EFFECTIVENESS OF AQUATIC EXERCISES PROGRAM TO IMPROVE THE LEVEL OF PHYSICAL FITNESS FOR CHILDREN WITH DISABILITIES

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Abstract: *Background & Purpose*, Taking into account the limitations and sedentary lifestyles of children with disabilities, aquatic therapy can be a promising intervention strategies to improve their physical fitness and motor skills. The purpose of this study was to determine the effect of 8-weeks adapted aquatic program on some of the selected parameters (cardiorespiratory function, muscle strength, motor and balance performance on land) related to the children with disabilities who participate in Special Olympics programming.
Methods, Six children (2 males, 4 females) age range 10 to 16 years participated in this twice-per-week aquatic program lasting 4 mounts. The children's diagnoses included Down syndrome, autism spectrum disorder and cerebral palsy. The strengthening component consisted of exercises using bar bells, aquatic noodles, and water resistance. For the aerobic conditioning subjects participated in swimming laps, shallow water running, jumping and hopping activities and ball games. The following outcomes were measured: functional balance, muscle strength and cardiovascular endurance.
Results, Significant improvements in the balance and motor performance assessed through PBS score, were observed and for secondary outcomes of strength and t*he 16-meter PACER laps.* The results of our study suggest that aquatic therapy may be useful in the management of patients with disabilities and is an approach on the way to an enhanced integration and more independent life style.
Key words: *aquatic program, children, disabilities*

Introduction

The aquatic therapy is known as a set of therapeutic or preventive techniques and methods aiming at the well-being of the person with or without neurological injuries, or even with other types of physical, musculoskeletal, cardiorespiratory or functional dysfunctions.
Aquatic therapy intervention contains many of the exercises that would be used on land, like stretching, resistive exercise, cardiovascular exercises, and motor skills. It also incorporates adjustment to water, functional independence, movement control, rotation, swimming, and respiratory activities[1]. Both land and aquatic intervention comprise methods of play during therapy, which is functional for pediatric populations.
Children with disabilities suffer from low cardiovascular endurance and experience a decrease in muscle endurance, balance and coordination which limit motor skills and capacity to participate with other people in community based activities. For this reason they tend to be less physically active than children without disabilities. Maintaining balance during different activities is often a difficult task for children with an intellectual and developmental disability. Improved balancing ability helped disabled persons manage better in everyday situations. Balance exercise in water enables to perform balance with the correct speed, balance correction and step strategy. The pulmonary system is affected when the body is immersed in water to the chest, the lung function and respiratory dynamics are changed, and respiratory muscle effort is increased.
Diminished physical activity level can put children at risk for acquiring secondary health conditions. Physical therapy programs which can promote participation, increase flexibility and range of motion, gross motor skills, and aerobic capacity are recommended for children with disabilities. Aquatic exercise programs which provide safe and beneficial alternative low impact exercise have been particularly recommended as a part of physical activity programs for children with disabilities.
Aquatic interventions are commonly used as a clinical environment for people with disabilities[2]. Water therapy, has a number of physiological and psychological benefits. The physical properties of water offer postural support and decrease joint loading, allowing children to move independently. Water buoyancy provides support and favors the initiation of movement while viscosity and drag forces provide gradual resistance to movement and potential for muscle strengthening. Hydrostatic pressure gives

extensive stimulation of proprioceptors and increased pressure on the respiratory muscles.

Taking into account the limitations and sedentary lifestyles of children with disabilities, aquatic therapy can be a promising intervention strategies to improve their physical fitness and motor skills.

The purpose of this study was to determine the effect of 8-weeks adapted aquatic program on some of the selected parameters (cardiorespiratory function, muscle strength, motor and balance performance on land) related to the children with disabilities who participate in Special Olympics programming.

Methods

This study included 6 children (age 10-16 years) with disabilities (Down syndrome, Autism spectrum disorder, Cerebral palsy) 4 girls and 2 boys, who participated in a 4-month intervention aquatic program at a community pool (the hotel's swimming pool Helin, Craiova). Each aquatic exercise session lasted 55-60 minutes, two times a week for 16 weeks. A qualified physical therapist supervised all pool sessions. In addition, 3-5-volunteer students assisted children with the exercises and have ensuring safety and optimal participation. The warm aquatic environment was 32-33 degrees C and has complied with rules regarding hygiene.

