

Effects of an aquatic therapy program on vital capacity, quality of life and physical activity index in children with cerebral palsy

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Abstract. The aim of this paper is to track the aspects and results of applying an aquatic therapy intervention program adapted and integrated in the treatment of neuromotor reeducation of children with cerebral palsy on gross motor function, spasticity and range of motion. Material and methods: The aquatic therapy program had a duration of 6 months, 2 weekly sessions. The average duration of a session was 45 minutes. The water temperature was 36°C. Besides the aquatic therapy sessions the children participate in 2 physical therapy sessions which were included in the rehabilitation program of the institutions they belonged to. Twenty-four children diagnosed with cerebral palsy have participated in this study. The average age was 12.5±2.7 years. The assessment methods used were: Physical Activity Index is calculated by multiplying physical activity frequency, intensity and duration. Spirometry: The following device was used in order to assess vital capacity: MIR Spirobank II Spirometer, S/N 000912. Results: After the use of the aquatic therapy program, results have been statistically significant for physical activity index scores $p < 0.001$. Baseline percentage of the maximum physical activity index score was 16.8% and the final percentage of the maximum physical activity index score was 68%. KINDLR - Questionnaire for measuring quality of life in children and adolescents. The scores of the questionnaire assessing quality of life in children and adolescents, KINDLR, show statistically significant increases ($p < 0.001$), where we can observe a significant increase from a mean score of 67.3 ± 6.9 to a mean score of 96 ± 4.1 . At the end of the 6-month aquatic therapy program, the values for vital capacity have shown a statistically significant increase, $p < 0.001$. The mean value of baseline vital capacity was of 2.2 ± 0.7 , the mean value of final vital capacity was of 3.4 ± 1.1 . The values for vital capacity increased by 56.7% when compared to baseline values. Conclusion: The aquatic therapy program along with the classic rehabilitation program is a factor which influences these parameters.

Key Words: aquatic therapy program, physical activity index, quality of life, vital capacity.

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Introduction

Swimming and aquatic exercises are often recommended for children with disabilities, since they are recognized as part of paramedical treatment programs (Huberman 1976, Ruoti *et al* 1997). The specific advantageous features of aquatic activities for children with disabilities include: (a) water buoyancy, which favors the initiation of movement even if the neuromuscular system is unable to move against gravity, (b) increased viscosity of water, which provides gradual resistance (braking force) and together with the amplitude of movement makes very demanding exercises almost impossible, (c) heat transfer in the water is much faster than in the air, water reaching 32°C or more decreases spasticity and leads to the lack of involuntary movement, (d) hydrostatic pressure provides extensive stimulation of exteroceptors and proprioceptors, increased pressure on the lungs and other internal organs, as well as pressure on the respiratory muscles. These are assumed to improve coordination, breathing and associated functions such as feeding and speech (Harris 1978; Peganoff 1984; Broach & Dattilo 1996).

Despite the enthusiasm for the therapeutic effects of aquatic exercises, very little information has been published in this field (Hutzler *et al* 1998).

Rothman (1978) observed a significant decrease of respiratory functions in children with cerebral palsy compared to children without disabilities (37-38% below normal values).

The respiratory system is deeply affected when the body is immersed in water to the chest. An effect is chest compression by water, as well as the change in lung function, increased respiratory muscle effort and the change in respiratory dynamics. Vital capacity decreases by 7-9% when the body is immersed in water up to the neck as compared to when it is immersed to the xiphoid process. Part of this decrease is due to increased blood volume in the thoracic cavity, part is due to the hydrostatic force of water which resists inspiratory muscles (Hong *et al* 1996; Agostoni *et al* 1996).

Inspiratory muscle weakness is an important component of many chronic diseases. Given the accommodation of respiratory functions in an environment that causes significant changes

in respiratory function, immersion can be used for respiratory training and rehabilitation (Mangelsdorff *et al* 2001).

Aquatic therapy can be very useful in the management of patients with neuromuscular disability of the respiratory system, such as spinal cord injuries and muscular dystrophy (Adams & Chandler 1974; Koessler *et al* 2001; Topin *et al* 2002; Wanke *et al* 1994).

Aquatic physical therapy combined with land physical therapy can improve respiratory functions in children with cerebral palsy (Hutzler *et al* 1998).

