Effectiveness of Equine-Assisted Therapy in Enhancing Gross Motor Function and Balance in Individuals with Cerebral Palsy – A literature review

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Abstract

Background: Cerebral palsy (CP) is a non-progressive neurological disorder characterized by central motor dysfunction, impairing movement, posture, and muscle tone. It manifests as abnormal gait, muscle imbalances, and coordination deficits. Classified by limb involvement, CP affects 2-3 per 1,000 live births, with symptom variability and potential functional improvement due to neural maturation. **Aim:** This literature review aims to evaluate the current literature on equine-assisted therapy interventions for Cerebral palsy, focusing on studies published between 2015 and 2025. The review seeks to identify the effectiveness of equine-assisted therapy approaches that enhance motor function and improve balance in individuals with CP. **Methods:** A comprehensive literature search was conducted using databases such as Google Scholar, Research Gate, PubMed, and Medline. Keywords included "Cerebral palsy," "Equina-assisted therapy", "horseback riding," "balance," and "motor functions." Articles published in English and meeting the inclusion criteria were considered for review. **Selection Criteria:** Inclusion criteria encompassed peer-reviewed research articles, systematic reviews, clinical trials, observational studies, and case studies focusing on equine-assisted therapy for CP. Articles had to involve human participants diagnosed with CP across any stage or age group. Exclusion criteria included non-research articles, non-English publications, and articles published before 2015. **Results:** 7 of the 46 initially found articles met the inclusion criteria for detailed examination. These studies employed Equine-assisted therapies (EAT) to notably improve gross motor function, balance, and postural control in people with cerebral palsy. Studies show sustained GMFM and GMPM improvements, with increased muscle mass and stability. However, spasticity effects remain discrepant, and quality-of-life benefits require further research. **Conclusion:** Individuals with cerebral palsy benefit greatly from equine-assisted therapies (EAT) regarding improved balance, postural control, and gross motor function. Although improvements in motor function are well-established and lasting, the effects on spasticity are still erratic and require more research. To improve the clinical use of EAT in rehabilitation, future studies should concentrate on streamlining treatment plans and evaluating long-term functional results.

Keywords: Equine-assisted therapy, Cerebral palsy, motor functioning, balance, horseback riding.

Introduction

Cerebral palsy is a neurological disorder characterized by gross motor function, posture, and muscle tone impairments. It is defined as nonprogressive central motor dysfunction resulting from abnormalities in the developing brain[1]. Individuals with cerebral palsy often experience abnormal gait patterns due to irregular muscle tone, impaired muscle control, balance deficits in static and dynamic conditions, coordination difficulties,

muscle asymmetry between agonists and antagonists, and compromised equilibrium reflexes[2]

Additionally, muscle contractures and alignment deformities in children with cerebral palsy significantly impact functional abilities, making fundamental daily activities such as maintaining balance and walking increasingly difficult. These musculoskeletal impairments can further contribute to movement limitations and reduce overall mobility. Considering its anatomical distribution, cerebral palsy is classified based on the number of affected limbs, including hemiplegia, which affects one side of the body; diplegia, which primarily affects both legs; triplegia, involving three limbs; and quadriplegia, which affects all four limbs, leading to varying degrees of motor impairment and functional challenges[3,4]. Because the nervous system matures with age, CP symptoms can vary from a child with limited brain injury who may have trouble with just one aspect of the musculoskeletal system to a child with a wide range of symptoms who may have activities that interfere with their everyday activities and other potentially fatal comorbidities. These symptoms can improve over time[5]. Cerebral palsy (CP) is the most common cause of movement disorders in children, with a prevalence of 2 to 3 per 1,000 live births[6].

The management of people with CP is based on a framework that considers effective intervention programs to be those that promote optimum function throughout the life span [7]. Rehabilitation of balance and walking ability is of utmost importance for children diagnosed with cerebral palsy [8,9]. Balance refers to the capacity to sustain an upright position or vertical alignment while being able to perform various activities, including sitting, standing, and walking [10,11].

