Effectiveness of Hippotherapy as A Kinesiotherapy in Improving the Quality of Life of Cerebral Palsy Patients: A Review of Literature

Aakanksha PT[a], Tamanna Chaudhary PT[b], Kritika Thakur PT[c]
[a] *MPT Neurology, Physiotherapist, Sardar Bhagwan Singh University, Dehradun (UK)*
[b] *MPT Neurology, Assistant Professor, Guru Kashi University, Bathinda.*
[c] *MPT Neurology, Assistant Professor, Baddi University, Baddi(HP)*

Abstract- BACKGROUND: Hippotherapy is a therapeutic intervention based on the practice of horsemanship activities that uses the horse as main kinesiotherapy agent. In this there is use of specific techniques of inhibition, facilitation and neuromuscular stimulation facilitating standard motors of more appropriate movements. It was used as study object for subjects with cerebral palsy and various psychological and neurological disorders. The motion of horse imposes perturbations on the rider that differ in magnitude and direction according to gait. In faster gait suspension phases are present, the rider accommodate greater vertical and horizontal accelerations of horse trunk through 3-D movements of their axial body segments. The review addresses the current state of knowledge of literatures, experiments, mechanics, effect and intervention of hippotherapy in various countries like,USA, Germany, Brazil, Sweden, Turkey, Switzerland, Austria. AIM To provide the literatures regarding hippotherapy through the articles or researches which has been published in previous 1997-2023 worldwide. METHODOLGY For this study initially 147 articles were identified through Google Scholar, Google, Pub Med, Medscape, Science Direct, Academia etc., based on key words of this study. In this study 31 articles were excluded due to their obsolete contents and 93 articles were screened, 62 articles assessed for eligibility & 57 articles are added in this study. CONCLUSION Hippotherapy is a treatment modality whose effectiveness has been confirmed in a large patient group with physical & mental disabilities, this field is aware of lack of research and funding. Lack of scientific documentation of benefits is a major obstacle to overcome.

Keywords: Equine-assisted therapy, Cerebral palsy, Hippotherapy, Kinesiotherapy

INTRODUCTION

The term "Hippotherapy" is foreign to most of the population and often evokes images of therapy hippopotami. This type of therapy received its name from the Greek language where "hippos-" means horse.[1] The movement of horse means to a treatment goal where specific riding skills are taught .Uses of horse as a main Kinesiotherapy agent as horse pelvis , just like the human pelvis displays a 3-axial movement pattern (Anterior/Posterior tilt, Lateral pelvic tilt, Rotation) while walking. There is a multidimensional swinging rhythm of the horse's walk that is transferred to the patient and moves the patient's pelvis as the legs would do during normal walking.[2] The movement of walking horse produces put to 100 rhythmic impulses/minute, this encourages patient to achieve proper balance and posture by repetitively challenging postural reactions to remain sitting on the horse.[3] It is use of specific techniques of facilitation, inhibition, objectifying to modify postural tonus, abnormal movement, neuromuscular inhibition and facilitate standard motors of more appropriate movements. According to Gold, there is no other treatment modality that can match the versatility of the horse and creative environment of hippotherapy[4].

For centuries, horses have been used to help rehabilitate people with neuromuscular disorders. It is implemented by licensed therapist. Hippotherapy is a form of physical, occupational and speech therapy in which therapist uses the characteristic movements of horse to provide careful graded motor and sensory input[1]. The motion of a horse can provide sensory stimulus & movement pattern that mimic those of natural human activities such as walking.[6,11] In recent

years, the use of animal – assisted interventions(AAI) has become a popular trend , a variety of animals may be incorporated into therapeutic activities ,including dogs, guinea pigs, dolphins, rabbits, llamas, & horses .AAI reportedly occurs in a variety of settings including hospitals, schools, libraries, offices & prisons. The benefits of AAI include allowing feelings of relaxation & companionship to occur so therapy can take place.[5,7]