It was established that both children and adults with cerebral palsy have low levels of physical activity compared to people without disabilities. This sedentary lifestyle affects their health and physical fitness (Damiano 2006). People with cerebral palsy are prone to the risk of developing a form of depression, anxiety and increased stress, low self-esteem and motivation, as well as withdrawal from social life.

Interventions based on therapeutic exercises have been shown to have a positive effect on social life, self-esteem, depression and self-confidence in terms of involvement in physical activities (Shapiro & Martin 2010).

The aquatic environment particularly promotes social interaction and a persistent level of acceptance. Some have attributed this additional benefit to the opportunity provided by water in order to initiate multiple social interactions with teachers and peers (Getz *et al* 2006).

The World Health Organization Quality of Life Assessment Group defines quality of life as “an individual’s perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns” (WHOQOL 1996). Shelley *et al* 2008 stated that this is a multidimensional system that evaluates an individual’s sense of well-being in many areas of their lives. There was a conceptual separation between quality of life and function, a task which was partly carried out by the World Health Organization (WHOQOL 1996) and other researchers in the early 1990s, defining quality of life as the “assessment missing in health care” (Fallowfield 1990).

The definition of quality of life aimed, on the one hand, to be used as a measure of assessment in research, and on the other hand, from a broader perspective, to extend the way in which health was measured beyond conventional indicators, such as mortality and morbidity. Quality of life goes beyond the purpose of the scientific objective to eradicate the disease, for a more balanced and humanistic approach of the individual’s well-being (WHOQOL 1996).

This paper aims to observe the effects of a 6-month aquatic therapy program associated to a physical therapy program on vital capacity, quality of life and physical activity index in children with cerebral palsy.

Materials and method

The study included 24 children diagnosed with different clinical forms of cerebral palsy enrolled in two of the special schools in Cluj County. The age of the participants in the study was between 8 and 16 years.

Inclusion criteria were the following: diagnosis, ability to follow simple verbal instructions. None of the children has ever attended aquatic therapeutic intervention sessions.

The Gross Motor Function Classification System (GMFCS)

The degree of mobility of children and teenagers at home, at school and in the community can be best described using the expanded and revised Gross Motor Function Classification System (GMFCS – E&R). This classification system covers a wide range from level 1, where individuals work at an advanced level, being able or having the potential to walk without restrictions, to level 5, for individuals very limited in their ability to move themselves around even with the use of assistive technology.

Physical Activity Index

Physical activity index is calculated by multiplying physical activity frequency, intensity and duration.

To generate positive effects in terms of health, a physical activity must be performed frequently, must last enough time (not less than 20-30 minutes, but not much more than the exercising level or phase) and must engage as many muscle groups as possible, at an appropriate level of intensity.

KINDLR - Questionnaire for measuring quality of life in children and adolescents

KINDLR is a generic instrument for assessing health-related quality of life (HRQoL) in children and adolescents aged 3 years and older. The original version of the questionnaire, KINDL, was developed by Prof. Monika Bullinger in 1994. Prof. Ulrike Ravens-Sieberer & Monika Bullinger revised KINDL and developed KINDLR in 1998.

KINDLR is a short and flexible questionnaire, providing 24 items. There are three different versions of the instrument, suitable for different age groups and stages of disease development. KINDLR can be used for children and adolescents aged between 3 and 17 years. In addition, each version of the questionnaire can be completed by both children and adolescents, as well as by their parents.

The factorial structure of the questionnaire consists of six factors:

1. Physical well-being (e.g.: I felt nauseous; I felt active and full of life);
2. Emotional well-being (e.g.: I was happy and in a good mood);
3. Self-esteem (e.g.: I was proud of myself)
4. Family (e.g.: I get along well with my parents)
5. Social relationships (e.g.: I feel different from other children)
6. School (e.g.: I worry about my future)

Calculate a total score of the scale by summing the partial scores of the six factors. A better health status is determined by a higher total score. To make comparisons, the total score can be converted into a mean total score for the entire questionnaire.

The clinical usefulness of the questionnaire: KindLR can be used to assess the effect of different therapeutic procedures (with baseline and end of treatment assessments) (Ravens & Sieberer 2001; Ravens & Sieberer 2003).

Spirometry

The following device was used in order to assess vital capacity: MIR Spirobank II Spirometer, S/N 000912.

The respiratory function tests were administered by the same technician after the child had been habituated to the spirometer for 10 minutes.