The inclusion of animals within the therapeutic environment has existed since the end of the seventeenth century[12]. Equine-assisted therapy is a multisensory activity in which the rhythmic and three-dimensional sway of horseback riding stimulates the patient's postural reflex mechanism[13]. Equine-assisted treatments are increasingly used to improve motor functions of children with CP[14]. Several studies have reported that HRS training improves static and dynamic balance abilities, postural control, and motor functions [15,16]. In equine-assisted therapy (EAT), the movement of the horse is utilized to improve the functional and sensory limitations of individuals with movement disorders[17,18]. The joint range of motion is increased, and muscles are strengthened during EAT. Additionally, their stability, movement coordination, muscular synergy, weight shift, and balance control are enhanced while the patient's oscillation is decreased due to their efforts to maintain posture when riding a horse. EAT also improves hip and pelvic flexibility, which increases hip and trunk stability [19]. In the Equine-Assisted Activities and Therapy (EAAT) program, the therapist directs the horse's movements to facilitate improvements in the rider's posture, balance, coordination, strength, and sensorimotor function. Simultaneously, the rider actively engages with the horse, adapting to its motion and responding to postural and sensory challenges [20].

Methodology

Study design: A comprehensive literature review was conducted from 2015 to 2025 using search engines such as Google Scholar, ResearchGate, PubMed, Medline, and others.

Search strategy: The keywords used were Cerebral palsy, Equina-assisted therapy, balance, motor functions, and gait abnormalities.

Sample size: A sample size of 46 was obtained after searching in databases using the following keywords: Cerebral palsy, equine-assisted therapy, balance, and motor functions. Based on the inclusion and exclusion criteria and year of publication, further articles were scrutinized, and seven appropriate articles were selected for this systematic review.

Inclusion Criteria

1. Relevance to Equina-assisted therapy: Articles that specifically focus on Equina-assisted techniques or approaches in the management of cerebral palsy.

2. Study Types: Includes clinical trials, observational studies, and case studies.

3. Publication Dates: Articles published within the last 11 years are included.

4. Participants: Studies involving human participants diagnosed with Cerebral palsy of any stage or age group are included.

5. Exclusively engaging in Equina-assisted therapy.

6. Languages: Articles published in English are included.

Exclusion Criteria:

1. Non-research articles or peer-reviewed articles are excluded.

2. Languages: Articles other than English are excluded.

3. Publication dates: Articles published before 2015 are excluded.

5. Articles without full-text

Selection Of Inclusion And Exclusion Criteria

Seven articles were chosen by particular inclusion and exclusion criteria. English-language articles were selected for examination to guarantee precision and minimize misinterpretation. To avoid incorrect assumptions and make sure the data evaluated was suitable for this analysis, non-English articles were eliminated. Except for those published before 2015, the chosen articles were released between 2015 and 2025. To guarantee thorough data collection, only full-text articles were included. Since the study's focus was on using equine-assisted therapy to improve motor function and balance in people with cerebral palsy, articles that lacked pertinent information on neurodegenerative disorders and their prevalence were disqualified.
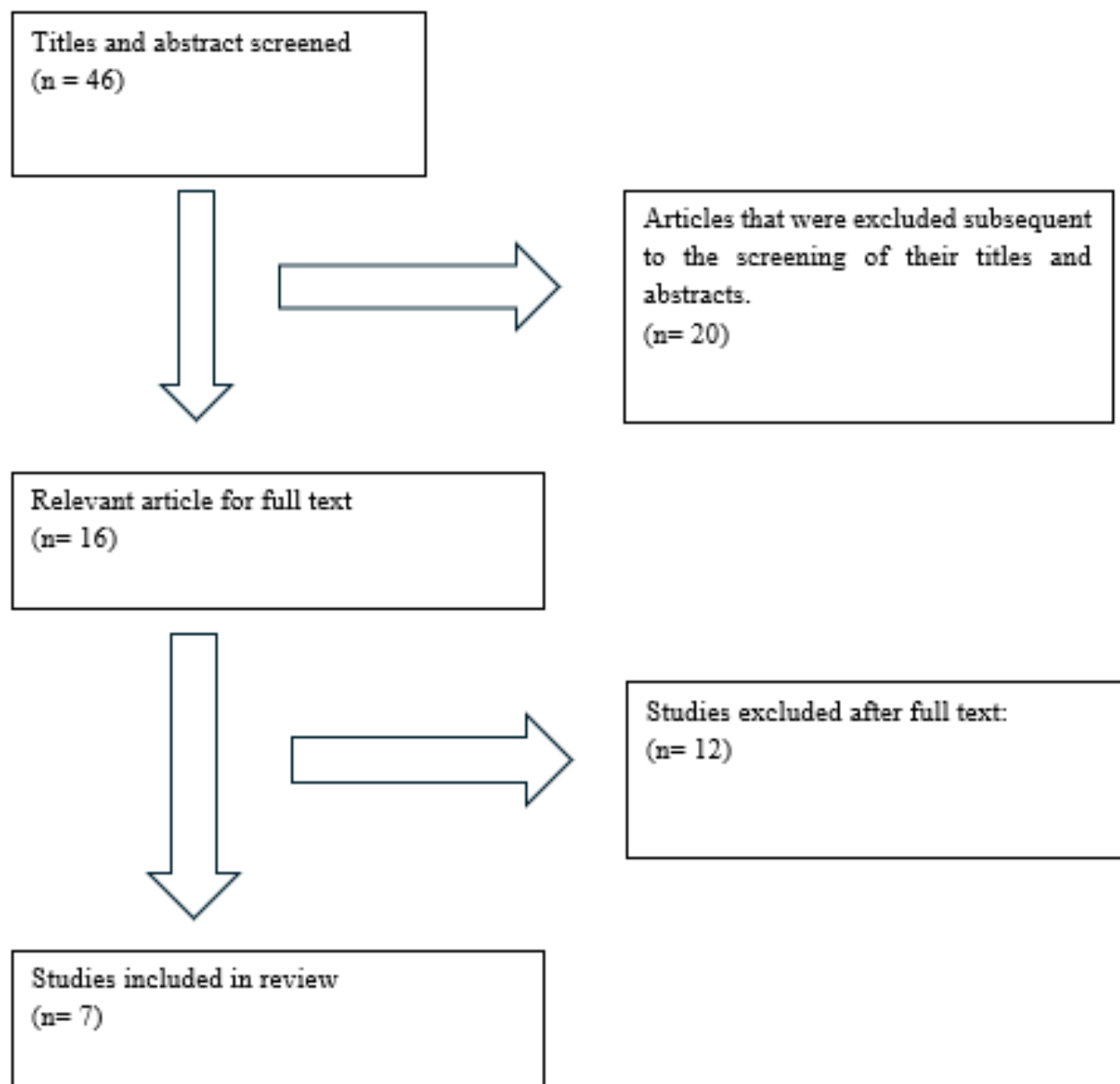
Titles and abstract screened
(n = 46)

Articles that were excluded subsequent to the screening of their titles and abstracts.
(n= 20)

Relevant article for full text
(n= 16)

Studies excluded after full text:
(n= 12)

Studies included in review
(n= 7)

Figure 1. Literature identification, screening, and inclusion process results.

RESULT:

Out of 46 articles that were initially identified, Table 1 presents the 7 articles that were retrieved based on the specified eligibility criteria outlined. Numerous articles were excluded during the selection process for various reasons, which included the failure to meet the defined requirements, non-compliance with the inclusion and exclusion criteria, and duplication in content. These exclusions were made so that the results would be distinguished. We looked at case studies, observational research, and other relevant literature to learn more about how equine-assisted therapy affects people with cerebral palsy. This information provides a theoretical foundation and recommendations for effective equine-assisted therapy in motor function and balance in the case of cerebral palsy.

