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The effectiveness of hippotherapy in relation to cerebral palsy - a review

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Summary

Cerebral Palsy (CP) includes a group of movement and posture development disorders which cause activity limitation and are related to non-progressive disturbances during the fetal or infant brain development. In recent years, the use of hippotherapy as a rehabilitation of spstatic movement disorders in patients with cerebral palsy is gaining in popularity. Hippotherapy is a physical therapy treatment based on the horse's movements, under the direction of an expert physical therapist. The horse's seat is considered as a dynamic support base.

Thus, it is an excellent tool to improve and develop postural control, trunk strength, and balance. It allows to build overall postural strength and endurance, address weight-bearing, and motor planning. The therapeutic results obtained with the application of hippotherapy treatments has encouraged research into developing an advanced hippotherapy platform or simulators that "imitate" the movements of a horse, so that this therapy may be more accessible and adaptable to patients. The purpose of this report is to identify the forms and programmes of hippotherapy used, and to summarise and assess the latest available evidence of their clinical effectiveness in the rehabilitation of symptoms in patients with cerebral palsy. Method: a review of publications on the effectiveness of hippotherapy programmes in the rehabilitation of symptoms in patients with cerebral palsy. Finally, 8 original tests were included in the review whose data have been extracted. The results of the research indicate that hippotherapy may be beneficial in the rehabilitation of symptoms in patients with cerebral palsy. The review suggests that further research is needed to establish a solid evidence base for hippotherapy among people with these problems. The promising results so far support further research projects.

Key words: hippotherapy, cerebral palsy, rehabilitation

1. Introduction and purpose

Cerebral Palsy (CP) includes a group of movement and posture development disorders which cause activity limitation and are related to non-progressive disturbances during the fetal or infant brain development. CP upper motor neuron syndrome prompts a few sorts of muscle overactivity which includes spasticity. Spasticity causes an abnormal distribution of muscle tone in trunk and limbs. Specifically, the abnormal muscle tone of the hip muscles and the associated sensory deficits, such as the poor cutaneous perception and proprioception, could produce a poor postural control and balance [6]. This condition is due to the hip is the center for balance control, thus it contributes applying the forces and/or postural compensations necessary for maintenance of the head, arms, and trunk segment balanced over the lower limbs. Improvements in the pelvic kinematics could be related to a better postural control and/or balance, and vice versa. Thus, due to spasticity of hip muscles is directly related to pelvic kinematics, it is probably that a reduction in hip adductors spasticity causes a gain in the postural control and balance (Lucena-Antón et al., 2018). The physiotherapeutic goals for children with CP have aimed at restoring their highest possible level of functional independence by reducing impairments, practicing functional movements and using strategies that compensate for lost function. Hippotherapy provides a dynamic support base for participants, making it an excellent method for improving trunk strength, control, posture, balance, and gross motor function in children with CP of various functional levels (Hsieh et al., 2017)

To date, the most popular strategies for the rehabilitation of symptoms have been gait training I strenght training. Gait training was the most effective intervention in improving gait speed for ambulatory children with CP. Strength training, even if properly dosed, was not shown to be effective in improving gait speed.

In addition to the literature listed, it lists the following: Velocity training, electromyographic biofeedback training, and whole-body vibration that were effective in improving gait speed in individual studies and warrant further investigation (Moreau et al., 2016).

In recent years, the use of hippotherapy as a rehabilitation of spstatic movement disorders in patients with cerebral palsy is gaining in popularity. Hippotherapy is a physical therapy treatment based on the horse's movements, under the direction of an expert physical therapist. The horse's seat is considered as a dynamic support base. Thus, it is an excellent tool to improve and develop postural control, trunk strength, and balance. It allows to build overall postural strength and endurance, address weight-bearing, and motor planning (Lucena-Antón et al., 2018). The therapeutic results obtained with the application of hippotherapy treatments has encouraged research into developing an advanced hippotherapy platform or simulators that "imitate" the movements of a horse, so that this therapy may be more accessible and adaptable to patients (Herrero et al., 2010)

The purpose of this report is to identify the forms and programmes of hippotherapy used, and to summarise and assess the latest available evidence of their clinical effectiveness in the rehabilitation of symptoms in patients with cerebral palsy.

Method: a review of publications on the effectiveness of hippotherapy programmes in the rehabilitation of symptoms in patients with cerebral palsy was carried out according to the scheme described below.