Hippotherapy makes use of the movement impulses of a walking horse to facilitate movement responses in the user astride the horse, the user does nothing to actively influence the movement of horse ; on the contrary , the user is moved by the horse and responds to the horse's movement. The physiotherapist directs a trained horse handler to vary the horse's movement in terms of stride, cadence, acceleration/ deceleration and direction to facilitate motor learning specific to the user's need. Hippotherapy is different from other forms of therapeutic riding ; it is specialist physiotherapy and rehabilitative treatment , not a recreational activity. People with cerebral palsy constitute one of the main user groups of hippotherapy.[12,23] Hippotherapy is a tool which is used in therapeutic process by using horse riding , it is believed that hippotherapy improves neuromuscular coordination of riders through impulses of walking horse which is carried to central nervous system(CNS) , this situation provides patient's transmission which contributes to cure postural control and balance and decrease spasticity. There are 5 situations which hippotherapy is useful to cure patients, they are namely spinal cord injury (SCI), functional scoliosis, cerebral palsy, avoiding fall of olds, psychological inabilities.[24]

The main purpose of hippotherapy is to retrain a patient's sense of balance or trunk stabilization. The 3D movement of the horse's back is thought to constantly challenge the patient's mechanism of balance , muscle control & coordination by causing continual adjustments in the patient's centre of gravity thus improving the patient's trunk control and mobility. This produces equilibrium righting reactions in the patient that are similar to those which occur during human walking, with the exception of the trunk stabilization provided by the horse.[10,4] During hippotherapy activities are based on participant's position & movement while mounted. Goals for hippotherapy session often include improving overall function, balance & posture. Coordination & postural control are dynamic processes which can be addressed during hippotherapy session. This is significant since postural control is the ability to maintain equilibrium in the field of gravity. Postural stability is also the basis for performing increasingly more difficult motor tasks. The horse is a dynamic base of support & the repetitive movement during session provides rider with multiple opportunities to practice postural control & develop-then practice- new skills.[8,9,13] The proposed physical effect of hippotherapy on people with neuro-muscular disorders are the regulation of muscle tone , improved trunk control, improved gait, improved motor function, the stretching of contractures , improved balance and coordination and sensory integration. A considerable proportion of the literature on the hippotherapy is based on observation rather than rigorous and systematic evaluation of outcome.[14,15,23]

Review of literature

Sr No.	Author and year	Type of study	No. of patient	Outcome measure	Treatment as Hippotherapy	Follow up	Result
1.	Sanna M.R., Mika V., Heta R. et al (2023) [32]	Mixed (qualitative and quantitative)	22 CP	COPM, SF-36, R-BD1, CPAQ, NRS	Equine facilitated therapy 3/week for 20-30 min	6 months	Improvement in self esteem, balance and coordination, ADL's, pain
2.	Priscilla L., Yonghee L., Nancy K., et al (2021) [33]	Pilot study	4 CP	Timed up go, 10 min walk test	Physical therapy incorporating hippotherapy	8 sessions	Improved functional mobility & balance
3.	Maria J M R, Mar Sevilla M, Juan C S (2021) [34]	Systemic review		Oxford Scale, SCED scale, MAS	Hippotherapy		Decrease in involuntary movements, improvement in muscle tone and spasticity

Sr No.	Author and Year	Type of Study	No of Patients	Outcome measure	Treatment as Hippotherapy	Follow up	Result
4	Julio R, Silvia A C, Kamila G J et al., (2020) [35]	Cross-sectional , randomized quantitative study	30 CP	EMG	Hippotherapy introduced for 30 minutes	6 weeks	Increase in neuromuscular activation of iliocostalis, longissimus, multifidus, trapezius
5	Matisiak-Wieczorek et al., (2020) [36]	Cohort study	39 CP	GMFS-88	Hippotherapy as Pt rehab 1/week for 30 minutes	12 weeks	Improves trunk control & balance in sitting position, greater control of arms & hands
6	Lucena-Anton et al., (2018) [37]	Cohort study	44 CP	MAS, GMFS-88	Hippotherapy 1/week for 45 minutes	12 weeks	Improved short term spasticity, muscle tone &mobility improved
Sr No.	Author and Year	Type of Study	No of Patients	Outcome measure	Treatment as Hippotherapy	Follow up	Result
7	Champagne, Corriveau & Dugas(2017) [38]	Quasi-experimental	13 CP	GMFS-88, BOT2- SF	Hippotherapy for 30min/ week	10 weeks	Gross motor & fine motor functions improved in standing, walking, running, jumping
8	Lakomy G, Jozefowicz K, Langer et al., (2017) [39]	Quasi - Experimental	24 CP	EMG biofeedback, GMFS-88	Hippotherapy 2 sessions/ week	3 months	Improved sensory feedback & back geometry
9	JamiV, Lic L P, Urbano S C et al., (2016) [40]	Descriptive observational study	13 CP	MMSE scale, GMFS-88	Hippotherapy for 3/week for 30 minutes	10 weeks	Better effect on motor cognitive & social levels

