

The effect of α tradinional dance training program on neuromuscular coordination of individuals with autism

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Abstract:

The purpose of this study was to evaluate the effect of a structured program of traditional dances on neuromuscular coordination of individuals with autism. Methods: A total of 10 individuals with autism who attend school for people with disabilities, participated in this study. They were divided into two groups, the intervention (IG) and the control (CG) groups, respectively. Pre- and post- training exercise tests were performed to determine the neuromuscular coordination ability. The effect on neuromuscular coordination was measured with the Korperkoordinationstest fur Kinder (KTK), (Kiphard & Schilling, 2007, 1974). The IG group underwent a 8-wk Greek traditional dance training program (individually and/or in pairs), at a frequency of 3 times per week and for a duration of 35-45 min per season. The CG group followed the physical education program of the school, at a frequency of 2 times per week, and for a duration of 45 min per season. Results: Post-training results showed that the individuals with autism on the IG group improved during treatment, from their baseline scores on neuromuscular coordination measurements (total score of neuromuscular coordination: $p < .05$, balance and walking backwards: $p < .001$, jumping over an obstacle on one foot: $p < .05$, lateral jumps right and left: $p < .05$, lateral movement and repositioning: $p < .05$). The CG group did not show any improvement between the two measurements. Conclusions: Individuals with autism may be able to improve their neuromuscular coordination when performing a systematic and well-designed Greek traditional dance training program.

Key words: Autism, neuromuscular coordination, traditional dances.

Introduction

Autism is defined as a developmental disability that impairs a person's ability to communicate, form relationships, socially interact, and respond appropriately within a given environment (American Psychiatric Association, 2000). The deviating stereotypical and self-stimulating behaviors and the fixations are evident trait of children with autism (Heflin & Aliamo, 2007). In the last twenty years, the prevalence of autism has grown significantly, 1 in 88 children up to 8 years displays some kind of form of autism. In comparison, the prevalence is higher in boys (1:54) than girls (1:252) (Department of Health and Human Services, 2012). A diagnosis of autism can take place between the second and the third year of life of a child (Kleinman et al., 2008).

Persons with autism usually display low levels of physical fitness (Auxter, Pyfer, & Huettig, 1997), deficits in sensorimotor development (Piek & Dyck, 2004), in gross (Emck, Bosscher, Beek, & Doreleijers, 2009) and fine motor movement (Provost, Heimerl, & Lopez, 2007), in motor coordination (Fournier, Hass, Naik, Lodha, & Cauraugh, 2010, Green et al., 2009), in balance (Minshew, Sung, Jones, & Furman, 2004), and in muscle weakness (Hardan, Kilpatrick, Keshavan, & Minshew, 2003). May be hypotonic (Ming, Brimacombe, & Wagner, 2007), have problems with their body stance (Downey & Rapport, 2012) and walking (Jansiewicz, Goldberg, Newschaffer, Denckla, Landa, & Mostofsky, 2006) and display locomotor's coordination developmental disorder (Baxter, 2012; Downey & Rapport, 2012).

People with developmental disorder of motor coordination display weakness, difficulty and inability to perform with acceptable success and performance of different motor skills, depending on the environment in which they live and their development age (Wall, Reid, & Paton, 1990). Moreover, people with difficulty in developmental disorder of motor coordination have problems with gross and fine motor coordination, in visual kinetic coordination (Markovitis & Tzouriadou, 1991), exhibit neuromuscular coordination problems, namely

deficit in cooperation between muscular and nervous system, and usually characterized by lack of harmonic uncertainty and disarray in their movements (Kiphard & Schilling, 2007; 1974). According to researchers, developmental disorder of motor coordination is connected to autism (Gillberg & Kadesjö, 2003).