Stage one: Search procedure

In spring 2020 we performed a search in the PubMed database (NCBI). The strategy was to search for published articles in English using "cerebral palsy hippotherapy" descriptors with filter enabled for Clinical Trial. The query resulted in 14 results published between 2003 and 2020.

Stage two: Applying the criteria for the inclusion of the study

First, we applied the following inclusion criteria:

- 1) the work concerned hippotherapy on a horse or using a hippotherapy simulator
- 2) works whose full texts had open access to the Medical University of Lublin

Stage 3: Extracting data

All selected articles have been read in full in order to extract data related to the nature of the study, sample size, hippotherapy program, tools for measuring the results.

2. DESCRIPTION OF THE STATE OF KNOWLEDGE

Finally, 8 original tests were included in the review. The extraction of data was realized in Table 1.

(McGibbon et al., 2009) conducted a two-phase study whose phases were treated as 2 separate studies due to different subjects.

Tabel no 1.

1st author and year	Article type	Size of samples with age	Programme of the examined group	Programme of the control group	Evaluation tools and type	Results
(Lucena-Antón et al., 2018)	Randomized controlled trial	44 between 3 and 14 years old	12-week hippotherapy programme (1 time/week, 45 min) in addition to their conventional therapy, consisting of physiotherapy sessions twice a week	Conventional therapy sessions twice a week (Le Métayer and sensory integration methods)	The hip adductors spasticity was measured using the MAS scale The first one was made the week before the beginning of the intervention and the second one the week after the intervention	The mean of MAS score of the left adductors decreased -0,05 (2,59 to 2,54) in the control group and -0,27 (2,77 to 2,50) in the intervention group. The mean of MAS score of the right adductors decreased -0,09 (2,40 to 2,31) in the control group and -0,45 (2,22 to 1,77) in the intervention group. In this way, MAS scores decreased in both groups, but scores of the intervention group were significantly higher than the control group ($p < 0.05$).
(Hsieh et al., 2017)	Single-blinded clinical trial with no control group	14 between 3 and 8 years old	36-week study composed of baseline, intervention, and withdrawal phases (12 weeks for each phase, ABA design). Hippotherapy was implemented for 30 min once weekly for 12 consecutive weeks during the intervention phase	-	ICF-CY checklist including Body Functions (b) and Activities and Participation (d) were used as a performance measure during the initial interview and at the end of each phase Collected at four timepoints, i.e. initial (Week 0), pretreatment (Week 12), post-treatment (Week 24), and follow up (Week 36).	After hippotherapy, the percentage of impaired categories from the ICF-CY checklist, in more than 20% of population, were decreased to 52.7% (29/55) in Group A and 78.2% (43/55) in Group B. In addition, after hippotherapy, the number of impaired categories from the ICF-CY checklist, in more than 50% of population, were decreased to 30.9% (17/55) in Group A and 58.1% (32/55) in Group B. Three months after hippotherapy, the percentage of impaired categories in more than 20% of population were 52.7% (29/55) in Group A and 81.8% (45/55) in Group B. In addition, the number of impaired categories in more than 50% of population were 32.7% (18/55) in Group A and 70.9% (39/55) in Group B.
(Herrero et al., 2010)	Double-blinded randomized controlled trial	37 between 4 and 18 years old	10 treatment sessions (one weekly, 15 minutes) with horseback riding simulator switched on	10 treatment sessions (one weekly, 15 minutes) with horseback riding simulator switched off (without rhythmic movement)	SAS (Sitting Assessment Scale) Surface Electromyography (EMG) Electronic inclinometer and traditional goniometer Gross Motor Function Measure (GMFM) A first measurement will be made at the beginning of the study, a second one when the ten treatment sessions have concluded, and a third measurement after the 3-month follow-up period.	Study not completed

