International Journal of Clinical Trials
Chandolias K et al. Int J Clin Trials. 2022 Nov;9(4):268-273
http://www.ijclinicaltrials.com
pISSN 2349-3240 | eISSN 2349-3259
DOI: https://dx.doi.org/10.18203/2349-3259.ijct20222657

Original Research Article

The effectiveness of a specialized hydrotherapy program based on Halliwick concept in the transition from supine to sitting of children with cerebral palsy: a randomised control trial

Konstantinos Chandolias[1]*, Chrysoula Moscolouri[1], Paris Iakovidis[2], Alexandra Hristara-Papadopoulou[2], Ilias Kallistratos[2]

[1]Department of Physiotherapy, University of Thessaly, Lamia, Greece
[2]Department of Physiotherapy, International Hellenic University, Thessaloniki, Greece

Received: 13 October 2022
Revised: 16 October 2022
Accepted: 18 October 2022

***Correspondence:**
Dr. Konstantinos Chandolias,
E-mail: konchand@uth.gr

ABSTRACT

Background: Halliwick concept focus on people with disabilities, to participate in water activities and move independently. Many studies found a considerable improvement and positive outcomes in children that were included in hydrotherapy programs. The aim of this study was to investigate the Halliwick hydrotherapy in combination with on-land intervention, versus only on-land treatment, on the supine-sitting transition and head symmetry.
Methods: 54 children with cerebral palsy (CP), two groups, the intervention group-water (N=28) (1 water and 1 on land treatment) and the control group-on land (N=26) (2 treatments on land). The duration was 3 months and the assessment via gross motor function measure (GMFM), parameter B, questions 18-37, and head angle via the Kinovea software.
Results: In GMFM before intervention the mean value of the intervention group was 69.632 (±13.1269), while for the control group was 61.227 (±20.4681) and after for intervention group was 75.757 (±12.3766), 6.125% improvement, while for control group was 65.308 (±20.6663), 4.081% improvement. In the sitting head angle before intervention, the mean value of intervention group was 19.36 (±9.639) while for the control group was 20.15 (± 11.199) and after for the intervention group was 13.93 (±7.333), 5.43^{o} improvement, while for control group was 16.46 (±9.205), 3.69^{o} improvement.
Conclusions: The addition of intervention in water in combination with intervention on land in the rehabilitation program of children with cerebral palsy can lead to a statistically significant increase in the effectiveness of the therapeutic program.

Keywords: Hydrotherapy, Pediatric physical therapy, Cerebral palsy, Bobath, Halliwick, Sitting position, Symmetry

INTRODUCTION

Cerebral palsy (CP) is a neurodevelopmental disorder caused by brain damage resulting in poor coordination and deficits in motor control.[1] According to the European committee of PD, symptoms such as spasticity, dystonia, chorea, atrophy, and ataxia are presented.[2] These symptoms may be present in combination with each other. Also, people with CP present asymmetries in both posture and head position.[3] Asymmetries have been associated with muscle spasticity and the inability to voluntarily change position in people with CP.[4]

Exercise and physiotherapy programs are widely used to manage the symptoms of CP to improve mobility, respiration, manage pain and delay the deterioration of

motor difficulties.[5,6,7,21] These programs are considered by the scientific community to be preferable to treatment methods based solely on pharmacological or surgical intervention.[10,11]

In addition, several studies have occasionally highlighted the importance of rehabilitation of people with CP in a water environment using several different procedures of hydrotherapy.[10,12-16] During hydrotherapy, both voluntary and passive movement is produced in individuals with CP, enabling individuals to perform movements that would be impossible to perform out of water.[15] According to research data, hydrotherapy is safer for joint protection compared to land-based exercises and results in a significant reduction in spasticity symptoms.[22] It is also one of the most enjoyable rehabilitation programs and contributes to long-term improvement in the quality of life of people with CP.[4,10-14,20] Finally, interventional programs that combine both water and land-based exercise on a weekly basis have, long-term improvement in gross motor function.[2]

Research data evaluating the ability to change the posture of individuals with CP from a supine to a sitting position is limited in the literature. Thus, the present study will provide new data on this research gap. The purpose of the present study was to investigate the effect of hydrotherapy not on generalized conclusions but on a specific activity that children with cerebral palsy show a deficit as well as on head symmetry.

