

Examination of Hippotherapy's Effect on Balance and Mobility in Children with Cerebral Palsy

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ABSTRACT

Cerebral Palsy is caused by abnormal brain development or damage to the developing brain that affects a person's ability to control his or her muscles. People with Cerebral Palsy often have balance and mobility problems associated with their diagnosis. Because a common symptom is stiff muscles, physical therapy is a common way to help decrease spasticity (CDC). Hippotherapy is an alternative form of therapy that has been gaining popularity. This treatment aims to help patients gain the necessary muscles needed to walk and perform daily activities while riding a horse. When riding a horse, a person must make adjustments each time the horse takes a step, which is beneficial for patients who need to learn balance skills. This review explores the effects of different types of Hippotherapy on patients with different types of Cerebral Palsy. The results of several research papers suggest that Hippotherapy does have an impact on patients' overall balance and motor skills after a series of therapy sessions.

Introduction

Chronic non-progressive infantile encephalopathy, also called Cerebral Palsy, is affected by the size, variety, and location of Central Nervous System Lesions (Moraes et al, 2016).

Children with Cerebral Palsy (CP) may show symptoms like abnormal stiffness in muscle and musculoskeletal and mobility problems, which can cause abnormal movement or sitting posture (Lee, C. et al, 2014). There are four types of CP: Spastic, Dyskinetic, Ataxic, and Mixed. Spastic CP is when patients have an increased muscle tone; this is the most common type and has different categories within its designation. Spastic CP has three different classifications: Diplegia, Hemiplegia, and Quadriplegia. Diplegia is when there is more spasticity in the legs than in the arms; this can affect one's walking ability. Hemiplegia affects one side of the body, and Quadriplegia affects the arms, legs, trunk, and face and is the most acute (CDC). Many kids must develop new functions and ways of life to compensate for the changes they experience with different muscles and positions. Long-term compensation leads to "muscle imbalance, increased hypotonia, and deformities that affect postural balance (Moraes et al, 2016)." The Somatosensory system, as well as the visual and vestibular systems, work together to help abnormal posture because of its connection to the Central Nervous System. Hippotherapy works with these systems to help the patient regain control and balance in their posture, allowing them to participate in different functional activities (Moraes et al, 2016). This review will consider different approaches to Hippotherapy and its effect on children with different types of Cerebral Palsy.

Level I and Level II Classifications of Cerebral Palsy

The effects of Hippotherapy on children with different types of cerebral palsy have been limited in the past, but in Matusiak-Wieczorek et al. (2020), children from ages 6-12 with both Level I and Level II Diplegia or Hemiplegia are considered. The classifications are based on the Gross Motor Function Classification System (GMFCS), which reports a child's general function. Level 1 in the GMFCS is defined by the ability to walk indoors and outdoors with some difficulty. In contrast, Level II is characterized by an ability to walk with support from a railing and having decreased balance on uneven surfaces or inclines. It is necessary to mention that the GMFCS goes to Level V, which refers to individuals who are wheelchair-bound (Foundation, C.P.A.R.). The twelve-week study comprised of forty-five children split into three groups: Group 1 received Hippotherapy twice a week (24 total), Group 2 received therapy once a week (12 total), and Group 3 was the control. Before the sessions began, participants were observed using the Sitting Assessment to record initial data for control and function of the head, trunk, foot, arm, and head. In this test, the child had to perform tasks like looking to each side, leaning forward, grabbing an object, and standing up from a chair. Usually, part of the procedure for the assessment is to film the various tasks to refer back and to compare results after therapy, but because these are minors, the parents did not consent to film (Foundation, C.P.A.R.).