Table 1. Main characteristics of the participants

No. of participants		24
Age of participants		Average 12.5 ± 2.7 years
Gender of participants	Boys	18
	Girls	6
Clinical forms	Spastic cerebral palsy	19
	- Paraparesis	5
	- Tetraparesis	10
	- Hemiparesis	right 2 left 2
	Dyskinetic cerebral palsy	4
	Ataxic cerebral palsy	1
GMFCS Level		No. of participants
Level I Independent walk, restrictions of the advanced ability of movement		0
Level II Walking without aid, restrictions of the walk in the outdoor environment or on accidental ground		10
Level III Walking with assistive mobile devices, restrictions of the movement outdoor or in the community		8
Level IV Diminished mobility, the child is transported or needs other means of transport outdoors or in the community		2
Level V Independent mobility is severely restricted even with technical support		4

Aquatic therapy program

It is a useful strategy for teaching swimming for people with neuromotor disorders. The program uses the principles of fluid mechanics in order to enable subjects to achieve stability and controlled movement in the water.

The aquatic therapy program was conducted over a period of 6 months, consisting of two weekly sessions. Every session was 45 minutes long. Water temperature was 36 °C.

The program aims to achieve water independence for children with CP. In order to maintain water balance, it is necessary to adapt to the mechanical changes occurring in this environment. These adaptations are the result of a psycho-sensory-motor learning process that enables the individual to learn how to maintain balance in an unstable environment. Once balance (stability) is established, movement can be initiated and controlled (Lambec & Stanant 2000, Lambec & Stanant 2001).

Statistical analysis

The SPSS statistics software version 20 was used for statistical analysis. Data were classified as categorical or quantitative. Categorical variables were described using frequency and percentage, and quantitative variables were described using the mean and standard deviation or the median. Kolmogorov-Smirnov test was used to check the normality of the quantitative data.

To determine whether there were changes between conjugate variables we used the Wilcoxon signed-rank test or the test for marginal homogeneity, depending on the situation. General linear models for repeated measures were used to check the influence of a parameter on the variation in the values of a conjugate variable. Statistical significance was set at a threshold value of 0.05.

Results

Physical Activity Index

After the use of the aquatic therapy program, results have been statistically significant for physical activity index scores $p < 0.001$.

Table 2. Physical activity index scores

Mean		N	Standard deviation
IAF initial total	16.8	24	3
IAF final total	68	24	9.7
% initial of max.	16.8%	24	3
% final of max.	68%	24	9.7

Table 2 presents the total baseline score and the total final score for physical activity index, where we can observe a significant increase from an average score of 16.8±3 to an average score of 68±9.7. A significant increase of 51% compared to baseline assessment scores could be noticed. Baseline percentage of the maximum physical activity index score was 16.8% and the final percentage of the maximum physical activity index score was 68%.

For GMFCS level 2, the mean baseline score was 18 and the mean final score was 70.4 ± 8. The results show high statistically significant differences, $p < 0.001$. There was a 52.4% progress from the baseline assessment for GMFCS level 2.

Table 3. Physical activity index mean scores and standard deviation according to the Gross Motor Function Classification System for cerebral palsy (GMFCS)

IAF scores	Initial	Final	Initial %	Final %	P
GMFCS II Mean	18	70.4	18%	70.4%	<0.001
St. deviation	0	8.2			
GMFCS III mean	18	72	18%	72%	<0.001
St. deviation	0	8.5			
GMFCS IV-V Mean	13.5	58.6	13.5%	58.6%	<0.001
St. deviation	4.9	8.2			

For GMFCS level 3, the mean baseline score was 18 and the mean final score was 72 ± 8.5 . The results show high statistically significant differences, $p < 0.001$. There was a 54% progress from the baseline assessment for GMFCS level 3.

For GMFCS level 4-5, the mean baseline score was 13.5 ± 4.9 and the mean final score was 58.6 ± 8.2 . The results show high statistically significant differences, $p < 0.001$. There was a 45.1% progress from the baseline assessment for GMFCS level 4-5.