The gross motor function measure (GMFM) was used in the present study. The GMFM is a valid and reliable tool for measuring gross motor function in people with CP.[17] It is also an effective tool for measuring the change in gross motor function.[17] For the head angle in sitting position was used Kinovea, a free 2D motion analysis software that can be used to measure kinematic parameters.

METHODS

Participants

The study was a randomized clinical trial. A total of 54 children with spastic cerebral palsy, classified with the gross motor function classification system (GMFCS) and five levels I-V, participated in the present study. The 54 children with CP were randomly assigned to 2 groups, 28 were in the intervention group, and 26 the control group. The intervention group of 28 children was the water group, as they had a weekly Halliwick-hydrotherapy session that replace one land-based physiotherapy session, and the control group was the land-based intervention group. Both groups had 2 therapy session per week for three months from May 2022 to July 2022. The therapy sessions were carried out in a private practice physical therapy center with indoor heated pool. The research initially started with 59 children with cerebral palsy, of which 5 were excluded. 1 due to chlorine allergy, 1 due to worsening of his condition, 2 due to surgery, 1 due to non-regularity of the parents in the treatment program.

Specifically, 54 children aged 3-14 years (mean age 7.53). Of these 26 were boys and 28 were girls.

The classification of the 54 children with cerebral palsy, based on the spasticity distribution, was as follows: quadriplegia, right or left hemiplegia, and diplegia.

These children were classified according to the severity of their clinical condition, based on the gross motor function classification system (GMFCS): in the intervention group, 4 children with GMFCS I, 8 children with GMFCS II, 5 children with GMFCS III, 7 children with GMFCS IV, and 4 children with GMFCS V; and in the control (onshore intervention) group, 4 children with GMFCS I, 9 children with GMFCS II, 8 children with GMFCS III, 3 children with GMFCS IV, and 2 children with GMFCS V.

Inclusions and exclusions criteria for the subjects were: children aged 3-14 with diagnosed cerebral palsy, children who have not had any type of surgical intervention or botulinum toxin injection in the last year, and all participants had as a participation criterion the attendance of a therapeutic program by the same therapist either in the water or on land.

Children with autism were excluded. Children who had any planned surgical intervention or botulinum toxin injection were also excluded. The research did not include children with severe vision problems as well as children who could not follow verbal instructions or reproduce a test representation. Also excluded children absent from the therapeutic program either in water or on land for more than one week.

Before conducting the research, permission was required from the bioethics and ethics committee of the physical therapy department of the International Hellenic University, which was issued under protocol number EC-05/2022. The research was also registered in the records of clinical trials with ID, NCT05091892.

The statistical package for the social sciences (SPSS) 22 was used. In order to examine the change in these two variables, a t-test was performed, in order to check if the average before and after the intervention in each group is different.

In the analysis of the questions, statistical frequency tables, bar charts, and pie charts were used for the graphical representation of the findings. Descriptive statistical measures such as mean, median, maximum, minimum values, and standard deviation were also used.[27]

Parametric and non-parametric control methods were used to test statistical hypotheses of mean value equality, depending on the data.

Procedures

The author - a pediatric physiotherapist and hydrotherapist and two pediatric physiotherapists - hydrotherapists from the center of developmental physiotherapy "movement laboratory", distinguished for their many years of experience, participated in the process of assessment by applying the GMFM and the evaluation of head angle using the Kinovea software. All assessment procedures, as well as re-assessments, were videotaped by one of the three assessors, who was not involved in the assessment procedure. Scoring was done by the other two assessors separately, watching the videotaped tests, in order to eliminate and blind the possibility of influence between them.

All assessments were performed at approximately the same time in the morning and before children's participation in any rehabilitation program, e.g., sessions of physical therapy, occupational therapy, speech therapy, and hydrotherapy.

All assessments were carried out in the same place, in the same room, where the required equipment was available (mats, ladder, appropriate seat height, rods, toys, and balls). The equipment was arranged by the examiners so that the layout of the room was the same during all assessments. Emphasis was placed on maintaining a consistently pleasant temperature in the examination room at such levels that the child each time was dressed in as little clothing as possible so that the execution of the skills is not difficult, and the effort can be videotaped in the best possible way.

