

Hydrotherapy In Children With Cerebral Palsy

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ABSTRACT

Background: Cerebral palsy concerns the medical community due to its high prevalence, its complexity and its difficult treatment. These are some of the reasons why scientists need to further investigate this particular disease the effectiveness of hydrotherapy in the rehabilitation of numerous diseases and in particular cerebral palsy, however there are no documented recommendations for the Halliwick method and its effect on the mobility and health of patients with cerebral palsy.

Purpose: The purpose of this work is the systematic study of the modern literature regarding the effects of hydrotherapy and specifically the Halliwick method on the overall health and functionality of people diagnosed with Cerebral Palsy.

Methods: In order to find articles, a search was made with Greek and English key words in scientific sites such as Google Scholar , Pub Med and Springer Link. Hydrotherapy, cerebral Palsy, halliwick, effects and rehabilitation are the key words used for the search. The Pedro scale was used to assess the methodological quality of these studies. 150 studies were selected for review as relevant to the research question of this analysis.

Results: From the 150 studies that were initially selected, a screening process was carried out and finally only 14 were included, which met all the inclusion criteria. Both clinical studies and systematic reviews were included in this review.

Conclusions: The review concluded that the Halliwick method is able to improve the ability to adapt to the water, sociability of the patient and their motor functions, strengthen their respiratory system, reduce spasticity, increase range of motion and balance. However, due to limitations the results of the concentrated work are not completely secure.

Keywords: Hydrotherapy, Cerebral Palsy, Halliwick , Effects ,Rehabilitation.

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I. Introduction

Cerebral palsy (CP) is one of the most common motor disabilities that appear during infancy, which is why the rehabilitation-treatment of people suffering from this condition is of great concern to the medical community. CP first described in 1861 by the English orthopedist William Little (1) ,however, he could not give a clear and complete definition of it. Specifically, scientists describe CP as a set of disorders of posture, movement, balance and muscle tone, which causes motor limitations and is attributed to the non-progressive disorder of brain development (2) .

Epidemiological data and research that have been carried out show that OP occurs with an average frequency of 2.08/1000 live births (3). However, there are certain conditions that present a greater risk. More specifically, newborns born with a weight ranging between 1000 g to 1499 g and those born before completing the 28th week of pregnancy (before the 7th month) are some of the cases that show a higher index of having some brain damage, especially the frequency amounts to 59.18/1000 live births and 111.8/1000 live births respectively (3). Furthermore, pregnant women , who do not have financial potential have more chances (50%) to have a baby with CP. This occurs due to nutritional deficiencies, placental infections, and hypoxia during labor (4) . Another key thing to remember, in 2021 a research examined the risk factors of CP and found that the risk of developing the disease is lowest in the postpartum period (17.1%) and highest in the perinatal period (30.5%) (5). The research reported a risk rate of 21% for the the prenatal period.

Physiotherapists often choose hydrotherapy because it is an easy , economic and a non-chemical treatment. The benefits of hydrotherapy have been highlighted many times by experts, this is the main reason health professionals show a keen interest. Some of these benefits are that this treatment has the potential to reduce the load on the joints and friction between the articular surfaces due to buoyancy. Furthermore, hydrotherapy strengthen endurance , aerobic capacity , muscle strength and reduce spacity (6) . Moreover, water provides sensory information, improves lymphatic circulation, postural support, feeling of independence, possibility of rotational movements, things that some patients could never feel without hydrotherapy and the properties of water.

Finally, it must not be forgotten that this method is fun and can be also a way of socializing, bringing about relaxation and well-being.

Existing research makes many references to the effectiveness of hydrotherapy in the recovery of a multitude of diseases, such as multiple sclerosis, skin diseases and musculoskeletal-neurological problems (7) (8) (9). In addition, through scientific studies the beneficial effect of water therapy on cerebral palsy has been proven (10). However, evidence-based recommendations for the Halliwick method and its effect both on mobility and overall health of patients with CP are incomplete. This review will try to give a clearer picture about the effect of hydrotherapy and specifically the Halliwick method on the overall health of people diagnosed with CP. Also, this review aims to highlight the advantages of hydrotherapy and help people to understand the importance of hydrotherapy in the recovery plan. This will be achieved through the analysis of already existing research data.