					Moreover, two of these outcome variables (hip abduction range of motion and Electromyographic activity in adductors) will also be measured before and after each treatment session.	
(Žaliene et al., 2018)	Clinical trail with no control group	15 between 3 and 19 years old	The duration of the participation in riding activities was various: for the advanced subjects it ranged from 1 to 4 years (2.66 years ± 1.16), while for the beginners it consisted of only two weeks (10 sessions). Group I (the advanced riders) consisted of eight subjects (7 boys and 1 girl) who regularly participated in horse therapy sessions once a week, although the duration of their participation in this experiment differed. Group II (the beginner riders) consisted of seven children (1 girl and 6 boys) who only participated in 10 continuous riding sessions.	-	GMFCS: <i>Gross Motor Function Classification System for CP</i> For Group I (the advanced riders), the tests results were recorded before, during and at the end of the study, while for Group II (the beginner riders) the results were recorded before and after the study.	Only one subject's (second) gross motor functions remained unchanged during the whole of the study in quantitative terms, but the subject's thigh abduction and range of extension motion of the foot increased. Meanwhile the gross motor functions of the remaining subjects improved in comparison with the results that were recorded prior to when the research began. The GMFM of the first investigated person changed by 2.4%, but this difference was not statistically significant. The difference in the third participant's GMFM after the experiment (32.8%) was statistically significant (p<0.05) compared with the results obtained at the beginning of the study.
(Borges et al., 2011)	Randomized controlled trial	40 between 3 and 12 years old	12 treatment sessions administered in a two weekly basis, with 40 minutes of duration each, on the horseback riding simulator	12 sessions of conventional physical therapy based on the NeuroDevelop mental Treatment (NDT) with emphasis on specific techniques for trunk control, with two weekly sessions of 40 minutes each	All subjects had postural control evaluated by the record of their body oscillations before and after the period of intervention. The evaluation of the anterior-posterior (AP) and medial-lateral (ML) body oscillations was performed by recording the maximal displacement of the pressure center according to the protocol used by Lacoste ¹⁴ in the F-Scan system (software version 4.21) and F-Mat sensor platform-type (model 3100, Tekscan, Inc., South Boston, MA) The Gross Motor Function Classification System (GMFCS) before and after the period of intervention	the individual measures obtained in the AP displacement in the pretest in both groups, the average of the post-test results of the RS group was statistically higher than the average obtained by the CT group (p<0.0001). The same results were observed in the ML displacement where the average of the individual post-test measures in the RS group was statistically higher than the average of the CT group (p=0.0069). The GMFCS: Five children from RS and two children from CT obtained different functional levels before and after intervention, as shown in Table. Although the level change is not statistically significant, the children treated with a horse ridding simulator had 1.63 times more chances to show a better score after the treatment than before the treatment (p=0.0110). Similarly, the children treated by conventional therapy had 1.22 times more chances to obtain a better score after treatment than before the treatment (p=0.1510). The scale AUQEI showed that the level of happiness was satisfactory in both groups.

					At the end of the study, all children were evaluated by the AUQEI scale	However, when specifically focusing on the physical therapy practice was observed that the group RS had more satisfactory results when compared to the CT group (p=0.0026)
(Silkwood-Sherer et al., 2012)	Clinical trial with no control group	16 between 5 and 16 years old	Treatment hippotherapy sessions (40–45 minutes) were given twice weekly for 6 weeks		Balance was measured with the standardized 14-item PBS,19,20 a children's version of the adult Berg Balance Scale.21 Functional performance of daily life skills was assessed with the self-administered 30-item Activities Scale for Kids-Performance (ASKp).	PBS: statistically significant difference between the preintervention assessment and the postintervention assessment (Tab. 2). Scores on the PBS showed median increases of 5.5 and 4.0 points from the baseline 1 and baseline 2 assessments, respectively, to the postintervention assessment. ASKp: postintervention scores (median//92.1) that were statistically higher than their baseline 1 cores (median//80.0, T//3.5, P < .01) or baseline 2 scores (median// 81.7, T//0, P < .01).
(McGibbon et al., 2009)	Clinical trial with no control group	6 between 5 and 12 years old	36-week repeated-measures design divided into three 12-week segments: baseline (no hippotherapy), treatment, and posttreatment (no hippotherapy). The 6 children each received a once-weekly session of hippotherapy for 12 weeks during the treatment portion of the 36-week protocol The hippotherapy treatment followed a standard 30-minute (approximately) hippotherapy protocol on horseback riding simulator		Adductor muscle activity using surface electromyography. Gross Motor Function Measure-66 The Self-Perception Profile for Children, ages 8 to 13, and the Pictorial Self-Perception Profile for Young Children, ages 4 to 7 The evaluation was made in 4 timepoints: 12 Weeks Pre-HPOT T1 11.6 Immediately Pre-HPOT T2 Immediately Post-HPOT T3 12 Weeks Post-HPOT T4	Adductor Asymmetry After 12 weeks of weekly hippotherapy, 4 of 6 children (subjects 1, 2, 4, 6) showed improved adductor muscle symmetry during walking. The improvement was maintained 12 weeks posthippotherapy. Subject 3 did not show baseline stability, so improvement posttreatment is open to question. Subject 5 did not show improved adductor symmetry after hippotherapy, but this may be a result of extraneous factors (see table 6, footnotes). Gross Motor Function Measure All 6 children improved on the Gross Motor Function Measure-66 and maintained improved function over baseline 12 weeks posttreatment (table 7). One child began walking without a walker for the first time after 4 weeks of hippotherapy. Figure 3 shows the changes in the GMFM scores after the hippotherapy phase compared with the baseline and posttreatment phases. Self-Perception Profiles The results for these tests were varied. Five of the 6 children completed all Self-Perception Profiles (subjects 1, 2, 4, 5, 6), and all improved in at least 1 area (tables 8 and 9). Subject 3 did not complete this testing. During initial testing attempts, he frequently looked away from the pictures as if unwilling or unable
(McGibbon et al., 2009)	Randomized controlled trial	24 between 4 to 16 years old	One 10-minute session of hippotherapy on horseback riding simulator	One 10-minute session of barrel-sitting	Surface electromyography before and after intervention	There was no difference in adductor muscle asymmetry between the groups prior to the interventions of hippotherapy or barrel-sitting. After intervention, the hippotherapy group demonstrated significantly less adductor muscle asymmetry than the barrel-sitting group (table 3).