Traditional dances are a music-kinetic activity that can be applied almost anywhere since no additional equipment are needed. Also, the use of simple teaching methods, allow participation of people with disabilities and/or growth disorders. From the review of the literature though, it is evidenced the absence of studies on the effect of traditional dances as means of intervention in autistic spectrum. In addition, researchers have focused primarily on how to reduce unwanted behaviors and to improve fitness levels, as a result of participation of people with autism in exercise programs (Axarli, 2009; Levinson & Reid, 1993; Rosenblatt et al., 2011; Ulrich & Pitetti, 2007, Yilmaz, Yanardag, Birkan, & Bumin, 2004). It is evident from the above the absence of research on effects of exercise in developmental disorder of motor coordination and especially in neuromuscular coordination of individuals with autism. Therefore, the aim of this study was to investigate the effect of a program of traditional dances in neuromuscular coordination of people with autism.

Method

Participants

A total of 10 individuals with autism who are enrolled in special education schools in the area of Thessaloniki participated in the study. Participants were divided into two groups (intervention and control) according to their desire or not to participate in the program of traditional dances. Five people with autism were the intervention group (IG), while another five people with autism the control group (CG), respectively.

The diagnosis was made by an experienced psychiatrist, according to the criteria of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 1994). All participants were healthy, without orthopedic or sensory problems and able to understand visual and verbal instructions. In the beginning of the study, participants and parents or legal guardians were informed and consented to the purpose and the research processes. The physical characteristics of all the participants are shown in Table 1. No significant differences were observed in age, height, body mass and body mass index (BMI) between the two groups.

Table 1. Physiological characteristics of participants

Groups	Age (Years)	Height (cm)	Body mass (kg)	BMI (kg.m ⁻²)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
IG (n=5)	16.8 ± 1.8	172.2 ± 8.9	78.6 ± 14.5	26.4 ± 4.1
CG (n=5)	16.6 ± 1.3	172.8 ± 8.9	74.2 ± 8.9	24.9 ± 3.1

Note. IG = Intervention Group; CG = Control Group

Measurement/Instrument

Neuromuscular coordination was assessed with *Körperkoordinationstest für Kinder* (KTK) (Kiphard & Schilling, 2007; 1974), a quantitative test used for diagnosis of neuromuscular coordination for the entire body. Specifically, were evaluated the ability of balance when walking backwards, jumping on one foot, jumping sideways (left and right) and, sideways movement and repositioning.

Procedure

Körperkoordinationstest für Kinder (KTK) was used to assess neuromuscular coordination which is one of the most reliable ($r = .90$) measuring instruments for the quality evaluation of neuromuscular fitting for typical population and people with disabilities. In the beginning of the measurement a demonstration of the test took place along with a trial practice of each participant in order to become familiar with the test equipment. Neuromuscular coordination was determined by balancing when walking backwards, overcoming obstacles with one leg, sideways jumps (right and left) and, sideways movement and repositioning. In between tests there was a break for 3-5 minutes. The instructions provided at each participant were the same for everybody in order to avoid influence from internal or external motivation. Furthermore, no verbal communication or intervention allowed during testing and the examiners were the same for all the participants.

The clinical examination and measurements of the physical characteristics of the participants took place at the Laboratory Developmental Medicine and Special Education of the Department of Physical Education and Sports Science in Aristotle University of Thessaloniki. The measurements of neuromuscular coordination and the implementation of the intervention program took place in the gymnasium of the school unit in which the participants were enrolled. An orientation session for all the participants was given one day prior to the evaluation session. During the evaluation session, a demonstration of the tests and visual instructions were given to the participants while for their parents or their legal guardians, the instructions were written. Following the demonstration, participants performed a number of trials to familiarize themselves with the assessment procedure and the equipment.

All measurements were performed by two examiners familiar with the operation of instrumentation and measurement procedures. The evaluation of the participants in the IG included two measurements (initial and final), before and after the implementation of the intervention program, respectively the CG who followed the physical education program of the school, was subjected to the same measurements with the IG. The IG participated in a program of traditional dances of total duration of eight weeks. All participants wore sneakers and sportswear during the sessions.