II. Methods

Strategic Search: A literature review aims to gather all empirical evidence that meets predefined eligibility criteria in order to address a specific research question. In this context, the review at hand collects data from reputable digital scientific databases, with the goal of establishing the effects of the Halliwick method on the overall health of individuals with cerebral palsy (CP). To compose a literature review, a specific protocol is followed. The first step is formulating the research question, which should be clear and concise. The immediate subsequent step is determining the search strategy and locating scientific data relevant to the question. Finally, the last and most critical step is initially establishing inclusion and exclusion criteria, followed by evaluating the selected data from the literature search according to the predetermined criteria. Specifically, in this review, following the aforementioned protocol, the research question "The effects of hydrotherapy on cerebral palsy" was chosen, and key terms were selected for searching published scientific articles on platforms such as Google Scholar, PubMed, and SpringerLink. The search phrases included the keywords: "Hydrotherapy AND cerebral palsy," "Halliwick AND cerebral palsy," "Hydrotherapy AND rehabilitation," and "Halliwick AND Effects." Furthermore, the search did not include any chronological restrictions, and quotations were not included.

Design: The design of this systematic review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-P) protocol (PRISMA, 2021).

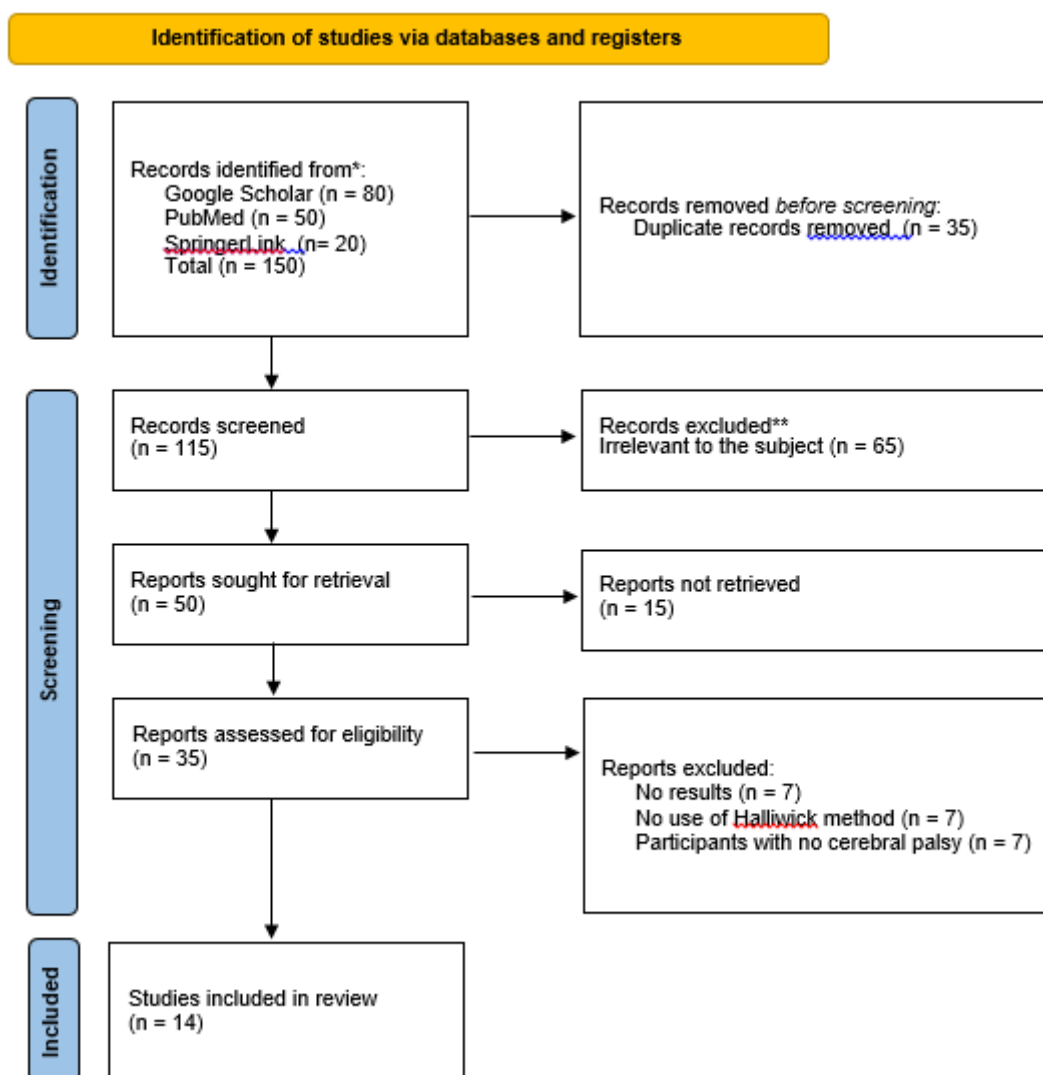
Inclusion Criteria: The selection criteria define all the conditions that each article must meet to be included in the review. The selection criteria for including studies in the present review were as follows: (a) The complete text of the studies should be published on a reliable scientific platform, either in Greek or in another language, (b) The primary therapeutic intervention in the patient sample should be hydrotherapy, specifically the Halliwick method. The control group, if present in any study, may undergo any other physical activity or participate in the research without being enrolled in a specific program, (c) Studies evaluating the effects of the Halliwick method on pain, functionality, and quality of life in individuals with cerebral palsy, (d) The study samples should consist of children or adults diagnosed with cerebral palsy, (e) Participants could be in any phase of the therapy they were undergoing, (f) The intervention should take place in a specially designed space, under the supervision of a specialist, and with detailed guidance, and (g) Studies should be included regardless of their publication date.