						After the 10-minute hippotherapy intervention, children in all GMFCS levels showed improved adductor muscle symmetry, including the 2 children with level III and the 5 children with level IV (table 4). None of the children in GMFCS levels III and IV responded positively to the barrel. The interaction between groups and GMFCS levels was not significant because there was an insufficient number in each of the subcategories
(Hemachithra et al., 2020)	A randomized controlled trial	24 between 2 to 4 years old	Single 30-minute HRS session lasted 30 min.	Control group was placed on the corner seat in a comfortable position supported by pillows for 30 min.	MAS was used to measure the hip adductor muscle tone. The goniometer was used to measure the PROM in hip joint especially hip abduction	It was observed that there was no difference between the pre and post assessment values in control group, experimental group, including pre and post interventions, were depicted in Figure 3; this shows that there was significant reduction in AT and improvement in hip abduction range of motion in both sides with the P value ($P < .001$) after the intervention

The studies that were found differed in nature and size. The studies had samples between 6 and 44 people. Some of them had a small sample without a control group (Hsieh et al., 2017; McGibbon et al., 2009; Silkwood-Sherer et al., 2012; Žaliene et al., 2018). However, there were 3 studies with a larger group of subjects, with a randomized division into control and study groups. (Borges et al., 2011; Hemachithra et al., 2020; Herrero et al., 2010; Lucena-Antón et al., 2018; McGibbon et al., 2009). Some studies lacked information on the quality of the assessor blindness (McGibbon et al., 2009; Silkwood-Sherer et al., 2012; Žaliene et al., 2018). Some researchers carried out hippotherapy using horseback riding simulators (Borges et al., 2011; Hemachithra et al., 2020; Herrero et al., 2010; McGibbon et al., 2009) and part of it was studying riding a real horse (Hsieh et al., 2017; Lucena-Antón et al., 2018; Silkwood-Sherer et al., 2012; Žaliene et al., 2018). Two studies focused on the immediate effects of a single hippotherapy session on muscle spasticity (Hemachithra et al., 2020; McGibbon et al., 2009). These studies, which evaluated the effectiveness of entire therapeutic programs, consisted of programs lasting between 6 and 24 weeks. Among the studies with the control group, Hippotherapy was compared to the lack of all therapeutic activities (Hemachithra et al., 2020; Herrero et al., 2010; McGibbon et al., 2009). Study of (Borges et al., 2011) compared conventional therapy to hippotherapy while study of (Lucena-Antón et al., 2018) compared hippotherapy with conventional therapy to conventional therapy only.