Intervention program

The IG participated in a program of traditional Greek dances of total duration of eight weeks, with a frequency of three times per week and duration per session of 35-45 minutes. All persons in the IG did not participate in any other exercise program during the research program.

A period of three weeks was allocated before the implementation of the intervention program for learning the dance steps by the participants in order to avoid the loss of time during the sessions. Overall, the intervention program included four Greek traditional dances (Table 2).

Table 2. Greek Traditional Dance Program

Traditional Dance	Duration
Syrtos sta tria	2' 41''
Giatros	2' 21''
Chasapikos grigoros (I)	2' 49''
Chasapikos grigoros (II)	2' 27''

Practice took place individually or in pairs. Initially, the session began with a 5 min warm-up that included stretching exercises to avoid possible injury to the ankle joint and the gastrocnemius muscle and continued with a 5 min rhythm exercises. Followed by, the main part, a 15-25 min session, to practice the traditional dances. In between the dances there was a break for 1 minute and a 5 min period as a rest period. Each session ended with a 5 min period where the participants could dance freely. During each session, participants received continuous verbal and visual feedback. Until the completion of the program, no one of the participants was absent for more than 15 % of the total number of sessions (4 absences in a total of 24 sessions).

The selection of traditional dances was done by: a) the musical measure in relation to the tempo (in two quarters dances selected were slow and relatively at a fast pace), b) formations and footwork in space (selected footwork and formations were simple) and c) familiar or most desired sounds from participants.

The CG participated in the physical education program of the school, with a frequency of twice a week and 45 minutes per session.

Statistical analysis

For the statistical data analysis the statistical package SPSS 20 was used. The calculation of averages and standard deviations used descriptive statistics. An ANOVA 2x2 (2 groups : intervention - control) x (2 measurements: initial - final) with repeated measures analysis of the results was used. The statistical significance of differences was tested with post-hoc (Scheffe) test. The level of significance was set at $p < .05$.

Results

The analysis of variance with repeated measures showed no statistically significant effect of the factor measured in the balance when walking backwards [$F_{(1,8)} = 38.526, p < .001$], a significant interaction between the independent variables measured and both groups [$F_{(1,8)} = 13.474, p < .01$], and there were no differences between groups ($p > .05$). From the post-hoc (Scheffe) analysis a statistically significant difference was found in balance ($p < .001$) when walking backwards for IG between the two measurements, while no differences were observed for CG (Table 3).

Furthermore, there was no statistically significant effect of factor measurement ($p > .05$) and the factor group ($p > .05$) in overcome an obstacle at one leg, but there was a statistically significant interaction of independent variables measuring \times group [$F_{(1,8)} = 7.216, p < .05$], while statistically significant difference was found between the two measurements for IG ($p < .05$), but not for the CG ($p > .05$) (Table 3).

Moreover, a statistically significant effect of the factor measuring the lateral jumps right - left [$F_{(1,8)} = 10.506, p < .05$], but not the agent group ($p > .05$) was found. Significant interaction was observed between the independent variables measure \times group [$F_{(1,8)} = 6.806, p < .05$]. Between the two measurements, the IG showed statistically significant differences ($p < .05$), while no differences were found for the CG (Table 3).

Additionally, a statistically significant effect of the factor measuring the lateral movement and repositioning [$F_{(1,8)} = 9.175, p < .05$], a significant interaction of the independent variables measure \times group [$F_{(1,8)} = 8.450, p < .05$], but no effect of the agent group ($p > .05$) was found. IG showed statistically significant differences between the two measurements ($p < .05$). In contrast, no differences were observed in the CG (Table 3).