Exercises were performed with gradual increases in intensity and duration according to the ability of each child. They followed a normal sequence of warm-up, conditioning, strengthening, and cool-down routines. The programme consisted of 20–30 minutes of aerobic activities, 5–10 minutes of muscular strength and endurance training and 5 minutes of cool down and stretching activities.

The general aims of the exercise program were to increase functioning and improve levels of activity. *Individual aims* consisted of improving active joint stability, joint mobility, flexibility of musculoarticular structures, muscle strength, proprioceptive control, coordination and balance, respiratory function and functional activities. Aquatic exercise therapy comprised of a supervised program based on: initially shallow water walking and increasing water depth subsequently, lower body and trunk strengthening using resistive devices: foam barbells, cuff weights, aquatic noodles and water resistance. For the aerobic conditioning subjects participated in swimming laps, shallow water running, jumping and hopping activities and ball games.

Our work was completed with the participation of children in Special Olympics Regional Events in Craiova, included swimming, Boccia and athletics.

Table 1. Description of the Aquatic Exercise Program

WARM UP
Forward walking; 4 widths
Backward walking; 4 widths
Toe walking; 2 widths
Heel walking; 2 widths
Side steps; 2 widths
Lunges; 2 widths
MAIN EXERCISE
Leg kicks using side of pool (x 40 sec.)
Side lateral raises (2 sets/8 reps)
Shoulder flexion-extension (2 sets/8 reps)
Shoulder abduction-adduction (2 sets/8 reps)
Arm circles (x10)
Double knee bend in deep water (2 sets/10 reps)
Seated knee extension (2 sets/10 reps)
Jumping Jacks (x10)
Single leg bicycle (2 sets/8 reps)
Single leg balance shallow water (2 sets/8 reps)
Balance exercises in choppy water (2 sets/10 reps)
Squats (x10)
Steps-ups (x10)
Run in place (x 30 sec.)
Hopping, shallow water (x10)
Kickboard swim in supine position; 4 widths
Kickboard swim in prone position; 4 widths
Diving (x5)
Breathing exercises in water (3 min.)
Ball games (5 min.)
10 minute break – partner activity
COOL DOWN
Walking forward (4 widths)

Walking backward (4 widths)
Free floating in supine position with floating belts (3 min.)

Patients were evaluated at entry (T1) and after 4 months applying the aquatic program (T2). Both evaluation included assessment of balance, upper and lower extremity strength and endurance and cardiovascular endurance.

Functional balance was assessed using *Pediatric Balance Scale (PBS)*. This scale was developed as a balance measure for school-age children with mild to moderate motor impairments[3]. PBS consists of 14 item assessment tool designed to measure balance during functional activities like sitting, walking and changing positions. The items are scored on a five point scale, with zero showing incapacity to perform the task without assistance and four denoting the ability to execute the task with complete independence. The score is based on the time for which a position can be maintained, the distance to which the upper limb is capable of reaching in front of the body, and the time needed to complete the task. The maximum score is 56 points. A score of less than 45 is indicative of balance impairment.

For measuring upper extremity strength and endurance we used *modified push-ups test*. The subjects started with knees bent and touching the floor, hands shoulder-width apart and elbows fully extended. The children lower their upper body until the chest was about 5 cm from the floor and rise up again.

We used *Leg lift test* to assess the lower extremity strength and endurance. The subjects lie flat on their backs with their hands clasped behind the neck. The children raise their legs, keeping the knees extended till a 90º angle is achieved. Subjects do as many leg lifts as possible. The number of leg lifts is recorded during 20 seconds.

Cardiovascular endurance was measured using t*he 16-meter modified Progressive Aerobic Cardiovascular Endurance Run (PACER).* This test is a multistage aerobic capacity fitness test adapted from the 20-meter shuttle run test, which was found to be advantageous for youngsters with intellectual disabilities[4]. The participants were tested during each round of PACER testing and each child had a volunteer student "partner" who verbally motivated him/her to continue running as long as possible. One lap was counted for every 16-meter distance covered. The test was ended when the subjects could no longer complete a 16-meter lap.