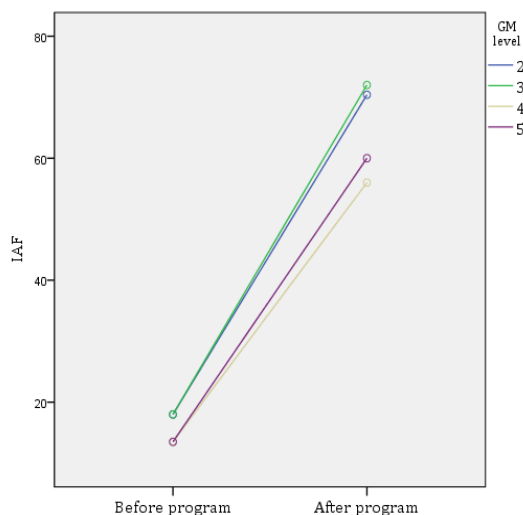


Fig. 1. Evolution of physical activity index scores depending on GMFCS level before and after the program

KINDLR - Questionnaire for measuring quality of life in children and adolescents

The scores of the questionnaire assessing quality of life in children and adolescents, KINDLR, show statistically significant increases, $p < 0.001$.

Table 4. shows the total baseline score and the total final score of the questionnaire scores assessing quality of life in children and adolescents, KINDLR, where we can observe a significant increase from a mean score of 67.3 ± 6.9 to a mean score of 96 ± 4.1 . There is a significant 23.7% increase compared to baseline assessment scores. There was a 56% baseline maximum score of the questionnaire assessing quality of life in children and adolescents (KINDLR) and a 79.8% final maximum score of the questionnaire assessing quality of life in children and adolescents (KINDLR).

Table 4. Scores of the questionnaire assessing quality of life in children and adolescents – KINDLR

	Mean	N	St. deviation
Total KINDLR initial	67.3	24	6.9
Total KINDLR final	96	24	4.1
initial % of max.	56	24	5.8
Final % of max.	79.8	24	3.4

Table 5. KINDLR scores - the mean and standard deviation based on the GMFCS

KINDLR Scores	Initial	Final	Initial %	Final %	P
GMFCS II mean	68.6	95.5	57.1%	79.5%	<0.001
St. deviation	8.8	4.14			
GMFCS III mean	67.6	96.3	56.3%	80.3%	<0.001
St. deviation	6.8	4.1			
GMFCS IV-V mean	64.8	96.5	54%	80.4%	<0.001
St. deviation	2	4.6			

For GMFCS level 2, the mean baseline score was 68.6 ± 8.8 and the mean final score was 95.5 ± 4.1 . The results show high statistically significant differences, $p < 0.001$. There was a 22.4% progress from baseline for GMFCS level 2. Baseline maximum score of KINDLR questionnaire was 57.1% and final maximum score of KINDLR questionnaire was 79.5%.

For GMFCS level 3, the mean baseline score was 67.6 ± 6.8 and the mean final score was 96.3 ± 4.1 . The results show high statistically significant differences, $p < 0.001$. There was a 23.9% progress from baseline assessment for GMFCS level 3. Baseline maximum score of KINDLR questionnaire was 56.3% and final maximum score of KINDLR questionnaire was 80.3%.

For GMFCS level 4-5, the mean baseline score was 64.8 ± 2 and the mean final score was 96.5 ± 4.6 . The results show high statistically significant differences, $p < 0.001$. There was a 26.3% progress from baseline assessment for GMFCS level 4-5.

The highest values were obtained for SELF-ESTEEM and SOCIAL RELATIONS.

There was a 35.2% increase from baseline values for SELF-ESTEEM, from a 38.9% maximum possible score to a 74.1% maximum possible score, $p < 0.001$.

There was a 35.6% increase from baseline values for SOCIAL RELATIONS, from a 45.2% maximum possible score to an 80.8% maximum possible score, $p < 0.001$.

There was a 29.3% increase from baseline assessment for PHYSICAL WELL-BEING, from a 54.6% maximum possible score to an 83.95% maximum possible score, $p < 0.001$.

There was a 29.5% increase from baseline assessment for EMOTIONAL WELL-BEING, from a 51% maximum possible score to a 79.6% maximum possible score, $p < 0.001$.

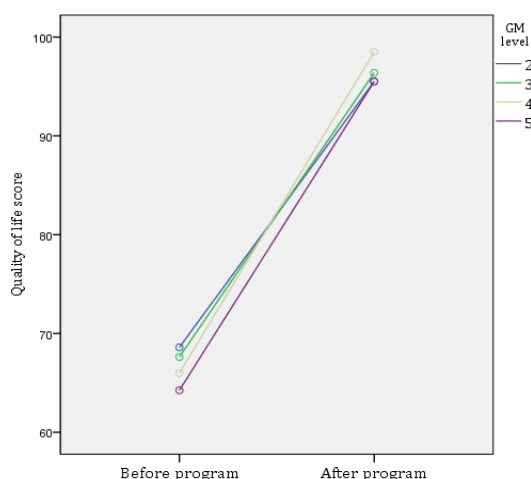


Fig. 2. Evolution of KINDLR questionnaire scores based on the GMFCS level before and after the program

There was a 6.8% increase from baseline assessment for FAMILY, from an 80.6% maximum possible score to an 87.50% maximum possible score, $p < 0.001$.