Exclusion Criteria: The exclusion criteria define all the elements that render an article unsuitable for inclusion in the review. The exclusion criteria in this specific case are as follows: (a) Any clinical trial that was incomplete or had inaccessible results, (b) Any research study that did not use the Halliwick method as the primary approach, (c) Any study that reported conflicting interests and raised doubts about its objectivity, (d) Studies evaluated as "low quality" on the PEDro assessment scale, and (e) Studies examining isolated patient cases with only one participant as the sample.

Evaluation of research quality: In order to produce a paper that leads to valid, reliable, high-quality, and objective conclusions, it is necessary to assess the quality of individual studies. The PEDro scale (Physiotherapy Evidence Database) was used to evaluate the quality of the selected research studies. This scale has moderate to good reliability, particularly when two researchers are involved in the assessment (11). The PEDro scale consists of a total of 11 criteria for assessing research quality. Specifically, the first criterion examines external validity, which includes the origin of participants and their inclusion criteria in the study. Criteria 2 to 9 assess internal validity, while the last two criteria evaluate the interpretation of the results. All criteria, except the first one, contribute to the final score. Each question is answered with a YES or NO (where YES = 1 and NO = 0). Based on the final score, the study is classified accordingly. A study is considered "low quality" if it scores from 0 to 3, "moderate quality" if it scores from 4 to 6, and "high quality" if it scores from 7 to 10 (11). Since the first criterion does not contribute to the final score, the maximum total score for a study is 10, while the minimum score is 0.

Data extraction and synthesis: Out of the total of 150 studies selected from the search as relevant to the topic of this review, not all of them were included. After collecting the relevant literature, the relevance of the articles to the research question was assessed based on their title and abstract, taking into account the predetermined selection criteria. More specifically, out of the 150 studies, 25 were rejected as duplicates, 65 studies were excluded based on the title or abstract. Additionally, full-text retrieval was not possible for 15 studies, and another 19 studies were rejected for not meeting the inclusion criteria. Thus, a total of 16 studies were included in the review. All of this information is presented in Table 2. For each study included in this systematic review, its characteristics, intervention protocols, and results were recorded.

Figure 1: Flow diagram PRISMA 2020 statement: an updated guideline for reporting systematic reviews.



III. Results

At this point, we refer to a number of studies that focus on the study of the effects of hydrotherapy, specifically the Halliwick method, on mobility - functionality, but also on the overall health of people diagnosed with cerebral palsy.

