and modern) contributed positively to the strengthening of the balance (Boswell, 1991; Hackney & Earhart, 2010; Hackney et al., 2015; Hashimoto et al., 2015; Patterson et al., 2018; Joung & Lee, 2019; Cherriere, et al., 2020).

Traditional dance is an indispensable part of the Greek folk tradition, it contributes substantially to the cultural identity and has decisive impact on the cultural development of the society (Lykesas, 2018). It brings people together at important events of everyday life (e.g. weddings, Easter, festivals). Traditional dancing is a form of cultural expression that combines physical activity, social interaction, and emotional expression (Kapodistria & Chatzopoulos, 2021). All these elements create a pleasant environment and increase motivation for participation. Moreover, every movement pattern in the dances requires a good balance ability (e.g. most of the steps are performed on the balls of the feet). Therefore, a training program with traditional dances could be an attractive activity for enhancing postural control in children with ASD. The purpose of this study was to investigate the effect of Greek traditional dances on the static and dynamic balance of primary school students with ASD.

Methods

Participants

The participants of the study were 19 children, who attended a special school for children with Down syndrome. The children were randomly assigned to the intervention group and the control. The inclusion criteria were: (a) ability to walk and standing on one leg independently, (b) no drug therapies related to a psychiatric diagnosis, and (c) the children could follow simple verbal instructions. The intervention group consisted of 10 children (8 boys, 2 girls) and the control of 9 children (8 boys, 1 girl). The participants' characteristics are presented in Table 1. There were no significant differences between the two groups regarding their characteristics (age t=.79, p=.43, weight t=.35, p=.72, and height t=.11, p=.91).

Table 1. Characteristics of the participants (mean±SD) in intervention and control group.

	Intervention	Control
Age (years)	11.30±2.26	12±1.41
Weight (Kg)	51.15±18.78	48.33±15.74
Height (cm)	153.1±17.10	152.33±12.00

The study was conducted in accordance with the ethical guidelines of the local University and all procedures followed the latest version of the declaration of Helsinki. Informed consent was obtained from the guardians of the children before investigation, and they could withdraw from the study at any time.

Procedures

The intervention group was taught by an adapted physical education (PE) teacher who was also a certified traditional dance instructor. The dance group followed a 4-week dance program, which took place three times a week (total 12 sessions, 45 min/session). The dance program consisted of the following two traditional dances: "Syrtos in

three" which can be observed at the link https://www.youtube.com/watch?v=uKXYMDA2P30 and "Chasapikos dance" (Sirtaki dance), https://www.youtube.com/watch?v=tefoe9_UEFE). The dances were chosen according to the following criteria: (a) they consist of basic locomotor movements that can be performed by the children and (b) are highly repetitive (Little & Hall, 2017). The tempo of the dances was between 120-130 beats per minute and the meter 2/4 (Syrtosin three) and 4/4 (Sirtaki dance).

In order to promote children's self-expression the postures and dancing steps were combined with the Laban's' movement concepts: body awareness, spatial awareness, effort and relationships (Donnelly et al. , 2016). At the beginning the children were taught body awareness (i.e. what the body does and how limbs function in movement (Gilbert, 2015). For example, "what parts of your body are moving now?" or "how many parts of your body can you bend?". The children then performed the answers based on their abilities. Spatial awareness explores the movement of the body in space (e.g. level, direction, size and pathway). Effort awareness refers to the feeling and the pace of the movement (the speed, the accuracy, and the sustaining of the movement). The category relationships refers to the relationships of body parts to body parts, individuals to groups and body parts to objects (e.g. mirroring, shadowing, over and under).

The structure of the lessons included:

- Warm-up with dynamic stretching exercises and music (Chatzopoulos et al.,2015).
- Introduction of the dance theme and the dance steps.
- Practicing the dance steps.
- Searching for personal expression.
- Cool down with motion and relaxation rhythmic games.

The whole-part-whole teaching approach was used, and instructions were given with analogies (Chatzopoulos et al., 2020). At the beginning of the intervention we used slower tempi and gave long wait times to allow the children to process meaning and formulate a response (Amos, 2013). In mirroring tasks the children imitated a repetitive movement initiated by the teacher (e.g. arm swings) until synchrony occurred. Moreover, movement complexity gradually increased over the course of the intervention. Participants of the control group attended their regular physical education lessons during the 4-week intervention period. The control group was taught by their regular PE teacher.