Table 1. Findings of the seven articles are summarized below

Author, year	Title of study	Type of Study	No. of participants	Outcome measure	Intervention	Conclusion
Lee, S.J. et al.,2024 [20]	Impact of Equine-Assisted Activities and Therapies on Gross Motor Function in Children with Cerebral Palsy	A Prospective Case Series	9	1) Gross Motor Function 2) Balance 3)Surface electromyography 4) Muscle mass and body fat measurements 5. Statistical analyses	Equine-assisted activities and therapies program	EAAT improved **GMFM-66 and PBS scores** for most children, except Case 9. **Balance, stability, and EMG values showed no significant changes. Trunk skeletal muscle increased in Cases 5 and 8**, indicating **mixed effects.**
Stergiou. A.N. et al, 2023 [19]	The efficacy of equine-assisted therapy intervention in gross motor function, performance, and spasticity in children with Cerebral Palsy	A Prospective study	31	1. Gross Motor Function Measure-88 (GMFM-88) 2. Gross Motor Performance Measure (GMPM) 3. MAS (The Modified Ashworth Scale) 4. Gross Motor Function Classification System (GMFCS) 5. Wechsler Intelligence Scale for Children (WISC-III)	Equine-Assisted Therapy (EAT)	Equine-assisted therapy significantly improved **gross motor function (GMFM-88) and performance (GMPM) in all subcategories (p < 0.005)**, with effects lasting **two months post-intervention.** Spasticity showed improvement but was **not statistically significant.**
Chang. H.J et al.,2021 [7]	Virtual Reality-Incorporated Horse Riding Simulator to Improve Motor Function and Balance in Children with Cerebral Palsy	A Pilot study	16	1. Pediatric Balance Scale (PBS) 2. Gross Motor Function Measure (GMFM)-88 3. Gross Motor Function Measure (GMFM)-66	Horse-Riding Simulator (HRS) Training with Virtual Reality (VR) Interaction.	Children with CP showed improvements in gross motor function (GMFM-66, GMFM-88 D & E) and balance (PBS) following eight weeks of VR-incorporated HRS training. Since the intervention was successful, safe, and well-received, HRS with VR is a viable method for CP rehabilitation.
Lightsey P et al.,2021 [21]	Physical Therapy Treatments Incorporating Equine Movement: A Pilot Study Exploring Kinetic Interactions between Children with Cerebral Palsy and the Horse	A Pilot Study	4	1. Mobility Assessment -Timed Up and Go (TUG) Test -10-Meter Walk Test (10mWT) 2. Inertial Measurement Unit (IMU) Data	Hippotherapy-Based Physical Therapy	For kids with cerebral palsy, hippocampal therapy enhanced their functional mobility and synchronization of movements. They became more neuromuscularly engaged as they adjusted to the horse's movements. Hippotherapy is a potential method for enhancing gait patterns in people with cerebral palsy because of the rhythmic, reciprocal movement that improves motor learning.

Chinniah. H et al.,2020 [22]	Effects of horse riding simulator on sitting motor function in children with spastic cerebral palsy	A randomized controlled study	31	Gross Motor Function Measure (GMFM)-88	1. Horse-riding simulation (HRS) therapy. 2. Physiotherapy	The study found that both physiotherapy and **HRS therapy** improved sitting motor function in children with spastic diplegia. However, **HRS combined with physiotherapy** led to significantly greater improvements (p < .01), suggesting its added benefit in rehabilitation.
Alemdaroğlu E et al, 2016 [23]	Horseback riding therapy, in addition to conventional rehabilitation program decreases spasticity in children with cerebral palsy	A Comparative study	16	Functional and Motor Performance Measures	1. Conventional Rehabilitation 2. Horseback riding therapy	This study demonstrates the beneficial effect of horseback riding therapy on hip adductor spasticity when applied in addition to conventional rehabilitation in children with CP.
Antunes.F.N et al,2016 [24]	Different horses' paces during hippotherapy on spatio-temporal parameters of gait in children with bilateral spastic cerebral palsy: A feasibility study	A Comparative study	25	Modified Ashworth Scale (MAS) Gait Analysis – 1. Inertial measurement unit (IMU) 2. spatio-temporal gait parameters	hippotherapy protocols- 1. Walk Protocol 2. Walk-Trot Protocol	In children with bilateral spastic cerebral palsy, the walk-trot hippocampal program markedly decreased hip adductor spasticity and gait metrics. Compared to walking alone, trot intervals improved lower limb control and motor function more successfully.