First, Dragan Gajić et al (12) studied the effect of the Halliwick method on the rehabilitation of children with cerebral palsy. Specifically, 30 children (5-18 years old) who had been diagnosed with this disease participated in the research. The participants were divided into 3 equal groups, according to their characteristics, and followed a hydrotherapy program based on the Halliwick method lasting one year, for 60 minutes once a week. From the beginning to the end of the intervention, various tests were performed to assess movement in the water - swimming abilities using the SwimTest and functionality using the Gross Motor Function Classification System (GMFM) and the Barthel index test. The statistical analysis of the results showed an average increase for the SwimTest of 11.34 or 20.52%, while for the GMFM there were no significant changes in the mean

values with a numerical mean increase of only 0.50 or 0.87% and finally the Barthel index test showed a mean change of 0.50 units. After the intervention both the findings and the patients reported that their swimming skills and functionality improved.

Also, Vašáková et al (13) examined the influence of Halliwick on mobility in children with disabilities. Out of 10 total participants 6 suffered from cerebral palsy. More specifically, the main intervention was based on Halliwick's 10-point program. Aquatic skills were assessed using the WOTA water orientation test and motor skills were assessed using the GMFM test. The WOTA and GMFM results showed an improvement in aquatic skills and mobility by 0.64 points - 4.25% respectively for children with diplegia and by 0.76 units - 5.20% for children with quadriplegia. The measurements showed that after the intervention with the Halliwick method there was an improvement in the examined parameters for all children.

Moreover, Chandolias et al (14) investigated the effectiveness of hydrotherapy and specifically the Halliwick method on the balance of children with cerebral palsy. The sample they studied was 16 children who had been diagnosed with cerebral palsy. Of these, 10 children followed a hydrotherapy program based on the Halliwick method and the remaining 6 received a classical physical therapy program for 3 months. At the beginning of the program but also at the end, the children's balance was evaluated with the following tools: GMFM test, Berg Balance Scale (BBS) scale and foot pressure gauge. The researchers came to the conclusion that both groups had positive results, with the group of hydrotherapy to show greater improvement. Specifically, there was a statistically significant change between the 1st and 2nd measurements with the BERG and GMFM tools for the Halliwick group, with a mean increase of 3.9 points and 1.53 points, respectively. Thus they concluded that the Halliwick method is more effective than classical physical therapy in reducing the base of support and in the mobility of children, which ultimately lead to the improvement of their balance.

In a similar research context, Hamed et al. (15), studied the effectiveness of Halliwick on the mobility of children aged 3 to 5 who have been diagnosed with spastic cerebral palsy. In more detail, the researchers divided 34 children with CP into 2 equal groups, one of them received hydrotherapy and the other conventional exercise. The hydrotherapy program had a duration of 12 weeks with a frequency of sessions 3 times a week for 45 minutes. The children's mobility- functionality was assessed by an independent person with the GMFM test and the mean increase for the Halliwick group was 0.1 points and for the conventional exercise group 0.04. The findings showed that the mobility of the children in both groups improved, however the children treated with the Halliwick method showed greater improvement in skills such as sitting, walking, running, and jumping.

The purpose of the research of Martínez-Gramage et al. (16) was to study the efficiency of a combined program of physical exercise and Halliwick in hypertension of adults with OP. In more detail, 7 adults who suffered from OP participated in this research and received 12 sessions of hydrotherapy and 12 sessions of conventional physical therapy over a period of 3 months. The hypertonia before the intervention and at the end of it was evaluated with the help of the Ashworth scale, the electromyogram (EMG) and the control of the passive range with a goniometer. The study concluded that a program combining Halliwick and conventional physical therapy is capable of significantly reducing hypertonia, as on the Ashworth scale patients went from a mean score of 2.4 to 2.6 after the intervention and range of motion increased 6 units with the ankle joint scoring $p=0.02$.

Additionally on the subject of gross motor - aquatic skills Dimitrijevic et al.(17) also studied the effect of a hydrotherapy program on the gross mobility and the aquatic skills of children with CP. Especially, the sample was 26 children diagnosed with Cerebral Palsy and they were randomized in the intervention - Halliwick group and in the control group. The intervention lasted 6 week. and the participants of Halliwick group held two hydrotherapy sessions of 55 minutes per week. At the end of the study there was a 3-week follow-up period. The researchers measured motor function with the GMFM test and aquatic skills with the WOTA-2 test. The 2 groups did not have significant differences before the intervention, however after the second measurement GMFM test showed a statistically significant improvement for the intervention group compared to the initial measured value ($p < 0.05$). In the other side, the control group did not have significant changes in this value. Also, a measurement was made 9 weeks later and the results showed that the GMFM measurements worsened. The results showed significant improvements in the values of both examined parameters, which underlines the effectiveness of water treatment in children with CP, however the reduction of the GMFM test score , 9 weeks after the end of the treatment shows how necessary continuous therapeutic exercise is.