Results

Six children (2 boys and 4 girls) participated in the present study. Table 2 presents the total baseline score and the total final score for Pediatric Balance Scale, where we can observe an increase from an average score of 41.16±2.56 to an average score of 48.5±1.64. A significant increase of 17.81% compared to baseline assessment scores could be noticed.

The results obtained with the Leg lift test showed that the lower extremity strength/ endurance increased in a significant manner from a mean score of 7.66±1.63 to a mean score of 11.33±2.33after the second assessment (table 2). A significant increase of 47.82% could be noticed.

Table 2 Results for tests and PBS scale evaluated – the mean and standard deviation

**Data presented as mean ± SD.*

Table 3 Results achieved by the subjects before and after the aquatic exercises program

	Mean Difference T2/T1	Std. deviation T2/T1	Difference % T2 /T1
PBS	7,33	0,65	17,81%
Leg lift test	3,66	0,49	47,82%
Modified push-ups test	3,83	0,01	48,93%
16-meter (PACER)	2,33	0,39	28,57%

Modified push-ups test was used to determine the strength and endurance of upper extremities for children with disabilities. The mean value of baseline push-ups score was 7.83±2.22 and the mean value of final score was 11.66±2.25, the mean difference between the 2 tests being 3.66.The final values for push-ups test increased by 48.93% when compared to baseline values (table3).

The PACER laps completed by the participants before aquatic intervention had a mean of 8.16 laps and the mean final was 10.5 laps. There was a 28.57% progress from the baseline assessment for 16-meter (PACER) test (table3).

Discussions

It is well known that children with disabilities have low physical fitness levels compared to children without disabilities. This low physical

fitness could be related to the combination of low motivation and insufficient physical activity. The majority of the literature reviews emphasized the importance of physical exercise and recreational activities for optimizing the well-being of these children, by improving physical fitness, motor development and self-esteem[5].

This study proposed an aquatic exercises program founded on the physical properties of water for children with disabilities. This program proposed for the improvement of cardiorespiratory function, motor and balance performance and muscle strength was supervised and individualized according to the physical capacities and level of disabilities of each child, and also showed acceptable compliance and clearly demonstrated positive effects. The program lasted four months, period during which the children continued their other regular activities at school.

Dynamic and static balance abilities are important components of daily life activities for all children and for this reason improving balance in children with intellectual and developmental disabilities is of great value. They could also have deficits in motor skills which can cause limitations in physical activity. A promising intervention is an adjusted aquatic exercise program. When analyzing the improvement in balance and motor performance (assessed through PBS score) our study shows increase between baseline and final assessment scores after implementing the aquatic program.

A number of authors emphasized the importance of strength and endurance of lower and upper extremities on daily life activities of children and suggested that this parameter should be included in the measurement of physical capacity for children[6].

In this study Leg lift test and modified Push-ups test was used to measure lower and upper extremity strength and endurance for children with disabilities. Results show that evaluated children improved significantly after 4 month of water exercises.

Another aspect that drew our attention was cardiorespiratory function. We observed that the children group had a satisfactory progression because the scores increased from the second assessment in relation to the first. Therefore, water and swimming exercises can be an integral part of cardiovascular fitness development of children with disabilities.

The results of our study suggest that aquatic therapy may be useful in the management of patients with disabilities and is an approach on the way to an enhanced integration and more independent life style.

Conclusions

The results of this study are encouraging suggesting that the application of an aquatic therapy program can lead to better and persistent outcomes in children with disabilities. Furthermore, the aquatic environment makes activities in the water more attractive and motivating than exercising on land and promotes social interaction and a persistent level of acceptance.

We consider that aquatic physical therapy is an effective modality that can be used to improve fitness and physical activity levels. After applying the aquatic intervention we observed a positive influence on all parameters analyzed. Further studies, eventually on larger groups of children or longer periods of *therapy*, are needed to confirm these results and to promote the utility and benefits of aquatic exercise program.

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