There was a 7.9% increase from baseline assessment for SCHOOL, from a 66.2% maximum possible score to a 74.1% maximum possible score, $p < 0.001$.

Vital capacity

At the end of the 6-month aquatic therapy program, the values for vital capacity have shown a statistically significant increase, $p < 0.001$.

Table 6. shows the baseline and the final values for vital capacity assessed in liters, as well as the percentage of the predicted value for vital capacity. The mean value of baseline vital capacity was of 2.2 ± 0.7 with a minimum value of 1.1 liters and a maximum value of 4 liters, the mean value of final vital capacity was of 3.482 ± 1.1 , with a minimum value of 1.9 liters and a maximum value of 6.2 liters.

The mean baseline values represented 66.1% of the predicted vital capacity, with a minimum value of 38% and a maximum value of 91%. The mean final assessment reported 99.2% values for the predicted vital capacity, with a minimum value of 70% and a maximum value of 134%.

The values recorded were 36.3% lower than the expected values related to age, gender and height of subjects.

The values for vital capacity increased by 56.7% when compared to baseline values.

For GMFCS level 2, there was a mean baseline value of 2.4 ± 0.638 and a mean final value of 3.9 ± 0.8 . The results show high statistically significant differences, $p < 0.001$.

For GMFCS level 3, there was a mean baseline value of 1.8 ± 0.6 and a mean final value of 2.8 ± 1.1 . The results show high statistically significant differences, $p = 0.004$.

For GMFCS level 4-5, there was a mean baseline value of 2.2 ± 0.94 and a mean final value of 3.6 ± 1.4 . The results show high statistically significant differences, $p < 0.002$.

The most significant increase in the values for vital capacity was recorded in subjects with GMFCS level 2.

Table 6. Values for vital capacity – the mean and standard deviation according to the GMFCS

Vital capacity - liters	Initial	Final	↑ compared with initial	P
GMFCS II mean	2.4	3.9		
st. deviation	0.6	0.8	57.3%	<0.001
GMFCS III mean	1.8	2.8		
st. deviation	0.6	1.1	51.3%	<0.004
GMFCS IV-V mean	2.2	3.6		
st. deviation	0.9	1.4	59.7%	<0.001

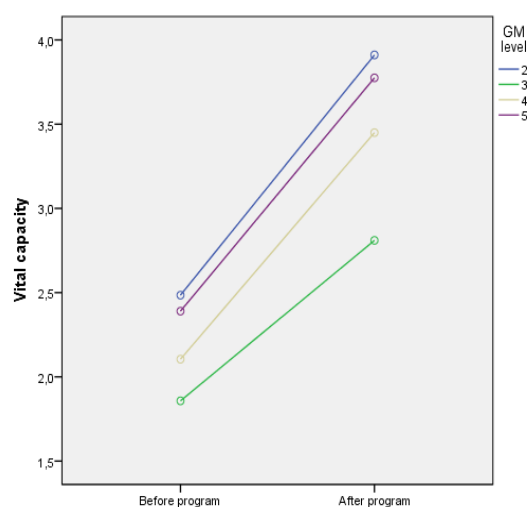


Fig. 3. Evolution of vital capacity values based on the GMFCS level before and after the program

Discussions

Rothman (1978) states the presence of a significantly reduced respiratory function in children with cerebral palsy compared to those without disabilities (37-38% below normal values).

In our study, the mean value recorded was 36.38% lower than the expected values related to age, gender and height of subjects. Rothman studied the effects of breathing exercises (for example, force exercises) on vital capacity and maximum expiratory volume in children with cerebral palsy. Five children made up the control group with no intervention, and five children made up the experimental group with 5-7 minute sessions of training exercises for inspiratory and expiratory muscles.

The results showed a 31% difference between the experimental group and the control group during the final assessment.