Chandolias et al. (18) explored the benefits that Hydrotherapy and especially Halliwick can bring to 10 children with CP aged 5- 15 years old . A total of 8 sessions were held, once a week, for 45 minutes at a time. Spirometer , oximeter, and triflow were used by the authors for the evaluation of respiratory system. Moreover, the children's ability to control breathing under water was measured with the Swim with Independent Measure (SWIM) scale, while the WOTA-1 and WOTA-2 tests were used to test orientation in the water. WOTA 1-2 tests did not show any change, all children showed difficulty in coordinating breathing in the water. With reference to heart rate , oxygen saturation, maximum expiratory flow-volume (MEFV) and vital capacity

authors found that they have significant increase in the mean score. The researchers found that Halliwick method can have positive impacts on children' with CP respiratory system .

Jorgic et al. (19) conducted a pilot study to evaluate the efficacy of a 6-week hydrotherapy program (2 sessions per week) on mobility and water adaptability in 7 children (9 years old) with spastic CP. In addition, hydrotherapy program was based on Halliwick method. Mobility was evaluated by GMFM test , final value of the test (91.11%) was significantly improved from the initial value (89.47%). Adaptability on water evaluated by WOTA – 2 and its final value (60,85%) was significantly improved from the initial one (35,62%). At the end of the intervention, significant improvements were observed in all parameters, especially in gross mobility.

Furthermore, (20) in their study compared the efficacy of water exercise and land-based exercise on social functioning, perceived competence ,social acceptance and quality of life in children with CP. The sample was 22 children, who were randomly divided into two groups (group with exercises in the water and group with exercises on land. Aquatic independence measure (AIM), Pediatric evaluation of disability inventory (PEDI) and physical competence sub-scale used from researchers for the evaluation. Hydrotherapy group achieved a 14% increase in aquatic skills. Also, there was no significant difference for the perceived competence while, at the same time the hydrotherapy group has a significant improvement on PEDI scale (mean score increased from 78,78 to 84,16) that evaluate the social acceptance.

Naidoo and Ballington (21) studied the subsequent effect of hydrotherapy on children with CP, in terms of their orthostatic control and balance in activities such as walking, running and jumping. The study involved 10 children (8-12 years old), who were divided into two groups (intervention and control). The intervention group participated in 30-minute sessions, twice a week, while the control group continued with standard land-based activities. This program lasted a total of eight weeks, with the gross mobility of the children being assessed before and after the intervention with GMFM test. The hydrotherapy program was based on 10 points of Halliwick concept . The group that followed the hydrotherapy program showed increased motor function compared to the control group ($p = 0,005$), while at the same time the average performance of gross mobility improved 4,25 unit of measurement. To sum up, the researchers argue that hydrotherapy should be integrated into the treatment program, along with other conventional techniques, to ensure long-term improvement in gross mobility.

In their systematic review Rohn, Novak Pavlic and Rosenbaum (22) explored the benefits and fun that swimming and halliwick method can bring to children with disabilities , such as CP - autism. Especially, the review involved 24 clinical trials. These studies compared an intervention group with a control group. The first group followed a hydrotherapy program based on Halliwick method. At the end of the study, it was observed that Halliwick method can improve the gross motor of children with disabilities, such as CP and autism.

The effects of a hydrotherapy program on children with spastic CP, in terms of motor function, exercise enjoyment, daily activities and quality of life was the study focus of Lai et al. (23). Two groups were formed. The first group (intervention group, 11 children) followed a conventional treatment program on land in combination with a hydrotherapy program. The second group (control group, 13 children) followed exclusively the conventional program on land. This intervention lasted 12 weeks, with the first group performing along with their conventional land-based treatment program two hydrotherapy sessions of 60 minutes per week, while the other group performed 2-3 sessions for 30 minutes. At the end of the study, it was observed that children who followed the hydrotherapy program saw, on average, a greater improvement in their mobility ($P=007$), compared to the control group, while, at the same time, they enjoyed the exercise more. Regarding the other measurements, there was no significant difference between the two groups, nor was there any improvement in one program compared to the other in terms of muscle tone. As a result, the researchers concluded that adding hydrotherapy to a land-based exercise program in children with CP is safe, effective and at the same time makes the therapeutic exercise program more enjoyable.