After the Hippotherapy sessions concluded and the Sitting Assessment was repeated, Group 1, who received therapy twice a week, improved in head, trunk, arm, and head control. Notably, the arm function, trunk control, and head position control were all statistically significant, whereas in Group 2, which only received one session a week, only trunk control was statistically significant. The difference in improvements based on the Level that the children who were in level I and participated in 24 therapy sessions showed a significant increase in body posture. Based on the data, Hippotherapy appears more effective for younger children in Groups 1 and 2. Overall, this trial shows that Hippotherapy done twice a week will improve the control and function of muscular sets that are weak in people with Cerebral Palsy. There are some possible errors could have affected the study. The paper mentioned that each child had individual treatment based on where each individual was with their balance and posture, meaning that all the children received different therapy exercises, which could cause discrepancies. It was also noted that all of the participants were in traditional rehabilitation therapy outside of the trial. This could cause errors with the results being skewed because possible progress in rehab therapy could be reflected as improvement through Hippotherapy sessions. This research was only done with a small number of participants and only those in Levels I and II, and Hippotherapy's effects could be different based on the severity of the disability, so these results cannot be generalized to all patients with Cerebral Palsy (Matusiak-Wieczorek et al, 2020).

Hippotherapy's' Improvement in Functional Ability for Everyday Activities

Another study by Moraes et al. (2016) looked at how Hippotherapy affects postural balance, dynamic balance, and functional performance. Similar to the study conducted by F.D.A. R., these authors investigated the effect of 12 vs 24 sessions and the Gross Motor Function Classification characterized participants before the experiment. The research was done with fifteen participants aged 5 to 10 with varying weight, height, and locomotive description. The participants went through 30-minute sessions twice a week for twelve weeks, and data was collected before beginning, after 12 sessions, and after 24 sessions. This data was gathered through the Berg Balance Scale and the Pediatric Evaluation of Disability Inventory (Moraes et al, 2016). The Berg Balance Scale is used to discover the balance of a patient based on their performance on fourteen designated tasks and is scored on a zero to four scale, with a four being a perfect score. Some examples of the tasks are standing without assistance, picking an object up from the floor, and transferring from one chair to another. Healthcare workers widely use this test in several settings, such as after a stroke or amputation (Berg Balance Scale, 2021). The Pediatric Evaluation of Disability Inventory looks at mobility and functioning for children six months to

seven years and includes an extensive function review. This test takes children through up to 197 tasks to determine a score between 0 and 100, with a greater score constituting better mobility (“Pediatric Evaluation”, 2017).

During each session, the child was introduced to several activities, including participating in a “zig-zag trajectory” course, a blindfolding task, and a change in ground type- from asphalt to grass. During the therapy sessions, children varied in position and footing while maintaining optimal balance. The Blindfolding activity included doing turns and straight-line walks with the horse, and this resulted in greater stimulation of the vestibular and proprioceptive systems, including an automatic trunk reaction. After data was collected, it was shown that Hippotherapy significantly improved self-care and social function variables. All assessment types differed statistically from previous assessments, but postural stability increased, especially after 24 sessions. The Berg Balance Scale scores showed significant differences; the original measurements mean was 27.93, and the final was 32.53, giving a 4.6-point increase after 24 sessions. The study stated that these results differed from those that used the Gross Motor Function Measure and the Sitting Assessment Scale, which did not observe significant differences with sitting position after Hippotherapy (Moraes et al, 2016). This difference can be explained by a varied classification of cerebral palsy and disease severity from participants. Even still, the study showed that 24 Hippotherapy sessions may improve balance and performance in differing tasks (Moraes et al, 2016). Some inconsistencies should be noted, including that the therapy sessions were all individualized to each child, which could yield different results. The study also used three different horses; although they were similar in size, this could still impact the results. This study was performed in a non-clinical environment with few participants, which could also influence their findings. Overall, this study showed that Hippotherapy’s effect may show that the continuous changes required by horse riders reveal why this approach may be an effective therapy. Because of the adjustments that a participant must make with each step of the horse, participants with Cerebral Palsy will likely be able to strengthen their muscles, thereby leading to greater mobility.