The intervention of the water intervention group took place in the same indoor heated pool for all children, 8 meters long, 4 meters wide and gradually increasing in depth from 0.80 meters shallower to 1.50 meters deeper. The water temperature was 32°C - 33°C during all interventions. Pool lighting was external only and the same for all trials and all children. No flotation aid was used. The children were dressed in their bathing suits, except for those with poor bowel control who also used a special water diaper or a special bathing suit.

An effort was made to perform the interventions without the presence of others (relatives, observers, or other children), so as not to distract the children. For the performance of all the tests, the presence of one of the two parents was deemed necessary, to ensure the feeling of security, while it was more possible to achieve the best possible cooperation and performance of the child.

During the implementation of each evaluation test, but also during their scoring, the instructions given by the authors in manuals were faithfully followed by both assessors. Verbal explanations were given, but also in some cases where the child's cognitive level required it, a demonstration was made by the assessor. This was noted in the first assessor's observations for each child so that the second could follow the same instructions. Each child was given three opportunities to perform each task.

RESULTS

Demographics

As already mentioned, 54 children participated in the study. Of these, 28 belonged to the intervention group and the remaining 28 to the control group. Here are some facts about the demographics of the two groups.

The two groups used contained individuals of both sexes. In the intervention group (28 people) we observe that there are 14 men and 14 women, while in the control group (26 people) there are 12 men and 14 women.

Table 1: Gender of participants in each group.

Group	Males	Females	Total
Intervention group	14	14	28
Control group	12	14	26
Total	26	28	54

In addition to gender, age was also examined in the two groups that were created. Regarding the intervention group, the average is 7.02 and the standard deviation is 3.251, while for the control group the average is 7.95 and the standard deviation is 3.061.

Gross motor function classification system

Another element examined was the spastic form of cerebral palsy classified on the gross motor function classification system (GMFCS) scale for each of the groups. The following table shows the classification on the scale for each group. Most people in both groups belong to have a relatively good sort of value.

Measurements before and after intervention

GMFM change

The GMFM variables and the head angle change before and after the existence of an intervention. In order to examine the change of these two variables, a t-test was performed, in order to check if the average before and after the intervention in each group is different.

Regarding the averages, it is observed that before the intervention the average value of the intervention group is 69,632 (±13,1269) while for the control group the average value is 61,227 (±20,4681). After the intervention, the average value of the intervention group is 75,757 (±12,3766) while for the control group the average value is 65,308 (±20,6663).

The value of GMFM before and after the intervention for both examined groups do not have the same variance as the p value in Levene's test is less than 0.05 (GMFM before

intervention p<0.05, GMFM after intervention p<0.05). Then we see that the difference in average values for GMFM before intervention is not statistically significant, while the difference in average values for GMFM after the intervention is statistically significant.

Head angle change

It is observed that before intervention the average value of head angle of the intervention group is 19.36 (±9.639) while for the control group the average value is 20.15 (±11.199). After the intervention, the average value of the intervention group is 13.93 (±7.333) while for the control group the average value is 16.46 (±9.205).

The value of the angle of the head before and after the intervention for both examined groups has the same variation as the p value in Levene's test is greater than 0.05 (head angle before intervention p>0.05, head angle after intervention p>0.05). Then we see that the difference in the average values for the head angle before intervention is not statistically significant, while the difference in the average values for the head angle after the intervention is statistically significant.

Table 2: The GMFCS of the participants in each group.

Group	GMFCS1	GMFCS2	GMFCS3	GMFCS4	GMFCS5	Total
Intervention group	4	8	5	7	4	28
Control group	4	9	8	3	2	26
Total	8	17	13	10	6	54

Table 3: GMFM change check before and after intervention for the two groups.

Groups	N	Mean	Standard deviation	Standard error mean
GMFM before				
Intervention group	28	69.632	13.1269	2.4808
Control group	26	61.227	20.4681	4.0141
GMFM after				
Intervention group	28	75.757	12.3766	2.3390
Control group	26	65.308	20.6663	4.0530

Table 4: Change in the head angle before and after the intervention for the two group.