In addition, Chrysagis et al (24) studied the effect of a 10-week hydrotherapy program on 12 children with CP to improve gross motor, range of motion(ROM) and spacity. Hydrotherapy group followed a swimming program based on Halliwick method 2 times per week. The GMFM test, a goniometer and the Ashworth Scale were used to check the examined parameters. The results showed that the intervention group showed a significant improvement in all parameters of gross mobility (mean score of GMFM increased 6,02 points), while control group increased the same value only 0.93 points. Also, spasticity in hip adductors and knee flexors decreased significantly 16.35 ($p=0.002$) and 5.33, ($p=0.49$), respectively. Moreover, range of motion increased in active shoulder flexion and abduction ($p = 0.052$), passive hip abduction ($p = 0.001$) and passive knee extension ($p = .045$). The results of the study showed that a hydrotherapy program can have a positive impact on mobility, ROM and spasticity, especially in children with CP .

Lastly, Meyer et al. (25) studied the effect of Halliwick method on children with spastic CP to improve passive range of motion of upper and lower limbs. The study involved 15 children with CP (4-14 years old), who were randomized in the intervention group and in the control group, both groups following a 1-week swimming program, 30 minutes at a time. The range of motion. was measured with a special goniometer before,

immediately after the second session and 30 minutes after the end of the third session. The research concluded that both types of water therapy are beneficial for patients and they increase the range of joints' motion, however the Halliwick method due to the rotational movements focuses on the most peripheral joints, while conventional therapy focuses on the proximal joints.

Author	Study design	Sample (n)	Tools	Results
Gajić D. et al.,2020.	RCT	30 children with CP (5-18 years old)	*Barthel index test *GMFM test *SWIM test	The SwimTest demonstrated a mean increase of 11.34 or 20.52%. The GMFM showed a numerical mean increase of only 0.50 points. The Barthel Index test exhibited a mean change of 0.50 points.
Vašćáková T. et al.,2015	RCT	6 children with CP	*WOTA, *GMFM test	There was an improvement of 0.64 points in WOTA for children with diplegia and 0.76 units for children with quadriplegia, while the GMFM showed an improvement of 4.25% and 5.20% respectively.
Rohn S. et al.,2021	Scoping review	24 clinical trials	----- ----- -- ----- ----- ----- -----	The researchers concluded that the Halliwick method is an effective treatment for the rehabilitation of motor dysfunctions in children with severe disabilities, such as autism and CP
Chandolias K. et al., 2022	Randomez clinical trial	16 children with CP Control group :6 Hydrotherapy group:10	* BBS * GMFM test * Footprint scan	The Halliwick method is more effective than classical physical therapy in reducing the base of support and mobility of children with the BERG and GMFM values for the Halliwick group having an increase of 3.9 points and 1.53 points, respectively.
Hamed S. A et al.,2023	Randomez clinical trial	34 children with spastic type CP (3-5 years old) Control group:17 Hydrotherapy group:17	* GMFM test	The GMFM test showed a mean value increase of 0.1 points for the Halliwick group and only 0.04 for the conventional exercise group.
Martínez-Gramage J. et al.,2010	Pilot study	7 adults with CP They have hydrotherapy sessions and conventional physiotherapy	*Ashworth Scale * EMG * Goniometer	The combination of Halliwick -conventional physical therapy reduces hypertension. There was a decrease in mean Ashworth scale score of 0.2 and range of motion increased by 6 points with the ankle joint scoring p=0.02.
Dimitrijević L. et al.,2012	Randomez clinical trial	26 children with CP (5-14 years old) They were divided into a control group and a hydrotherapy group	* GMFMtest * WOTA 2	6 weeks after hydrotherapy the GMFM showed an improvement for the intervention group (p <0.05) on the contrary, for the control group there were no significant changes in this value. 9 weeks later there was a reassessment and the values of the variables for the same group had decreased.
Chandolias K. et al.,2018	Randomez clinical trial	10 children with CP (5-15 years old) received hydrotherapy	* Spirometer * Oximeter * Triflow * SWIMtest * WOTA 1 - 2	All children showed difficulty coordinating breathing in the water. There was an increase in mean heart rate by 26.37 units, oxygen saturation by 3.87 units, peak expiratory flow rate by 27.50 and rapidly expiratory volume by 2 units.
Meyer E., et al.,2013	Randomez clinical trial	15 children with CP (4-14 years old) They were divided into a control group and a hydrotherapy group	* Goniometer	The 3 sessions of 30 minutes with the Halliwick method increase the ROM of all joints but more of the peripheral ones.
Naidoo R. & Ballington S. J.,2018	Randomez clinical trial	10 children with CP (8-12 years old) Control group:5 Hydrotherapy group :5	* GMFM test	The mean score of the hydrotherapy group on the GMFM increased by 4.25 points.
Lai, C. J. et al.,2015	Randomez clinical trial	24 children with CP Control group:13 Hydrotherapy group:11	* Physical Activity Enjoyment Scale * Ashworth Scale * Vineland Adaptive Behavior Scale * GMFM test	Hydrotherapy group had a higher mean score after the treatment than the control group (P = 007). There was no post-treatment change for the Ashworth Scale. Finally, the pediatric hydrotherapy treatment group had a significantly higher mean score (98.9) on the Enjoyment Scale than the control group (88.9).
Jorgic B.,	Pilot	7 children with spastic	* GMFM test	there was an increase in the average value of GMFM