Sr No.	Author and Year	Type of Study	No of Patients	Outcome Measure	Treatment as Hippotherapy	Follow up	Result
10	Venesa W, Marion D, Sabine S (2016) [41]	RCT	16CP	BBS, FSS, VAS	Hippotherapy for 1/week for 30 minutes	12 weeks	Balance, pain & fatigue improved
11	Robin L G, J. Am A C et al., (2016) [42]	Quasi-experimental	15 CP	ASQ-C, ASQ-A, VABS II	Hippotherapy for 1-3 hrs/week	5 weeks	Behaviour, sensation & self-esteem improved
12	Rodriguez, Laiseca & Lerma C (2015) [43]	Descriptive Observational study	35 CP	GMFS-88, MAS	Hippotherapy for 3 times/ week for 20 minutes	27 sessions	Effective in management of spasticity
13	Eun Sook Pet al., (2014) [44]	Quasi-experimental	34 CP	GMFS-88, PEDI-FSS	Hippotherapy for 2/week for 45 minutes	8 weeks	Gross motor function improved and maximise functional activity

Sr No.	Author and Year	Type of Study	No of Patients	Outcome Measure	Treatment as Hippotherapy	Follow Up	Result
14	Reyes Domingues (2013) [45]	Quasi-experimental	21 CP	GMFS-88	Hippotherapy for 1/ week for 30 minutes	10 weeks	Opening of ROM , Ambulation improved

15	Fourmantin(2012)	Descriptive Observational study	25 CP	BBS	Hippotherapy for 2-3/week	8 weeks	Positive result in improving balance and stability
16	Mc Gibbon et al., (2009) [46]	Cohort study	47 CP	EMG, GMFS-88	Hippothreapy for 10-30 minutes/ session . 1/ week	12 weeks	Improvement in symmetry of adductor muscle during ambulation both in short term and long term.