Groups	N	Mean	Standard deviation	Standard error mean
Head angle before				
Intervention team	28	19,36	9,639	1,822
Control group	26	20,15	11,199	2,196
Head angle after				
Intervention team	28	13,93	7,333	1,386
Control group	26	16,46	9,205	1,805

DISCUSSION

The intervention program followed in this study was of 3 months duration and consisted of a specialized program both on land and in water. The results showed that the combined water and land intervention in the rehabilitation program of children with CP can lead to a statistically significant increase in the effectiveness of the treatment program. These data are also consistent with the results of Ballington and Naidoo, who compared the effectiveness of water-based exercise programs in improving gross motor function in children with CP compared to land-based exercise. The results showed that the water-based treatment improved mean scores on measures of gross motor function post-intervention compared to the control group who exercised on land alone (z=-2.803, p=0.005).[2] Furthermore, they suggest that water-based programs should be incorporated and considered as a core, ongoing treatment modality to ensure long-term improvement in gross motor function.[2]

Another recent study by Akinola et al, examined the effectiveness of hydrotherapy in children with CP and the results are in agreement with ours as a 10-week hydrotherapy exercise program was found to be effective in the functional recovery of children with spastic CP.[1] Also, a systematic review published in 2021 showed that hydrotherapy can help improve motor function and activities of children and adolescents with CP and can also improve their quality of life.[10]

In contrast, another systematic review published in 2017 showed that evidence on hydrotherapy interventions for children with CP is limited, as only 2 used a randomized control trial design and the results were mixed.[21]

Research conducted in children diagnosed with CP at GMFM levels IV and V has shown that land-based activities are more difficult than for children at levels I and II of the functional classification of gross motor functional classification system.[12] Therefore, children at levels IV and V of the functional classification of gross motor functional classification system usually show only modest improvement after land-based treatment.[16]

The present study shows similar results, as while improvements were observed in both groups, the intervention group had a 6.125% improvement in parameter B, while the land-based intervention group improved by 4.081%.

We also observed an improvement in symmetry in head angle in the sitting position for both the water intervention group (5.43º) and the land intervention group (3.69º). According to the international literature, at GMFCS levels I to II, head and trunk asymmetries are more frequent, whereas at GMFCS levels III to V, postural asymmetries vary depending on the position.[19] Postural asymmetries were also associated with scoliosis, hip dislocations, hip and knee contractures and inability to change position.[23]

In an extremely recent study by Casey et al, it was found that over half of children with CP have postural asymmetries in the sitting or supine position.[5] Also, children who were unable to maintain or change their position independently were at higher risk for postural asymmetry in both supine and sitting positions.[5] In fact, the authors of the study suggest that postural assessment should be included in follow-up programs to enable early detection and treatment.[5]

Limitations

During the study it was not possible to limit the therapeutic engagement of the parents with the children at home.

The sample of children was limited due to the difficulty of finding a sufficient number of children who could consistently follow the treatment program.

CONCLUSIONS

The implementation of programs that include hydrotherapy, appropriately adapted, can produce benefits in children with cerebral palsy. There is the possibility that the therapeutic approach using hydrotherapy will offer the child a better execution of movements than if this movement were carried out on land. The purpose of hydrotherapy is not only a part of the treatment or a way of restoring the movements of children with cerebral palsy, but it is also considered a way to be able to improve the person's daily life.

This research is the first in the literature to investigate the two treatment approaches over a long period of intervention and targeting a specific activity. Hydrotherapy-Halliwick positively helps, over time, to improve standing from supine to sitting as well as sitting symmetry in children with CP. Adding Halliwick hydrotherapy to the rehabilitation program of children with cerebral palsy enhances their improvement in gross motor function and symmetry