Lee et al (2013) investigated the effects of respiratory training on pulmonary function in children with cerebral palsy. Twenty-two children randomly divided into 2 groups (control group and experimental group) attended three weekly sessions of full recovery. The experimental group participated in respiratory training sessions. The program lasted for 4 weeks. Significant results regarding respiratory function were observed in the control group, where forced vital capacity recorded a 50% increase from baseline assessments.

Table 7. Values for vital capacity – liters

	Predicted vital capacity liters	Vital capacity values – -liters	Vital capacity – initial values – finale - liters	% Of vital capacity from predicted initial	% Of vital capacity from predicted final	% of increase compared with baseline %
N	24	24	24	24	24	24
Mean	3.5	2.2	3.4	66.1%	99.4%	56.7%
Standard deviation	1.1	0.7	1.1	15.5	14	22.4
Minimum	1.9	1.1	1.9	38%	70%	17.5%
Maximum	5.8	4	6.2	91%	134%	89.9%

Hutzler *et al* (1997) described the effects of an aquatic program on breathing in children with cerebral palsy. Fifteen children were part of the experimental group, participating in two weekly 30 minute-long sessions of individualized aquatic exercises. The average age of the children was 5.2 ± 0.8 years. Thirteen children were part of the control group, undergoing a Bobath neuro-developmental treatment program. The program lasted six months, period during which the children continued their other regular activities at kindergarten and school. Results show a 68% improvement in vital capacity compared to baseline assessment for the group participating in the aquatic therapy program and a 23% increase for the experimental group participating in respiratory sessions performed by the neuro-developmental therapist. The authors conclude that further research is needed in this field, conducted on a larger number of participants.

Hutzler *et al* (1998) studied the effects of a movement and swimming program on vital capacity. The study included 46 participants (23 in the control group, 23 in the experimental group) with cerebral palsy aged 5-7 years. The experimental group participated in two sessions of aquatic exercises and one group gym session, both on a weekly basis, while the control group participated in four weekly sessions of Bobath therapy. Hutzler reported improvements in vital capacity in the experimental group. There was a 65% increase from baseline assessment in the values for vital capacity in the experimental group. In our study, the values for vital capacity increased by 56.7% when compared to baseline values.

Hutzler observed that the values for vital capacity in children with CP were 23-35% lower during baseline assessment than predicted values calculated according to age, weight and height for healthy children.

The authors concluded that the aquatic therapy program can improve respiratory functions. They recommend including these water sessions in therapeutic programs for children with CP.

The effects of these aquatic therapy programs on social function, behavior and body awareness have been the focus of several research studies (Getz *et al* 2007; Ozer *et al* 2007; Aidar *et al* 2008).

Getz *et al* (2007) compared the effects of a water exercise program with those of a land exercise program. Their goal was to assess the effects on social function, skills perception (physical and cognitive skills) and social acceptance in 22 children with CP. Twelve of the children had participated in the water exercise program and 10 in the land exercise program. Social function

was measured by using the Pediatric Evaluation of Disability Inventory (PEDI). Perceived skills and social function were measured using the Pictorial Scale developed for children with CP. Their results showed statistically significant differences for social acceptance between the group undergoing land exercises and the group undergoing water exercises ($t=2.26$, $p<0.035$). There were increased scores for social acceptance in the group of patients participating in the water exercise program and no significant difference between the groups in terms of perceived physical skills. “The aquatic environment, especially buoyancy, allows children to be more active and to initiate more social interaction with their instructors and with other children” (Getz *et al* 2007).

A 14-week swimming program was applied by Ozer *et al* (2007) to assess its effects on social skills, behavior and body awareness (somatognosia) problems in 13 children with CP, aged 5-10 years. They found that the swimming program improved body awareness, but had no significant effect on behavior or social skills.

Another study on the effect of water activities on social function was performed by Aidar *et al* (2008), consisting of 21 children with CP. Social function was assessed using PEDI and motor function was assessed using the Manual Ability Classification System (MACS). The results showed a positive change in motor function and social function. Aidar *et al* (2008) found a correlation between self-esteem improvement and functional independence improvement.

Aidar *et al* (2008) have extrapolated that water exercise and increased motor function lead to an improvement in physical function which in turn improves social function, suggesting an increase in independence.

In our study, there was a significant increase in SELF-ESTEEM, represented by a 35.2% increase from baseline values in the KINDLR questionnaire.