Discussion

This study aims to assess the effectiveness of EAT (equina-assisted therapy) intervention in individuals with Cerebral palsy. The reviewed literature highlights the potential benefits of equine-assisted therapy (EAT) and virtual reality (VR)-integrated horse-riding simulators (HRS) in improving motor function, balance, and overall mobility in individuals with cerebral palsy (CP).

Before 2015, there was little study on using equine-assisted therapy (EAT) to help people with cerebral palsy (CP) with their motor control and balance. This was because of several reasons. Standardized treatment methods were not well established, and there was a comparatively low level of awareness regarding EAT as a therapeutic technique. Safety and ethical issues further limited research, and access to therapeutic facilities and qualified specialists was limited. Furthermore, money was mostly allocated to traditional rehabilitation techniques, and there was little multidisciplinary cooperation between horse and medical specialists.

Alemdaroğlu E et al.. (2016), in their study, found that horseback riding therapy, combined with conventional rehabilitation, positively impacts hip adductor spasticity and balance in children with cerebral palsy (CP). The

study reported significant spasticity reduction, aligning with previous research on hippotherapy's short-term effects in spinal cord injury patients. However, no significant improvements were noted in multiple sclerosis cases, suggesting diagnosis-specific variability. Balance enhancements were consistent with findings on gait and postural control. The study supports horseback riding therapy as an additional treatment for cerebral palsy, even if the sample size was limited. To confirm the long-term impacts on motor function and spasticity control, larger multi-center studies are required.

Antunes F.N et al. (2016), in their study, examined the effects of walk-only and walk-trot hippotherapy on hip adductor spasticity in children with BS-CP. The walk-trot protocol significantly improved gait parameters, postural control, and stability, likely due to increased sensory input and neuromuscular engagement. These findings support the benefits of rhythmic movement in motor function improvement. The immediate reduction in stiffness suggests hippotherapy as a potential supplement to CP rehabilitation. Additional studies are required to evaluate long-term outcomes and explore integration with other therapeutic approaches.

Chinniah H et al. (2020), in their study, assessed the impact of mechanical horseback riding simulation (HRS)

on improving seated motor function in children with spastic diplegia. The intervention included 15-minute HRS sessions, three times weekly for 12 weeks, alongside conventional physiotherapy. The Gross Motor Function Measure-88 (GMFM-88) sitting dimension was the primary outcome measure. As stated in the results, both groups significantly improved, although the experimental group made more progress. Through rhythmic, three-dimensional oscillations, HRS promotes trunk muscle activation, balance, and postural control. These findings show that HRS improves seated motor performance in children with cerebral palsy more effectively than standard therapy alone.

Chang H.J et al. (2021), in their study, examined the impact of VR-incorporated horse riding simulator (HRS) training on motor function and balance in children with CP. Results showed improvements in the Pediatric Balance Scale (PBS) and Gross Motor Function Measure (GMFM) scores, aligning with prior research on HRS and hippotherapy. VR integration enhanced postural challenges and engagement. The study was proven to be safe with no adverse effects, indicating its safety. However, the small sample size and lack of a control group limit reliability, and long-term effects remain uncertain. Future randomized controlled trials with larger samples are needed to validate VR-incorporated HRS as a standardized rehabilitation approach for CP.

This research study by Lightsey P et al.,(2021) indicates that hippotherapy (HPOT) improves functional mobility in children with cerebral palsy (CP) by improving postural control and motor skills. Improved gait efficiency is suggested by shorter completion times for the 10-Meter Walk Test (10mWT) and Timed Up and Go (TUG). The impact of HPOT in motor learning is highlighted by improved horse-rider synchronization. The multimodal input provided by equine movement improves balance, postural control, and reflexes for righting. According to research, regular weight shifts enhance gait speed and balance, which is consistent with the benefits that have been seen. However, generalizability is limited by participant heterogeneity and a small sample size. To better understand the biomechanical and neuromuscular consequences of HPOT, future research should improve sensor techniques and investigate other movement metrics.