Table 2.1: Tools Used Throughout the Research Findings

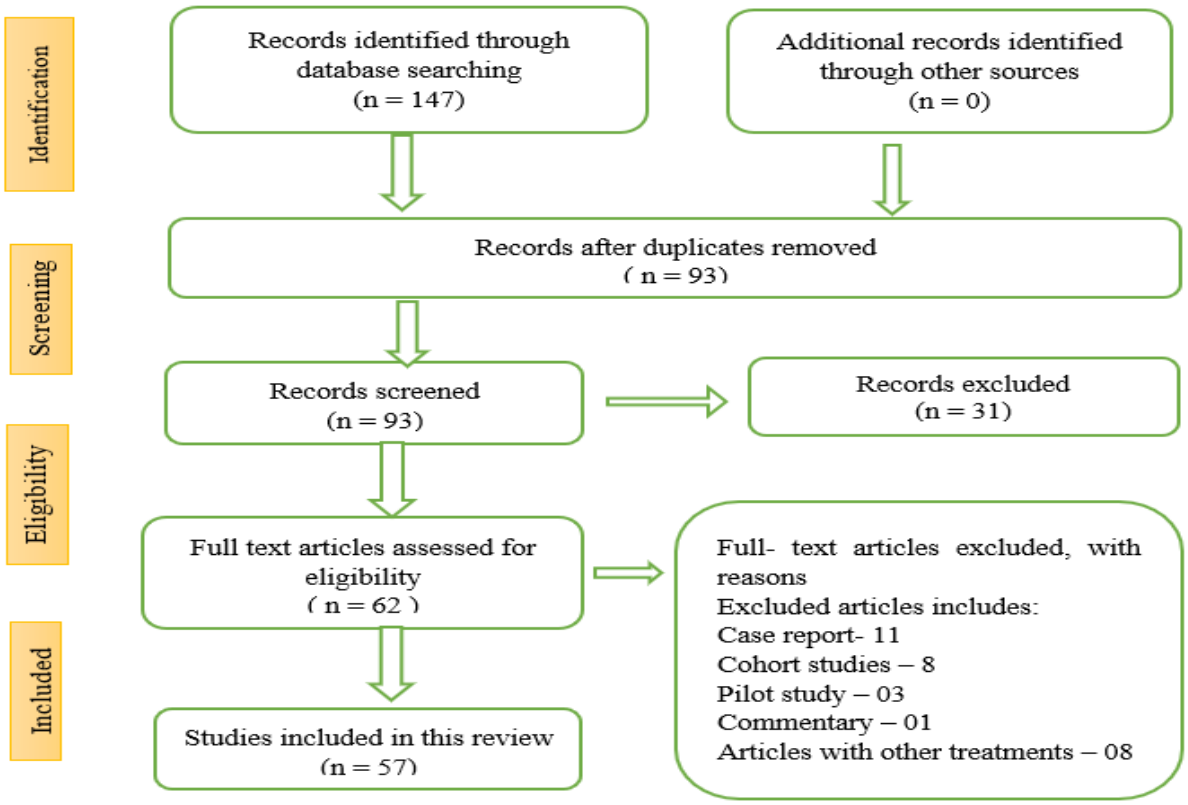
NAME OF TEST	ABBREVIATION	WHAT/HOW IT MEASURES
Paediatric Balance Scale	PBS	The PBS is a standardized 14- item scale measuring timed single-leg stance, tandem stance, alternating stool touch, & forward reach.
Gross Motor Function Measure (66,88)	GMFM-66 GMFM-88	The GMFM measures five dimensions of gross motor usage: lying - rolling, sitting, crawling - kneeling, standing, walking-running-jumping.
Internal Classification of Functioning, Disability and Health-Children ad Youth	ICF-CY	The ICF-CY measures various aspects of children's functioning from cognitive to physical. There are 55 categories measured by this scale.
EMG biofeedback device- Neuro Trac	EMG	The EMG biofeedback device uses electrodes placed on the body that measure increases and decreases in muscle tension
GAITRite Pressure Mapping System	GAITRite	The GAITRite is an 18-foot long floor mat system that measures foot function, gait, stride length, cycle time & other walking/foot functions.
Modified Ashworth Scale	MAS	The MAS is a rating scale that measures muscle resistance.
Formetric Instrument System	FIS	This system conducts a 3-D scan of a person's back & uses computer analysis to determine the geometry of that person's spine
Bruininks - Oserestsky Test of Motor Proficiency- Short Form	BOT2-SF	This assessment measures fine motor control , manual dexterity, body coordination, strength & agility.
Wireless Inertial Measurement Unit Device	IMU	This device measures spatial-temporal gait parameters wirelessly, it is worn on the person's waist & sends signals of the person's motion analysis via Bluetooth to computer .
NAME OF TEST	ABBREVIATION	WHAT/HOW IT MEASURES
Mini Mental State Examination	MMSE	It is a set of 11 questionnaire that healthcare professionals commonly use to check for cognitive impairment (problems with thinking, communication, understanding & memory). It takes about 5-10 minutes.
Fatigue Severity Scale	FSS	The 9-itemFSS is one of the most common used self-report questionnaire to measure fatigue.
Gainesville Riding Through Equine Assisted Therapy postural scale	G.R.E.A.T. postural scale	It is use to measure the quality of posture. At lateral view components: head cervical spine, shoulders thoracic spine, pelvis lumbar spine, hip angles & knee flexion heel orientation.
Berg Balance Scale	BBS	It is a widely used assessment to determine a person's balance abilities, the test contains 14 simple tasks & entire process takes about 20minutes to complete.
Canadian Occupational Performance Measure	COPM	It is designed for use by occupational therapists to assess client outcomes in the areas of self-care , productivity & leisure. It is a 5 step process which measures subject's daily functions which results in 2 main scores- Performance & Satisfaction.
Short Form-36 Total/Global/Overall Score	SF-36	It measures 8 scales: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, mental health. It is having 2 dimensions: physical & mental.
Beck's Depression Inventory	BDI	It is a 21-question multiple choice self report inventory, most widely used instrument
NAME OF TEST	ABBREVIATION	WHAT/HOW IT MEASURES
		for measuring the severity of depression
Chronic Pain Acceptance Questionnaire	CPAQ	A 20 item version scale, 7 score(0-6), to score the CPAQ add the items for activity engagement & pain willingness to obtain a score for each factor. Higher score indicate higher level of acceptance.
Ages & Stages Questionnaire	ASQ	It has 2 complementary components : ages & stages cover 5 developmental domains: communication, gross motor, fine motor, personal -social & problem solving.