Measures

The tests were administered before and after the intervention at the school of the children. Every child was tested individually, under the same conditions.

Dynamic Balance

Dynamic balance was assessed using walking on balance beams that were 3, 4.5, and 6 cm wide (3 m long) (Krombholz, 2018). There was one practice trial on each beam, and two testing trials, starting with the 6-cm beam. The number of steps on the beam was recorded; the maximum number for each trial was 8, yielding a maximum score of 48 (8 steps, 3 beams, 2 trials on each beam).

Functional Balance

Functional balance was assessed using the Timed Up and Go test (TUG). The TUG test is a reliable and responsive measure of balance and functional mobility for children (Carey et al.,2016). At the beginning, participants sat on a chair without arms, with their hips and knees flexed to approximately 90◦ and the feet resting on the floor. The children were asked to stand up from the chair, to walk 3 meters as fast possible, touch a target on a wall, walk back and sit down.

The timing of the TUG test began upon movement to stand after the cue "ready, go" and concluded when the participants sat down on the chair and movement ceased (Carey et al., 2016). Participants were given one practice trial to familiarize themselves with the task and afterwards, they performed two trials with a 1-minute rest period between trials. The best of two trials was used for statistical analysis.

Single leg stance on forceplate

Single leg balance was assessed using a force platform with a sampling rate of 100 Hz (KINVENT, www.k-invent.com). The dependent variable was the total distance travelled by the Center of Pressure (CoP) over the course of the trial duration (CoP-path).

The children were asked to stand still for 5 sec on their dominant leg, their arms were hanging relaxed at the sides and they were focused on a colored pelican placed on a wall at eye level 2 m away (Chatzopoulos, 2019). Each child was allowed to perform one practice trial before testing and performed three trials with a pause of approximately 30 sec. The best of the three trials was used for analysis

Statistical Analysis

Due to the small sample size (10 children in the dance group and 9 in the control) and that data dit not satisfy the normality requirements, the non-parametric Mann-Whitney U test was used to test the differences between the two groups.

The intragroup differences were tested with the Wilcoxon signed-rank test. Effect sizes were calculated using the formula $r = z/\sqrt{n}$, (z: standardised test statistic, n: total number of the sample for Mann-Whitney, whereas for Wilcoxon total number of pairs, r<.1 small effect, .3<r<.5 moderate effect and r>.5 large effect) (Rosental & Dimatteo, 2001). Significance level was set at p<.05.

Results

The descriptive statistics of the dependent variables are presented in Table 2.

Table 2. Mean±SD of the variables in pre- and post-tests.

	Dance group		Control group	
	Pre	Post	Pre	Post
Dynamic Balance (steps)	22.30±8.76	32.00±7.71*	23.22±8.99	23.44±8.36
Single leg (mm)	282.80±85.94	225.30±62.82	293.00±64.79	293.00±64.79
TUG test (sec)	5.90±1.45	5.12±1.12*	6.11±1.73	6.49±1.20

Abbreviations: *Significant difference between the two groups (p<.05), TUG: Timed Up and Go test.

Dynamic balance
According to Mann–Whitney U test there were no significant difference between the two groups at the beginning of the intervention (U = 41.5, Z = −.28, p = .78, effect size r = .07). At the end of the intervention the dance group performed significantly better compared to the control (U = 19.5, Z = −2.08, p = .03, effect size r = .48). Wilcoxon signed rank showed a significant improvement for the dance group between the pre and post tests (T =55, Z = −2.80, p = .005, effect size r = .89), whereas there were no significant improvements for the control (T = 24, Z = -.17, p = .858, r = .06).

Timed Up and Go test
At the beginning of the intervention, Mann–Whitney U test showed no significant differences between the two groups (U = 44, Z = -.08, p = .96, effect size = .02). On the contrary, at the end of the intervention the dance group performed significantly better compared to control ελέγχου (U = 16, Z = -2.36, p = .01, effect size = .54).