Dimitrijevi c L. et al.,2012	study	type CP (9 years old) received hydrotherapy	* WOTA 2	by 1.64 and WOTA 2 by 25.23 points. The ability to walk, run and jump was greatly enhanced.
Getz M. et al.,2007	Rando mized clinical trial	22 children with spactic diplegia. They were divided into a control group and a hydrotherapy group	* PEDI measures * AIM measures * Perceived physical competence sub-scale	Hydrotherapy group achieved a 14% increase in aquatic abilities. No significant changes were found in perceptual ability, while significant changes were found in social acceptance and social functioning, in favor of the aquatic group with the average value of the PEDI scale increasing by 5.38 points.
Chrysagis N. et al.,2009	Rando mized clinical trial	12 children with CP They were divided into a control group and a hydrotherapy group	* GMFM test * Modified Ashworth scale * goniometer	10-week hydrotherapy sessions reduced spasticity in knee adductors and hip flexors by 16.35 - p = 0.002 and 5.33, p = 0.49 respectively. The mean GMFM value increased by 6.02 points, and shoulder, hip, and knee range increased

IV. Discussion

A total of 16 papers based on the effects of hydrotherapy on mobility-functionality and overall health of people diagnosed with Cerebral Palsy. Most of studies are randomized clinical trials, but included also a systematic review and 2 pilot studies. Furthermore, 50% of studies conducted between 2007 - 2017 and the other 50% of included studies conducted the last 5 years (2018-2023). Also, it is worth noting that researchers of included studies chose different duration of hydrotherapy. In particular, the duration of treatment in the various studies ranged from 10 days to one year , 4 researchers chose the 3 months of hydrotherapy as the perfect duration for patients with CP in order to see the first mobility improvements. Regarding the individual duration of each session researchers seem to converge more. In all studies the session time ranges from 30 to 60 minutes, a difference that is not too great if one considers that the specific duration depends on the functional level of the sample, the physical condition of the participants and the structure-intensity of the program. The sample of the most of studies was children with CP aged 3 -18 years old. However, one study determines the effects on halliwick method in adults with the same disease. Despite the fact that Martínez-Gramage J.(16) chose a sample of adults and others researchers a sample of children, all studies come to the same conclusion. All the studies regardless of patients' age reported improvements in functionality after Halliwick treatment, which disproves that hydrotherapy does not lose its positive impact on patients with CP , even if it is not selected to be added to the recovery plan in time. The physiotherapists and the health care team of patients diagnosed with CP focus on the mobility improvements, this is proven by this review. Especially, this review includes 14 studies and the 12 of them examine the effects of hydrotherapy on mobility of patients with CP. The researchers in order to evaluate the mobility of the patients used the GMFM scale because it is valid and widespread. Evaluating all the studies that used this scale, it seems that the greatest improvement in GMFM values , comparing the initial with the final measurements, was shown by the sample of Chrysagis N. et al. (24) Especially, the intervention group of this study consisting of 6 children achieved an increase of 6.02 points in the mean score of GMFM. The second most impressive improvement on this scale (4,25 points) achieved by the sample of Naidoo R. & Ballington S. J.(21) study. Moreover, studies showed that expect the gross motor , there was improvements on the spacity level and ROM. These parameters were evaluated with goniometer and Ashworth scale. Also , due to the nature of the intervention that studies had , WOTA - 1 and WOTA– 2 used for the evaluation of the ability to adapt to water. Also, adding hydrotherapy to the recovery plan by physiotherapist is usually associated with improvements on mobility, only some therapists would combine Halliwick method – hydrotherapy with improvements on sociality, psychology, mood and other organ systems such as the respiratory Chandolias K.