Stergiou A.N. et al. (2023) found in their study that Equine-Assisted Therapy (EAT) significantly improved gross motor function in children with CP, as indicated by increased GMFM scores. Improvements were observed across all CP subgroups, regardless of severity. While spasticity reduction was noted, it was not statistically significant, aligning with previous short-term studies. EAT particularly benefited children with mild to moderate motor deficits (GMFCS II-III). Its clinical relevance is shown by the sustained improvements observed eight weeks after the intervention. Extended EAT participation may result in long-term gains, even though acute spasticity effects would only last a short while. To improve therapies and evaluate long-term results, more study is required.

Lee, S.J. et al. (2024) examined the long-term effects of short-term equine-assisted activities and therapies (EAAT) on motor function in children with CP. EAAT improved gross motor function and balance, reflected in higher GMFM-66 and PBS scores. Horseback riding's rhythmic movement likely enhances core strength, posture, and stability. However, a small sample size, methodological limitations, and lack of a control group weaken the conclusions. The necessity for standardized techniques was highlighted by the lack of substantial changes in balance measurements utilizing BioRescue and electromyography. In order to evaluate the effectiveness, future studies should employ wearable technology, bigger sample sizes, and randomized trials. Its therapeutic promise in CP rehabilitation is supported by studies, notwithstanding its limitations.

Conclusion

Equine-assisted therapy (EAT), hippotherapy (HPOT), and Horseback Riding Simulators (HRS) demonstrate promising benefits in improving motor function, balance, and postural control in individuals with cerebral palsy (CP). Studies show reductions in hip adductor spasticity, improved gait parameters, and enhanced gross motor function, particularly when integrated with conventional rehabilitation. The rhythmic and multidimensional motion of horseback riding stimulates neuromuscular activation, aiding in functional mobility. Additionally, VR-integrated HRS enhances postural stability and engagement. However, the necessity for more extensive, carefully monitored studies is highlighted by methodological flaws, small sample sizes, and contradictory results on spasticity reduction. To establish EAT and associated therapies as standardized CP rehabilitation techniques, future research should

improve intervention protocols, integrate sophisticated biomechanical analysis, and investigate long-term effects.

References

1. La Porta F, Caselli S, Susassi S, Cavallini P, Tennant A, Franceschini M. Is the Berg Balance Scale an internally valid and reliable measure of balance across different etiologies in neurorehabilitation? A revisited Rasch analysis study. Archives of physical medicine and rehabilitation. 2012 Jul 1;93(7):1209-16.

2. Chen CL, Shen IH, Chen CY, Wu CY, Liu WY, Chung CY. Validity, responsiveness, minimal detectable change, and minimal clinically important change of Pediatric Balance Scale in children with cerebral palsy. Research in developmental disabilities. 2013 Mar 1;34(3):916-22.

3. Huijing PA, Bénard MR, Harlaar J, Jaspers RT, Becher JG. Movement within foot and ankle joint in children with spastic cerebral palsy: a 3-dimensional ultrasound analysis of medial gastrocnemius length with correction for effects of foot deformation. BMC musculoskeletal disorders. 2013 Dec;14:1-2.

4. Stergiou AN, Varvarousis DN, Tzoufi M, Markozannes G, Plyta P, Vasileiadis G, Beris A, Ploumis A. Equine-assisted intervention in children with spastic quadriplegia: The effect on function and balance A prospective study. Archives of Hellenic Medicine/Arheia Ellenikes Iatrikes. 2024 Mar 1;41(2).

5. Paul S, Nahar A, Bhagawati M, Kunwar AJ. A review on recent advances of cerebral palsy. Oxidative medicine and cellular longevity. 2022;2022(1):2622310.

6. Cans C. Surveillance of cerebral palsy in Europe: a collaboration of cerebral palsy surveys and registers. Developmental Medicine & Child Neurology. 2000 Dec;42(12):816-24.

7. 7: Chang HJ, Jung YG, Park YS, O SH, Kim DH, Kim CW. Virtual reality-incorporated horse riding simulator to improve motor function and balance in children with cerebral palsy: a pilot study. Sensors. 2021 Sep 24;21(19):6394.