Additionally, Park et al. (2014) conducted a study on 34 children with Spastic Cerebral palsy who received Hippotherapy twice a week for eight weeks, each session lasting for 45 minutes. Like the previous study, researchers also used the Gross Motor Function and the Pediatric Evaluation of Disability (PEDI) to determine the balance and function of each participant before and after the Hippotherapy to compare. Most participants in this study had Bilateral CP, meaning both sides of the body are impaired, and only 2 had Unilateral CP, meaning that only one side of the body is affected. The patient characteristics, such as age and severity level provided had no significant difference in the study. The results showed that depending on age and severity of CP, results plateau around age 5 and 6 and are most successful in the first four years of life. The experimental Hippotherapy group suggested beneficial effects on Gross Motor Function and self-care improvement when compared to the control group. The PEDI looked at three domains in determining the participant’s skill in daily activities: Self-care, mobility, and social functioning. Self-care improved in the hippotherapy group, meaning the child improved in self-sufficiency. Mobility and Social Functioning were observed but did not show significant improvement. Mobility improvement is shown when their gross motor function increases, and social functioning improvement is when communication, listening, and language skills are developed during Hippotherapy practice. Some limitations of this study were stated, including that the sample size was too small to allow for the application of the results (Park et al, 2014). Like the past studies, this study included participants still in other physical and occupational therapy while doing Hippotherapy. This participation could affect the data by showing a false correlation between Hippotherapy and improvement in children with Cerebral Palsy If this correlation was due to the combination of Hippotherapy and a different therapeutic intervention. Further research is needed to build upon the findings in this research to determine if the younger the participant is related to the chance of improving. In conclusion, this research showed “modest but significant” benefits for children with Cerebral Palsy participating in Hippotherapy compared to other forms of physical and occupational therapy (Park et al, 2014).

Effects of a Horse-Riding Simulator

In Lee et al. (2014), the authors investigated whether a horse-riding simulator could mimic the same affects that Hippotherapy gives children with Cerebral Palsy. Because of the high cost and the lack of Hippotherapy resources, the device aims to provide riders with a feeling similar to an authentic horseback riding experience. The study included 26 participants equally divided into a hippotherapy group and a simulator group. Both groups had 1 hour of therapy three times a week for 12 weeks. These sessions included a 20-min physical therapy session prior to the exercise. The study used the Balance Performance Monitor (BPM) to measure improvement throughout the study (Lee et al, 2014). The BPM includes two-foot plates that a participant stands on while the machine gives feedback on the distribution of weight and the degree of sway while standing still (Hass & Burden, 2006). The BPM measured the sway while standing, and the Pediatric Balance Scale (PBS) measured balance with movement or alteration to position. The PBS is an altered version of the Berg Balance scale previously described that measures the balance of patients during designated tasks (Pediatric Balance Scale, 2022). Using these tests, the results showed improved static and dynamic balance in both Hippotherapy and the simulator, however, no statistically significant differences were observed. The Hippotherapy group improved 4 points using the PBS and the horseback with an improvement of 3 points. These results show that both forms of therapy will produce improvement for children with Cerebral Palsy, but Hippotherapy caused a slightly more significant advance than the simulator (Lee et al, 2014). This device has the potential to be a great alternative to traditional therapy or Hippotherapy for patients who want to benefit from the effects but may not be able to afford or have access to a horse. In light of these findings, we suggest that future studies should investigate which classification or type of Cerebral Palsy are best suited for simulated riding therapy.

The Difference Between Hippotherapy and Therapeutic Horseback Riding

Hyun et al. investigated the effects of Hippotherapy and Therapeutic Horseback Riding on the Spasticity in children with Cerebral Palsy (Hyun et al, 2022). Therapeutic Horseback Riding (THR) differs from Hippotherapy because THR is performed by a certified therapeutic horseback riding instructor instead of a professional occupational or physical therapist like Hippotherapy. THR is recreational horseback riding that is modified so people with disabilities can participate. Hippotherapy is usually one-on-one with a therapist for treatment that could be for an extended time. In contrast, THR is usually done in group settings and focuses more on horseback riding skills during lessons (“Hippotherapy”). Hippotherapy falls under the broad term of Equine-Assisted therapy, where a licensed professional includes horses in the treatment plan. Equine-Assisted activity is when a non-licensed professional uses the benefits horses may bring to patients in a non-clinical environment. Therapeutic Horseback Riding is an example of Equine-Assisted activity. There is an additional clinical service called Equine Assisted Counseling or Equine Facilitated Psychotherapy, which is mental help therapy through the exchange with horses led by a mental health professional (Sheade, 2016).