The tools of evaluation were :

The Modified Ashworth Scale (MAS)

ICF-CY checklist including Body Functions (b) and Activities and Participation (d) (2

SAS (Sitting Assessment Scale)

Surface Electromyography (EMG)

Electronic inclinometer and traditional goniometer

Gross Motor Function Measure (GMFM)

F-Scan system

F-Mat sensor platform-type

the AUQEI scale

14-item PBS

Activities Scale for Kids–Performance (ASKp)

The Self-Perception Profile

The evaluation was usually before and immediately after the completion of the therapeutic program. Only one study conducted a prospective evaluation (McGibbon et al., 2009). In 3 studies the MAS was measured after each session (Hemachithra et al., 2020; Herrero et al., 2010; McGibbon et al., 2009).

3. Conclusions

The results of the research indicate that hippotherapy may be beneficial in the rehabilitation of symptoms in patients with cerebral palsy. The review suggests that further research is needed to establish a solid evidence base for hippotherapy among people with these problems. The promising results so far support further research projects. There is also a need for more systematic, step-by-step research that will develop and evaluate the individual components of the intervention to close gaps in knowledge or research approaches. The broadening of knowledge about these phenomena will facilitate the identification of those interventions that are most effective.

References

- Borges, M. B. S., Werneck, M. J. da S., Silva, M. de L. da, Gandolfi, L., & Pratesi, R. (2011). Therapeutic effects of a horse riding simulator in children with cerebral palsy. *Arquivos de Neuro-Psiquiatria*, 69(5), 799–804. <https://doi.org/10.1590/s0004-282x2011000600014>
- Hemachithra, C., Meena, N., Ramanathan, R., & Felix, A. J. W. (2020). Immediate effect of horse riding simulator on adductor spasticity in children with cerebral palsy: A randomized controlled trial. *Physiotherapy Research International*, 25(1), 1–6. <https://doi.org/10.1002/pri.1809>
- Herrero, P., Asensio, Á., García, E., Marco, Á., Olivn, B., Ibarz, A., Gámez-Trullén, E. M., & Casas, R. (2010). Study of the therapeutic effects of an advanced hippotherapy simulator in children with cerebral palsy: A randomised controlled trial. *BMC Musculoskeletal Disorders*, 11. <https://doi.org/10.1186/1471-2474-11-71>
- Hsieh, Y. L., Yang, C. C., Sun, S. H., Chan, S. Y., Wang, T. H., & Luo, H. J. (2017). Effects of hippotherapy on body functions, activities and participation in children with cerebral palsy based on ICF-CY assessments. *Disability and Rehabilitation*, 39(17), 1703–1713. <https://doi.org/10.1080/09638288.2016.1207108>
- Lucena-Antón, D., Rosety-Rodríguez, I., & Moral-Munoz, J. A. (2018). Effects of a hippotherapy intervention on muscle spasticity in children with cerebral palsy: A randomized controlled trial. *Complementary Therapies in Clinical Practice*, 31, 188–192. <https://doi.org/10.1016/j.ctcp.2018.02.013>
- McGibbon, N. H., Benda, W., Duncan, B. R., & Silkwood-Sherer, D. (2009). Immediate and Long-Term Effects of Hippotherapy on Symmetry of Adductor Muscle Activity and Functional Ability in Children With Spastic Cerebral Palsy. *Archives of Physical Medicine and Rehabilitation*, 90(6), 966–974. <https://doi.org/10.1016/j.apmr.2009.01.011>
- Moreau, N. G., Bodkin, A. W., Bjornson, K., Hobbs, A., Soileau, M., & Lahasky, K. (2016). *Effectiveness of Rehabilitation Interventions to Improve Gait Speed in Children With Cerebral Palsy: Systematic Review and Meta-analysis*. <https://academic.oup.com/ptj/article/96/12/1938/2866295>
- Silkwood-Sherer, D. J., Killian, C. B., Long, T. M., & Martin, K. S. (2012). Hippotherapy-an intervention to habilitate balance deficits in children with movement disorders: A clinical trial. *Physical Therapy*, 92(5), 707–717. <https://doi.org/10.2522/ptj.20110081>
- Žaliene, L., Mockevičienė, D., Kreiviniene, B., Razbadauskas, A., Kleiva, Z., & Kirkutis, A. (2018). Short-Term and Long-Term Effects of Riding for Children with Cerebral Palsy Gross Motor Functions. *BioMed Research International*, 2018. <https://doi.org/10.1155/2018/4190249>