McClung (1997), quoted in Shapiro and Martin (2010), found that adults with physical disabilities participating in recreational activities have improved their self-esteem and their confidence in the ability to perform physical activities. Young people with physical disabilities have obtained psycho-social benefits from conducting physical activities, including in terms of friendship, joy, empowerment and decrease in depression (Shapiro & Martin 2010).

Dorval *et al* (1996) evaluated the effect of a swimming program on self-esteem and functional independence in 20 adolescents

with CP, and observed statistically significant improvements after intervention, the results being maintained even nine months after the intervention.

Deckler *et al* (2013) studied the effects of a 6-week swimming program on quality of life in 7 children with a mean age of 10.2 years, suffering from cerebral palsy. They used the questionnaire for quality of life of people with PC (CPQOL) which measures the influence of an intervention on quality of life, the version for parents. The results showed a 3.7% improvement for participation and physical health when comparing the baseline and the final assessment and a 4.2% increase when comparing the final assessment and the assessment performed 3 weeks after program completion. There was a 1.2% increase in movement scores between the baseline and the final assessments and a 4.6% increase between the baseline assessment and the assessment performed 3 weeks after program completion. Scores for access to services increased by 20%, but they decreased during the assessment performed 3 weeks after program completion. Pain and impact of disability revealed a 19.4% improvement between the baseline and the final assessments and a 14.9% increase between the baseline assessment and the assessment performed 3 weeks after program completion. Family health increased by 4.3% between the baseline and the final assessment and by 7.3% 3 weeks after program completion. Five of the seven quality of life scales for people with CP have improved and almost all results were maintained during the assessment performed 3 weeks after program completion. In our study, quality of life scores assessing quality of life in children and adolescents - KINDLR, indicated a significant increase from a mean score of 67.3 ± 6.9 to a mean score of 96 ± 4.1 .

The highest values were obtained for SELF-ESTEEM and SOCIAL RELATIONS scores.

In 2006, Damiano stated that both children and adults with cerebral palsy have low levels of physical activity compared to people without disabilities. This sedentary lifestyle affects their health and physical fitness (Damiano 2006).

Fragala *et al* (2010) conducted a study whose purpose was to describe an aquatic therapy program, to analyze it and to determine its strengths and weaknesses from the parents' perception perspective. Sixteen children aged 6-12 years were included in this study. The program lasted 14 weeks and consisted of swimming, water games and water force exercises.

Following parental surveys, results showed that participants in the study have increased the number of days when children were involved in physical activity compared to the existing situation before applying the program. After program completion, children continued practicing physical activities. Parents declared that after the program, the 16 children continued performing physical activities at least 5 days a week, consisting of 60 minutes of moderate or vigorous activity, compared to 3 days of physical activity performed before the program (Fragala *et al* 2010). In our study, following the use of the questionnaire for physical activity index there is a significant increase of 51% compared to baseline assessment scores. Baseline maximum score for physical activity index was 16.8% and final maximum score for physical activity index was 68%. The subjects included in our study have greatly improved the frequency and the intensity and duration of physical exercises compared to activities performed prior to the implementation of the aquatic program.

Conclusions

This paper aims to observe the effects of a 6-month aquatic therapy program on vital capacity, quality of life and physical activity index in children with cerebral palsy.

Study results showed statistically significant increases in the values for vital capacity, in KINDLR questionnaire scores assessing quality of life, and in physical activity index.

Aquatic exercise programs can be beneficial types of therapy, a pleasant alternative for children and adolescents suffering from cerebral palsy, including for those with significant movement restrictions for whom physical activities on land are difficult, thus enabling patients with CP to improve the duration, intensity and frequency of physical exercise practice.

The two aquatic therapy sessions added to the already existing physical activities in the children's program, have increased physical activity index by increasing the intensity, frequency and duration of physical exercise.

The combination between aquatic therapy and land-based physical therapy can represent a factor which improves respiratory function in children with cerebral palsy. Aquatic therapy may be useful in the management of patients with cerebral palsy for the rehabilitation of respiratory deficiency. The effects of an aquatic therapy program on vital capacity are positive, leading to improved vital capacity.

After applying an aquatic therapy program we observed a positive effect on physical well-being, emotional well-being, self-esteem, family, social relationships, and school indices, with the highest values obtained for self-esteem and social relationships. The aquatic environment mainly promotes social interaction and a persistent level of acceptance. This additional benefit can be attributed to the fact that water provides opportunities to initiate multiple social interactions with teachers and peers.

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