(14) , Lai C. J.(23) ,Getz M et al.(20) distinguishing Halliwick's holistic approach to the patient, they wanted to investigate its effectiveness in other parameters expect mobility. The results indeed confirmed the suspicion of the researchers about the efficiency of the method in parameters ,such as mood, sociability, enjoyment, breathing, psychology and made the supporters of alternative treatments to have one more strong argument about the necessity of existence of these treatments in the rehabilitation plan of every patient suffering from CP. An important finding is also the fact that although the studies included in the review were not conducted in the same period ,the first with last included research have a difference of 16 years, they all come to the same conclusion .Especially, most of the included studies mention improvements on health of patients, after the hydrotherapy sessions. This shows the timelessness of the method, it also highlights its excellent contribution to the achievement of the goals set by the patient and his care team regarding health and functionality. It is important to note that none of the studies mentioned any side effect that harmed the health of the participants, which shows the absence of risks and emphasizes the safety of the method. Furthermore, this review included also a systematic review ,which examine the effectiveness of Halliwick in the rehabilitation of motor dysfunctions in children with disabilities, such as autism and CP. That review has many similarities with the present review such as the research question, the examined sample and the examined

parameters. However, the most important point that both these papers seem to completely agree on is the conclusion. In particular, both talk about the great contribution of the method to the improvement of mobility in children with CP. Nevertheless, the above study concerns specific cases and a small sample of patients, without this meaning that valuable information cannot be extracted. However, in order to draw a valid conclusion further study should be conducted on this research question. The long-term effects of Halliwick are not mentioned in this review because of duration of included studies.

V. Conclusion

In conclusion, hydrotherapy shows promising contributions to restoring mobility and overall health in both children and adults suffering from CP. Specifically, hydrotherapy programs based on the Halliwick method have demonstrated improvements in water adaptation, motor functions (such as jumping, walking, and running), respiratory system strength, balance, spasticity reduction, increased range of motion, and enhanced sociability. As a result, hydrotherapy should be an integral part of every recovery plan, complementing conventional physical therapy and other treatments, as no single therapy is sufficient.

Daily physical exercise is essential for all individuals, especially those with CP, as research indicates that progress achieved through exercise may be lost if physical activity is neglected. The primary goal of hydrotherapy, including the Halliwick method and other aquatic programs, is not merely to improve mobility but to enhance overall health and quality of life. While hydrotherapy offers numerous benefits, there are also alternative therapies, such as hippotherapy, acupuncture, laughter therapy, dance therapy, play therapy, and music therapy, which can be incorporated into patients' recovery plans. These alternative therapies have advantages in that they do not burden patients' health with chemicals, and they focus on the individual's well-being rather than solely targeting the disease.

However, due to certain limitations in existing research, such as sample size and duration of intervention, further clinical trials with stricter inclusion criteria and larger sample sizes are warranted to obtain more targeted and reliable results. Moreover, it is essential to extend research beyond CP to explore the effects of hydrotherapy on children with various disabilities. Continued research on the effects of hydrotherapy and other alternative therapies will be valuable for both the medical community and physical therapists in enhancing the treatment and well-being of individuals with disabilities.

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