One leg stance
There were no significant differences between the two groups neither at the beginning (U = 40, Z = -.36, p = .72, effect size = .08), nor at the end of the intervention (U = 25, Z = -1.63, p = .11, effect size = .37). However, the Wilconxon signed rank test showed significant improvements for the dance group between pre and post testing (T = 5, Z = -2.29, p = .02, effect size = .72), whereas there was no significant improvement in the control group (T = 23.5, Z = -.11, p = .90, r = .04).

Discussion

The purpose of this study was to examine the effect of a program of Greek traditional dances on the balance of primary school children with ASD.

The results of the research showed a positive effect of traditional dances on the functional and dynamic balance of the children in the intervention group. However, there were no differences between the dance and the control group in static balance. In terms of dynamic balance, the dance group performed significantly better at the end of the intervention, compared to the control group.
In addition, while the dance group showed a significant improvement between the initial and final measurements, the control group did not. A similar conclusion was reached by Arzoglou et al. (2013) in their research, which describes the positive effect of a Greek traditional dance program lasting eight weeks, on the dynamic balance of adolescents with ASD. Similarly, according to research by Dehghani & Gunay (2015), people with intellectual disabilities improved their dynamic balance after participating in an eight-week traditional dance program.

The analysis of the results also showed that in the intervention group, there was a significant improvement in functional balance (TUG test) after the program of traditional dances, compared to the control group. The results of the study are consistent with those of a previous study by Hashimoto et al. (2015), which found that dancing was effective in improving gait-related motor functions and balance in people with Parkinson's disease. Similar results were presented by Joung & Lee (2019) in their research, where a creative dance program had a positive effect, among other things, on the functional balance of the elderly.

Regarding static balance, according to the results there were no differences between the two groups either at the beginning of the intervention or at the end. One reason could be the duration of the intervention program. It is possible that the dance group would have had different results if they practiced in traditional dances for a longer period of time. In addition, the static balance assessment process presented a degree of difficulty that may have confused children with ASD, as it required absolute concentration during the test, and it may have caused further confusion around the reason why they had to balance on one leg.

However, in the dance group, there was a statistically significant improvement in the final measurements compared to the group's initial measurements. No such thing was observed in the control group, which did not show differences before and after the intervention.

The improvement observed in the dance group is an indication that the program may have had a positive effect on the children's static balance. The studies of Zhang et al. (2008) and Kattenstroth et al. (2010) are in line with the results of the present study that various types of dance have been found to contribute to the enhancement of balance, regardless of the age or mobility level of the participants (McKinley et al., 2008; Granacher et al., 2012; Hackney et al., 2015; Chatzopoulos et al., 2018). The limitations of the research pertain to the distinctiveness of the children in the research. In particular, regarding static balance, it was very difficult for them to stay focused on the measurement, perhaps because they did not perceive it as such. Therefore, future research may use different, more appropriate static balance tests for similar samples of children. Moreover, future research could involve more participants as well as make the intervention program longer. Also, it is recommended that they should use tools that will detect more parameters that affect balance. For example, they could assess children's proprioception (sense of strength and position of body parts) or reaction time, which are key factors in balance control. According to the results of the present research, a program of Greek traditional dances (Syrtos in three, Sirtaki dance) which was based on Laban Movement Analysis, may have a positive effect on the balance of primary school children with ASD. The conclusions drawn from the present study are of great interest as it appears that the participation of children with ASD in a program of Greek traditional dances, lasting four weeks, contributed to the improvement of their balance. This dance program is easily applicable to the Physical Education course of a Special Primary School, using simple methods and without the need for additional equipment. It is a simple but effective way to develop feelings of joy and entertainment, maintaining children's long-term interest in exercise. Therefore, it is recommended that exercise in the form of dances should be an integral part of the Physical Education curriculum for children with ASD. It is also recommended as an alternative for extracurricular activities because its environment differs from other therapeutic contexts in which children with ASD find themselves daily. Through a program of learning traditional dances, children will practice basic motor skills and at the same time, they will enhance and advance areas in which they may find themselves lacking, such as their social contacts and their interaction and communication skills.

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