

AZUSA PACIFIC UNIVERSITY

**EFFECTS OF AQUATIC THERAPY ON  
DECREASING SPASTICITY IN CHILDREN WITH  
CEREBRAL PALSY AND ADULTS WITH SPINAL CORD INJURIES:  
A SYSTEMATIC REVIEW AND A CRITICALLY APPRAISED TOPIC**

by

John Berber, Emily Berk, Audrey Caron, and Haley Gallegos

A doctoral capstone project submitted to the  
School of Behavioral and Applied Sciences  
in partial fulfillment of the requirements  
for the degree Doctor of Physical Therapy

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PREVIEW

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PREVIEW

## ABSTRACT

*Background.* Cerebral palsy (CP) is a neurological disorder that affects balance, posture, and mobility. The most common type of CP is spastic diplegia. Common treatments used to reduce spasticity are prolonged stretching and passive range of motion. The purpose of the systematic review (SR) was to look at the effectiveness of standard physical therapy (PT) versus standard PT coupled with aquatic therapy on spasticity in children with CP. The purpose of our critically appraised topic (CAT) was to look at the effectiveness of standard PT versus standard PT coupled with aquatic therapy on spasticity in adults with spinal cord injuries. *Methods.* Four independent raters conducted the SR over four databases from January to March 2023. The SR included studies using the following criteria: children with CP who received aquatic therapy as intervention in comparison to standard PT, such as prolonged stretching and therapeutic exercise, with outcomes on muscle spasticity and muscle tone. Articles were appraised using Physiotherapy Evidence Database (PEDro) and National Institute of Health-National Heart, Lung, and Blood Institute (NIH-NHLBI) criteria. A 95% confidence interval (CI) and effect size (Cohen's  $d$ ) was evaluated for most of the articles. Four researchers conducted the CAT over four databases in March 2023. Articles were appraised using the Oxford Centre for Evidence-Based Medicine (OCEBM) Levels of Evidence and NIH-NHLBI. A 95% CI was evaluated for the SR article, and no statistically significant results were reported for the remaining two articles.

*Results.* Eight studies were included in this review, which included one SR, three randomized controlled trials, one controlled intervention study, one cross-sectional study, one pretest-posttest study, and one qualitative case study. All studies demonstrated that

aquatic therapy had no significant differences when compared to standard PT in decreasing overall spasticity. However, greater improvements were made in children's overall gross motor function and quality of life. Three studies were included in the CAT, which all indicated that aquatic therapy can yield greater results in decreasing overall spasticity and increasing quality of life when combined with standard PT.

*Conclusions.* Aquatic therapy is a promising alternative to participation in standard PT alone for reducing spasticity in children with CP. Aquatic therapy could also be beneficial to the patient if coupled with standard forms of therapy. Due to limited findings on the effects of aquatic therapy on spasticity for children with CP, more research is needed and will greatly impact treatment interventions for this population. Overall, the quality of evidence can be improved, as half of the articles used within this SR were given a fair rating on the OCEBM scale.

*Keywords:* cerebral palsy, aquatic therapy, children, spasticity, spinal cord injury, motor function

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PREVIEW

## CHAPTER 1

### INTRODUCTION

Cerebral palsy (CP) is a common neurological disorder that affects function and motor disability in the pediatric population. The different types of CP have been defined as causing abnormal tone, posture, and movement (Patel et al., 2020). Although spastic diplegia CP is the most common type, other types include spastic, dyskinetic, hypotonic, and mixed.

Typically, to distinguish the level of function for a child, the Gross Motor Function Classification System is used (Paulson & Vargus-Adams, 2017). In addition to classifying function, the Modified Ashworth Scale (MAS) is used to assess spasticity. When looking specifically at children with spastic CP, treatment typically focuses on improving overall function by reducing spasticity and tone. Treatments tend to include prolonged stretching, resistance training, and exercises for passive range of motion, balance, mobility, postural control, and transfers (Patel et al., 2020).

Similar to spastic CP, patients with spinal cord injury (SCI) commonly experience increased spasticity and tone. Spasticity can lead to decreased functional independence by limiting mobility and transfers and increasing overall pain. Aquatic therapy has been shown to be beneficial for patients with neurological disorders like SCI, showing improvements in decreasing spasticity, improving mobility, and decreasing overall pain (Recio et al., 2017). In addition to improving the general function of these patients, aquatic therapy has also been shown to improve their general quality of life. With these additional benefits, researchers have wondered if aquatic therapy can be beneficial for pediatrics with CP. Researchers have found a wide range of benefits including improved

balance and flexibility, decreased pain, and increased feelings of self-efficacy (Recio et al., 2017).