Recently, another group investigated the effects of Hippotherapy on spasticity, or when an increase in muscle tone causes stiffness and a restricted range of motion in patients. In this study, Hyun et al. (2022) reported the effects of Hypnotherapy and THR on lower limb muscle spasticity. Ashworth Scale was used to determine the outcome of sessions; this assessment is used to determine spasticity by extending patients’ limbs to see the maximum extension and is scored 0-4. If a patient’s score is zero, they have no increase in muscle tone, meaning there is no spasticity, and four is an extreme case of spasticity with an extension being very challenging (“Modified”, 2021). The study compared seven studies’ data that used the Ashworth scale; four of the studies used Hippotherapy, and the other three used Therapeutic Horseback Riding. After comparing the data, results showed that lower limb muscles became less stiff after therapy, however it was not statistically

significant. Six out of the seven included studies concluded that the Hippotherapy or THR helped spasticity in muscles decrease. Results also showed that repeated sessions did not improve muscle stiffness in the short amount of time studied (Hyun et al, 2022). These conclusions suggest that the lower limb muscle stiffness could be reduced significantly if the therapy was continued long-term (Hyun et al, 2022). The study stated that over-time muscles activation and adaption to therapy may reduce the effectiveness of multiple treatments (Hyun et al, 2022). There are some issues with this review, including the fact that several studies had a very small sample size and needed to identify the type of Cerebral Palsy of the participants. In conclusion, this study shows that short-term effects decrease muscle stiffness, and both Hippotherapy and Therapeutic Horseback Riding benefit those with harsh side effects from Cerebral Palsy.

Table 1. A summary of significant findings from the studies in the paper.

Source	Significant Findings	Tests Used
Matusiak-Wieczorek, E. et Al, 2020	Participants who received therapy twice a week improved in head position control, arm function and trunk control	Sitting Assessment Scale (SAS)
Moraes, A. E. et Al, 2016	Significant difference in the improvement in dynamic balance between the initial measure (m=27.93) and the final measure(m= 32.53).	Berg Balance Scale (BBS) & the Pediatric Evaluation of Disability Inventory (PEDI)
Park, E. S. et Al, 2014	Evaluations concluded that after the study period the hippotherapy group had a significantly greater improvement compare to the control.	Gross Motor Function Measure (GMFM) & the Pediatric Evaluation of Disability Inventory (PEDI)
Lee, C. et Al, 2014	The hippotherapy group increased their PBS score by 4 points compared to the 3 point increase by the simulator group	Pediatric Balance Scale (PBS) & BPM Software
Hyun, C. et Al, 2022	Results showed that lower limb muscle became less spastic in the Hippotherapy group and this reduction became more evident as more treatments occurred	Ashworth Scale (AS) & the Modified Ashworth Scale (MAS)

Conclusion

After analysis of several studies on the effects of Hippotherapy for children with Cerebral Palsy, the findings support a positive relationship between Hippotherapy and improvements in mobility and balance. Several studies identified a more significant improvement for younger children with cerebral palsy than older participants (Matusiak-Wieczorek et al, 2020; Park et al, 2014). There are also fairly substantial improvements from a Horse-riding Simulator that could allow subjects from different socio-economic statuses to advance in their therapy goals. There is more opportunity for research to determine who would benefit most in terms of functional level, age, and GMFCS level from Hippotherapy or a Horse-Riding Simulator. This review has identified

several new avenues for future research and we conclude that Hippotherapy may have strong potential in the effort to improve the lives of children with Cerebral Palsy, helping them to decrease spasticity, improve in balance, and participate more in daily activities.