Table 3. Repeated measures analysis: pre-post values of neuromuscular coordination

Conditions		Groups	
		IG (n=5) Mean ± SD	CG (n=5) Mean ± SD
Balancing when walking backwards	Pre	15.8 ± 8.3	20.2 ± 6.9
	Post	30.6 ± 7.0**	24.0 ± 8.3 ^{NS}
Overcoming obstacles with one leg	Pre	9.0 ± 3.4	17.4 ± 11.4
	Post	19.6 ± 9.1*	16.4 ± 14.0 ^{NS}
Sideways jumps (right and left)	Pre	12.4 ± 3.7	16.0 ± 7.3
	Post	19.8 ± 5.1*	16.8 ± 9.1 ^{NS}
Sideways movement and repositioning	Pre	7.4 ± 2.7	10.0 ± 1.8
	Post	10.4 ± 2.9*	10.0 ± 2.4 ^{NS}
Total score	Pre	44.6 ± 10.4	63.6 ± 23.4
	Post	80.4 ± 14.2*	67.2 ± 27.6 ^{NS}

NS p>.05, * p<.05, ** p<.001

Finally was found, statistically significant effect of the factor measuring the total score of the test [$F_{(1,8)} = 25.365, p<.05$], a significant interaction of the independent variables measure × group [$F_{(1,8)} = 16.942, p<.05$], but no significant effect of the agent group ($p>.05$) was found. In the final count, the IG had a statistically significant improvement in overall score compared to the score of the initial measurement ($p<.05$), while the CG, had no statistically significant differences between the two measurements ($p>.05$) (Table 3).

Conclusions and discussion

Individuals with autism often exhibit developmental disorder of motor coordination (Gillberg & Kadesjö, 2003) resulting in an inability to perform motor skills according to their age (Gidley-Larson & Mostofsky, 2006; Jansiewicz et al., 2006), and at the same time low levels of neuromuscular coordination (Green et al., 2009, Kern et al., 2006) and motor control (MacNeil & Mostofsky, 2012) were observed.

Studies have shown that participation in a traditional dance program help's to improve neuromuscular coordination (Sanderson, 1988) and the development of stance and locomotion (Lykesas, 2002). The findings of this research clearly show that people with autism who participated in the Greek traditional dance program have improved their neuromuscular coordination, since there was an increase in performance in all parameters that were investigated, and of the total score's of the test, showing therefore that exercise in the form of a systematic program of traditional dances is an important factor for improving the kinetic development of these individuals. Instead, the physical education program of the school unit in which enrolled individuals with autism in the control group did not appear effective in improving neuromuscular coordination, since there were no substantial changes in performance.

From the review of the literature it is evident that there are no other similar findings, however different intervention programs seemed to have a positive effect on shortcomings of the autistic spectrum disorders. Specifically, researchers (Rosenblatt et al., 2011) reported improvements of the behavior of children with autism after applying a combined yoga and music therapy program. In a previous study (Levinson & Reid,1993) was observed that exercise (moderate intensity running) induced a decrease in stereotypic behaviors (15%) in children with autism, however, the researchers reported that 90 minutes after the end of exercise stereotypic

behavior was returned to the initial levels. Similarly, walking on a treadmill seemed to have a positive effect on young people with autism, and helped decrease unwanted behaviors in four of the five participants (Ulrich & Pitetti, 2007). Furthermore, the combined participation in physical education and therapeutic riding helped reduce stereotyped movements and self-propelled behaviors in children with severe autism, but two months after the end of the program there was an increase frequency of behaviors and a return to their original levels five months after the end of the exercise program (Axarli, 2009). Finally, the results from a case study of a child with autism reported improved fitness and reduce stereotyped movements following his participation in a swimming program (Yilmaz et al., 2004).