In current research, there has been a lack of studies examining the effect of aquatic therapy on spasticity, though it has been shown to be effective for gross motor function in neurological conditions such as CP and SCI. In addition, there should be further research on the effects of aquatic therapy coupled with standard forms of therapy on spasticity for neurological disorders. For our systematic review (SR), we investigated the effectiveness of aquatic therapy coupled with standard therapy versus standard therapy alone on spasticity in children with CP. For our critically appraised topic (CAT), we looked at the effect of aquatic therapy coupled with standard therapy versus standard therapy on spasticity in adults with SCI.

In our paper, chapter 2 includes the reviews, which looked at the effectiveness of aquatic therapy coupled with standard therapy versus standard therapy alone on spasticity in children with CP. Chapter 3 addresses the CP, which looked at the effectiveness of aquatic therapy coupled with standard therapy versus standard therapy alone on spasticity in adults with SCI. Chapter 4 is the discussion regarding both the SR and the CAT. Tables can be found in Appendix A, figures can be found in Appendix B, and the CAT summary handout can be found in Appendix C. In this capstone project, our paper was disseminated by four researchers as a poster presentation, which can be found in Appendix D.

## CHAPTER 2

### SYSTEMATIC REVIEW

Cerebral palsy (CP) is a group of disorders that cause abnormal tone, posture, and movement (Patel et al., 2020). It is the most common cause of motor disability in infants and children. CP is classified as spastic, dyskinetic, hypotonic, and mixed, with spastic diplegia being the most common type. Another way we classify CP is using the Gross Motor Function Classification System (GMFCS), which categorizes individuals with CP into five levels based on function (Paulson & Vargus-Adams, 2017).

A major treatment focus for spastic CP is reducing spasticity and tone to improve functional mobility, quality of life, and ease of daily activities. To address these aspects, typical physical therapy (PT) treatment for CP include exercises such as passive range of motion exercises and prolonged stretching to help with joint contractures, resistance training to increase muscle strength and endurance that involves all major muscle groups, as well as specific exercises that focus on balance, postural control, gait, mobility, and functional transfers (Patel et al. 2020).

Typically, the Modified Ashworth Scale (MAS) is used to assess spasticity. When testing children with cerebral palsy, researchers wanted to ensure that this particular scale was reliable. Yoo et al. (2022) found that the MAS can have satisfactory reliability as long as the scale was used with a standardized movement speed, specifically for ankle plantar flexors in children with CP. However, other researchers report that the MAS is not reliable because many factors can affect interrater reliability and intrarater reliability, such as human error and joint or muscle characteristics (Mutlu et al., 2008).

Research has shown aquatic therapy to be beneficial for patients with spinal cord injury by showing improvements with experiences of pain, decreasing spasticity, and improving mobility (Recio et al., 2017). Overall, because aquatic therapy has been able to improve general function for these patients, it has also been able to help improve their quality of life. With these beneficial effects for this specific population, researchers also wondered whether aquatic therapy could be beneficial for the pediatric population with CP. Through their research, they were able to see a wide range of benefits and gains for aspects of functional mobility such as balance, flexibility, strength, pain, and feelings of self-efficacy (Recio et al., 2017).

In current research, there is a lack of randomized controlled trials (RCTs) that examine the effect of aquatic therapy versus standard PT on spasticity for children with CP. Although literature addressing outcomes related to gross motor function are available, we were unable to find articles exploring the effects of aquatic therapy on spasticity in children with CP.

### **Purpose**

The purpose of this systematic review (SR) was to analyze and summarize the findings of studies related to our research question: In patients with cerebral palsy, does aquatic therapy coupled with standard therapy have a greater effect on decreased muscle tone and spasticity compared to solely standard therapy within 4–6 weeks? The SR looked further into the effectiveness of aquatic therapy on muscle spasticity and muscle tone for pediatric patients (ages 0–18) with CP compared to standard forms of PT intervention such as prolonged stretching and therapeutic exercises.

## Methods

### Evidence Acquisition

Four researchers, using the agreed-upon logic grids for each database, searched a chosen database individually and shared their findings with the group (Tables 2–6 in Appendix A). An initial search was completed in January 2023. A second search was completed in March 2023. Displayed in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, also known as PRISMA, figure (Figure 1 in Appendix B) is the strategy and organization of our search. The same search terms were used across each database to ensure uniform approaches and results among researchers. The tables below list how the researchers utilized and inputted their search terms for each database, and what inclusion and exclusion terms and limitations were they to narrow down the search.

### Data Sources and Search Strategies

The search dates were January to March 2023. The databases included the Cochrane Library, PubMed, Medical Literature Analysis and Retrieval System Online (MEDLINE), and Cumulative Index to Nursing and Allied Health Literature (CINAHL). For the population of this SR, the search terms included “pediatrics”, “child”, “adolescent”, “cerebral palsy”, and “spastic paralysis”. The intervention focused on aquatic therapy, hydrotherapy, and water therapy. For the comparison interventions, PT, prolonged stretch, and therapeutic exercise were included. Lastly, the outcomes the researchers decided to look at involved muscle spasticity, muscle tone, and MAS. See Tables 2–6 in Appendix A.