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References

- Berg Balance Scale. (2021, November 17). Cleveland Clinic.
<https://my.clevelandclinic.org/health/diagnostics/22090-berg-balance-scale>
- Foundation, C.P.A.R. (n.d.). Gross Motor Function Classification System (GMFCS). Cerebral Palsy Alliance.
<https://cparf.org/what-is-cerebral-palsy/severity-of-cerebral-palsy/gross-motor-function-classification-system-gmfcs/>
- Hass, B.M. & Burden, A.M. (2006). Validity of weight distribution and sway measurements of the Balance Performance Monitor. *Physiotherapy research international: the journal for researchers and clinicians in physical therapy*, 5(1), 19-32. <https://doi.org/10.1002/pri.181>
- Hippotherapy or Therapeutic Horseback Riding- What's the Difference? (n.d.). Granite State Carriage Association. <https://www.granitestatecarriage.org/index.php/news-resources/membership-and-liability-forms/11-horse-smarts-and-carts/77-hippotherapy-or-therapeutic-horseback-riding-what-s-the-difference>
- Hyun, C., Kim, K., Lee, S., Ko, N., Lee, I., & Koh, S. K. (2022). The Short-term Effects of Hippotherapy and Therapeutic Horseback Riding on Spasticity in Children with Cerebral Palsy: A Meta-analysis. *Pediatric Physical Therapy*. 34(2). 172-178. DOI: 10.1097/PEP.0000000000000880
- Lee, C., Kim, S. G., & Na, S. S., (2014). The Effects of Hippotherapy and a Horse-Riding Simulator on the Balance of Children with Cerebral Palsy. *J Phys Ther Sci*. 26(3), 423-425
<https://doi.org/10.1589/jpts.26.423>
- Matusiak-Wieczorek, E., Dzionkowska-Zaborszczyk, E., Synder, M., & Borowski, A. (2020). The Influence of Hippotherapy on the Body Posture in a Sitting Position among Children with Cerebral Palsy. *International Journal of Environmental Research and Public Health*. 17(18), 6846
<https://doi.org/10.3390/ijerph17186846>
- Modified Ashworth Scale. (2021, April 13). Physiopedia. http://index.php?title=Modified_Ashworth_Scale&oldid=270611.
- Moraes, A. E., Copetti, F., Angelo, V. R., Chiavoloni, L. L., & David, A. C. (2016). The effects of hippotherapy on postural balance and functional ability in children with cerebral palsy. *J Phys Ther Sci*. 28(8), 2220-2226 <https://doi.org/10.1589/jpts.28.2220>

Park, E. S., Rha, D., Shin, J. S., Kim, S., & Jung, S. (2014). Effects of Hippotherapy on Gross Motor Function and Functional Performance of Children with Cerebral Palsy. *Yonsei University College of Medicine*. 55(6), 1736-1742 <https://doi.org/10.3349/ymj.2014.55.6.1736>

Pediatric Balance Scale. (2022, November 7). Physiopedia.
http://index.php?title=Pediatric_Balance_Scale&oldid=319774

Pediatric Evaluation of Disability Inventory. (2017, March 22). Shirley Ryan AbilityLab.
<https://www.sralab.org/rehabilitation-measures/pediatric-evaluation-disability-inventory>

Sheade, Hallie. Equine-Assisted Activities vs. Therapies. (2016, March 15). Equine Connection Counseling.
<https://www.equineconnectioncounseling.com/blog/equine-assisted-activities-vs-therapies>

What is Cerebral Palsy? (2023, October 6). Centers for Disease Control and Prevention.
<https://www.cdc.gov/ncbddd/cp/facts.html#:~:text=CP%20is%20the%20most%20common,control%20his%20or%20her%20muscles.>