Furthermore, the findings of this study are reinforced from those of other studies who showed that dance in the form of regular exercise has a positive effect on physical fitness and motor development of people with disabilities or development disorders. Specifically, researchers reported improvement in dynamic balance of individuals with mild to moderate mental retardation as a result of a program of traditional dances (Tsimaras, Giamouridou, Kokaridas, Sidiropoulou, & Patsiaouras, 2012). A previous study observed adaptations in aerobic capacity and muscle strength of the anterior and posterior thigh in subjects with loss of hearing (Tsimaras, Kyriazis, Christoulas, Fotiadou, Kokaridas, & Angelopoulou, 2010), while a recent study reported that people with hearing loss improved their rhythm and orientation abilities, and their dancing skills, while their motivation increased significantly for participating in such activities (Kaltsatou, Fotiadou, Tsimaras, Kokaridas, & Sidiropoulou, 2013). Patients with chronic diseases improved functional ability and psychological state after exercise with traditional dances (Kaltsatou, Mameletzi, & Douka, 2011). Parkinson patients showed improved balance capacity, gait patterns and motor control after a training tango program for 12 weeks (Duncan, & Earhart, 2012).

According to researchers, the effectiveness of dance programs is due to the fact that participation and practice in dance activities leads to execution of specific sequences of movements, during which coordination of the whole body is required, thus providing alternative therapy for people with problems in movement, such as people with Parkinson's and autism (Earhart, 2009).

Efforts to improve the reduced motor activity in children with autism have been done only by physiotherapists and only with young age people (Downey, & Rapport, 2012). Regarding the control of posture, which is necessary for participation in traditional dances (Lykesas, 2002) has been observed that is delayed with autistic people (Minshew, Sung, Jones, & Furman, 2004). More specifically, the control of posture up to twelve years has not improved in individuals with autism, while at the age of fifteen years shows a plateau in those without growth disorders, there is no correspondence for people with autism (Schmitz, Martineau, Barthémy, & Assaiante, 2003). The reduced stability of posture may significantly limit participation in activities, while the simplest movements require complex control (Frank & Earl, 1990; Wallman, 2009), fact which was confirmed by the initial measurements of this research, since the participants presented similar problems, which though decreased significantly after the intervention program.

By comparison, people in the wider spectrum of autism show developmental disorder of motor coordination in relation to the average and, moreover, they need more time than the average person to design and execute a movement (Nazzarali, Glazebrook, & Elliott, 2009; Rinehart, Bradshaw, Bereton, & Tonge, 2001). In a study (Staples & Reid, 2010) regarding two-sided coordination was observed that people with autism have difficulties and delays in relation to their age, a finding that was reinforced by those of the initial measurements of the present study, however, after the training program, there was an improvement in the actual capacity.

Additionally, an earlier study (Jansiewicz et al., 2006) reported balance and gait problems in individuals with high-functioning autism and Asperger Syndrome, while a similar study in the same population (Freitag, Kleser, Schnieder, & Von Gontard, 2007) showed problems in dynamic balance and successive movements, as well as difficulties in the visual and motor coordination. Similar findings were observed in this study, reinforcing those of previous investigations.

In this study, the improved neuromuscular coordination of individuals with autism showed that if an intervention program focused on improving motor control, people with autism are able to respond successfully, finding that confirms similar findings from previous studies (Fuentes, Mostofsky, & Bastian, 2009).

In recent years, it has been widely recognized the importance of exercise as a means of therapy for people with autism since it has been shown that participation in specialized exercise programs helps to improve physical and motor abilities. The motor gains are necessary to perform simple but important for everyday life activities, like walking and climbing stairs, skills that are impossible to realize without sufficient neuromuscular coordination.

The present study showed that traditional dances are an excellent form of exercise to improve neuromuscular coordination in people with autism. Successful performance of fundamental motor skills is likely to have an overall effect on personality as the social and emotional interaction caused by participation in traditional dances has a direct effect on improving the quality of life.

Traditional dances are a music-kinetic activity that can be applied to the physical education program of the school by simple methods without requiring additional equipment. They are a simple but effective way of

developing feelings of pleasure and entertainment, keeping for long term the interest of people for exercise. Hence the exercise in the form of traditional dances should be an integral part of the physical education program for children with autism.

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