8. Jackman M, Sakzewski L, Morgan C, Boyd RN, Brennan SE, Langdon K, Toovey RA, Greaves S, Thorley M, Novak I. Interventions to improve physical function for children and young people with cerebral palsy: international clinical practice guideline. Developmental Medicine & Child Neurology. 2022 May;64(5):536-49.

9. Cho C, Hwang W, Hwang S, Chung Y. Treadmill training with virtual reality improves gait, balance, and muscle strength in children with cerebral palsy. The Tohoku journal of experimental medicine. 2016;238(3):213-8.

10. Vitrikas K, Dalton H, Breish D. Cerebral palsy: an overview. American family physician. 2020 Feb 15;101(4):213-20.

11. Pourazar M, Firoozjah MH, Ardakani MD. Improving dynamic balance by self-controlled feedback in children with cerebral palsy. Human Movement Science. 2023 Aug 1;90:103123.

12. Mandrá PP, Moretti TC, Avezum LA, Kuroishi RC. Animal assisted therapy: systematic review of literature. InCodas 2019 Jun 27 (Vol. 31, p. e20180243). Sociedade Brasileira de Fonoaudiologia.

13. Araujo TB, Silva NA, Costa JN, Pereira MM, Safons MP. Effect of equine-assisted therapy on the postural balance of the elderly. Brazilian Journal of Physical Therapy. 2011;15:414-9.

14. Heussen N, Häusler M. Equine-assisted therapies for children with cerebral palsy: A meta-analysis. Pediatrics. 2022 Jul 1;150(1):e2021055229.

15. Lee CW, Kim SG, Na SS. The effects of hippotherapy and a horse riding simulator on the balance of children with cerebral palsy. Journal of physical therapy science. 2014;26(3):423-5.

16. Herrero P, Gómez-Trullén EM, Asensio Á, García E, Casas R, Monserrat E, Pandyan A. Study of the therapeutic effects of a hippotherapy simulator in children with cerebral palsy: a stratified single-blind randomized controlled trial. Clinical rehabilitation. 2012 Dec;26(12):1105-13.

17. PATH International (2013). Available at: http://www.pathintl.org/ (Acessed January 19, 2013).

18. Sterba JA. Does horseback riding therapy or therapist-directed hippotherapy rehabilitate children with cerebral palsy?. Developmental medicine & child neurology. 2007 Jan;49(1):68-73.

19. Stergiou AN, Mattila-Rautiainen S, Varvarousis DN, Tzoufi M, Plyta P, Beris A, Ploumis A. The efficacy of Equine Assisted Therapy intervention in gross motor function, performance, and spasticity in children

with Cerebral Palsy. Frontiers in Veterinary Science. 2023 Aug 15;10:1203481.

20. Lee SJ, Lee SY, Choi JH, Seok M, Song SW, Lee HJ. Impact of Equine-Assisted Activities and Therapies on Gross Motor Function in Children with Cerebral Palsy: A Prospective Case Series. The Korean Journal of Sports Medicine. 2024 Mar 1;42(1):12-22.

21. Lightsey P, Lee Y, Krenek N, Hur P. Physical therapy treatments incorporating equine movement: a pilot study exploring interactions between children with cerebral palsy and the horse. Journal of neuroengineering and rehabilitation. 2021 Dec;18:1-1.

22. Chinniah H, Natarajan M, Ramanathan R, Ambrose JW. Effects of horse riding simulator on sitting motor function in children with spastic cerebral palsy. Physiotherapy Research International. 2020 Oct;25(4):e1870

23. Alemdaroğlu E, Yanıkoğlu İ, Öken Ö, Uçan H, Ersöz M, Köseoğlu BF, Kapıcıoğlu Mİ. Horseback riding therapy in addition to conventional rehabilitation program decreases spasticity in children with cerebral palsy: a small sample study. Complementary therapies in clinical practice. 2016 May 1;23:26-9.

24. Antunes FN, do Pinho AS, Kleiner AF, Salazar AP, Eltz GD, de Oliveira Junior AA, Cechetti F, Galli M, Pagnussat AS. Different horse's paces during hippotherapy on spatio-temporal parameters of gait in children with bilateral spastic cerebral palsy: A feasibility study. Research in developmental disabilities. 2016 Dec 1;59:65-72.