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Akinola BI, Gbiri CA, Odebiyi DO. Effect of a 10-week aquatic exercise training program on gross motor function in children with spastic cerebral palsy. Glob Pediatr Health. 2019;6:2333794.
2. Ballington SJ, Naidoo R. The carry-over effect of an aquatic-based intervention in children with cerebral palsy. Afr J Disab. 2018;7:361.
3. Bax M, Goldstein M, Rosenbaum P, et al. Proposed definition and classification of cerebral palsy. Dev Med Child Neurol. 2005;47:571-6.
4. Becker BE. Aquatic therapy: scientific foundations and clinical rehabilitation applications. Phys Med Rehabil. 2009;1:859-72.
5. Casey J, Rosenblad A, Rodby-Bousquet E. Postural asymmetries, pain, and ability to change position of children with cerebral palsy in sitting and supine: a cross-sectional study. Disab Rehab. 2022;44(11):2363-71.
6. Chandolias K, Konstantinidou E, Bikis E, Hourlia A, Besios T, Tsigaras G. The Effectiveness of 6 Months Hydrotherapy Program Based on Halliwick Concept on the Respiratory System of Down Syndrome Children. J Biosci Med. 2021;9:20-6.
7. Christodoulaki E, Chandolias K, Hristara-Papadopoulou A. The effect of hydrotherapy–Halliwick concept on the respiratory system of children with cerebral palsy. BAOJ Pediat. 2018;4(3):063.
8. Chen XL, Yu LP, Zhu Y, Wang TY, Han J, Chen XY, Zhang JH, Huang JL, Qian XL, Wang B. Combined effect of hydrotherapy and transcranial direct-current stimulation on children with cerebral palsy: A protocol for a randomized controlled trial. Medicine (Baltimore). 2021;100(49):e27962.
9. Colver A, Fairhurst C, Pharoah PO. Cerebral palsy. Lancet. 2014;383:1240-9.
10. Cui Y, Xiao D, Ding L, Qiu F, Cong F, Qiu Z. Effects of aquatic therapeutic exercise on motor function and activities for children and youth with cerebral palsy: a systematic review and meta-analysis. Chin J Rehabil Theory Pract. 2021;27:79-92.
11. Getz M, Hutzler Y, Vermeer A. Effects of aquatic interventions in children with neuromotor impairments: a systematic review of the literature. Clin Rehabil. 2006;20:927-36.

12. Gorter JW, Currie SJ. Aquatic exercise programs for children and adolescents with cerebral palsy: what do we know and where do we go? Int J Pediatr. 2011;712165.
13. Hutzler Y, Chacham A, Bergman U, Szeinberg A. Effects of a movement and swimming program on vital capacity and water orientation skills of children with cerebral palsy. Dev Med Child Neurol. 1998;40:176-81.
14. Kelly M, Darrah J. Aquatic exercise for children with cerebral palsy. Dev Med Child Neurol. 2005;47:838-42.
15. Lai CJ, Liu WY, Yang TF, Chen CL, Wu CY, Chan RC. Pediatric aquatic therapy on motor function and enjoyment in children diagnosed with cerebral palsy of various motor severities. J Child Neurol. 2015;30:200-8.
16. Lai CJ, Liu WY, Yang TF, Chen CL, Wu CY, Chan RC. Pediatric aquatic therapy on motor function and enjoyment in children diagnosed with cerebral palsy of various motor severities. J Child Neurol. 2015;30(2):200-8.
17. Alotaibi M, Long T, Kennedy E, Bavishi S. The efficacy of GMFM-88 and GMFM-66 to detect changes in gross motor function in children with cerebral palsy (CP): a literature review. Disabil Rehabil. 2014;36(8):617-27.
18. Fragala-Pinkham MA, Smith HJ, Lombard KA, Barlow C, O'Neil ME. Aquatic aerobic exercise for children with cerebral palsy: a pilot intervention study. Physiother Theory Pract. 2014;30(2):69-78.
19. Rodby-Bousquet E, Czuba T, Hägglund G, Westbom L. Postural asymmetries in young adults with cerebral palsy. Dev Med Child Neurol. 2013;55(11):1009-15.
20. Rogers A, Furler BL, Brinks S, Darrah J. A systematic review of the effectiveness of aerobic exercise interventions for children with cerebral palsy: an AACPDM evidence report. Dev Med Child Neurol. 2008;50:808-14.
21. Roostaei M, Baharlouei H, Azadi H, Fragala-Pinkham MA. Effects of Aquatic Intervention on Gross Motor Skills in Children with Cerebral Palsy: A Systematic Review. Phys Occup Ther Pediatr. 2017;37(5):496-515.
22. Thorpe DE, Reilly M, Case L. The effects of an aquatic resistive exercise program on ambulatory children with cerebral palsy. J Aqua Phys Ther. 2005;13:21-34.
23. Wimalasundera N, Stevenson VL. Cerebral palsy. Pract Neurol. 2016;16:184-94.

Cite this article as: Chandolias K, Moscolouri C, Iakovidis P, Papadopoulou AH, Kallistratos I. The effectiveness of a specialized hydrotherapy program based on Halliwick concept in the transition from supine to sitting of children with cerebral palsy: a randomised control trial. Int J Clin Trials 2022;9(4):268-273