METHODOLOGY

NATURE OF STUDY: This study is a review of literature entitled "EFFICACY OF HIPPOTHERAPY AS KINESIOTHERAPY IN IMPROVING QUALITY OF LIFE OF CEREBRAL PALSY PATIENTS: A REVIEW OF LITERATURE".

STUDY METHOD: For this study initially 147 articles were identified through Google Scholar, Google, Pub Med, Medscape, Science Direct, Academia etc., based on key words of this study as Hippotherapy, Cerebral Palsy, Functional Activity, Quality of Life, Equine assisted therapy, Kinesiotherapy. In this study 31 articles were excluded due to their obsolete contents and 93 articles were screened, 62 articles assessed for eligibility & 57 articles are added in this study. The reviews included in this study were taken between the period of 1997-2023 which includes various types of study design i.e. Systemic Review, Pilot Study, Randomized Control Trial, Quasi Experimental, Cohort Study, Descriptive Observational Study, Cross- sectional Study, Randomized Clinical Trail.

Flow Chart



DISCUSSION

There are literatures supporting the effectiveness of hippotherapy and it is recognized by the AOTA (American Occupational Therapy Association) as a valid form of occupational therapy. The horse works as a unique modality and intervention tool which help subjects with various physical conditions make improvement in body function & ADL's. The purpose of this research is to develop a thorough evidence based review of literature that outlines the efficacy of hippotherapy specifically related to physical conditions of cerebral palsy patients. The review will explore existing research on hippotherapy & occupational therapy's role in utilizing hippotherapy in physical rehab. The outcomes of this review research will contribute to define & differentiate the unique roles of medical professionals, occupational therapy, physical therapy & speech-language pathology practitioners play during hippotherapy

session. This will help to determine how occupational therapy is best suited to apply evidence based practice in hippotherapy to provide effective care. The therapeutic horse back riding has main goal of riding a horse & is not considered occupational therapy while the goal of hippotherapy is to support engagement in daily activities & improve occupational performance (AOTA, 2011). The articles for the review work has been collected from Google Scholar, PubMed, Scopus, ResearchGate, ScienceDirect, Directory of Open Access Journals & Google Books.

Govender, Barlow & Ballim,2016: Hippotherapy was cited in occupational therapy practice in the 1980s, but minimal attention & research have been done to the topic as time progressed. Rigby & Grandjean,2016: Hippotherapy has potential to increase its acceptance by practitioners. Naumann & Penning,2014: There is minimal existence of high-level, high quality evidence regarding the benefits of hippotherapy as a therapeutic modality. Fry,2013: It is beneficial for the growth of hippotherapy & occupational therapy as a profession to develop a more advance consensus of how the two work coherently. Selby,2009: Despite the fact there has been exponential growth of the equine -assisted therapy field, in the past decade, the quality of research is considered moderate at best.

The effect of hippotherapy was explored in more than country, because the hippotherapy practised in one country does not have same effect as practised in other country. Germany & UK had difference in hippotherapy practice and history. In Germany it has been practised by specialist physiotherapists for more than 30 years, but in Britain, hippotherapy has been practised for 10 years. In Turkey this kind of treatment is advised for patients having back & neck pain. In North America NARHA (North American Riding for the Handicapped Association) was established, hippotherapy treatment is given to handicapped individuals to reach functional results. It is widely used in USA but adjunct to traditional physical therapy in Germany. In India this method is not widely known by the physical & occupational therapists so not come under the use as in clinical interventions, there is lack of evidence based researches & literatures. According to the present scenario of India it is in the list of developing countries & not economically feasible as seen earlier that it is widely come under use in developed countries.

AHA,2017: Hippotherapy engage sensory, neuromotor & cognitive system. The horse's movement promotes active response in the service recipient which affect individual's overall function(AHA,2016). Variations in horse movement directed by qualified practitioner to achieve the desirable response such as improvement in balance, strength, gait, mobility, emotional regulation, sensory processing, speech, language, coordination, communication & in ADL's. Rigby & Grandjean,2016: They relies that a horse's smooth & rhythmic gait elicits motor response in the rider that are essential for movement patterns of human pelvis while walking. Harris et al., described 3 therapeutic gait patterns of horse during clinical implication i.e., walk, trot & canter.

Neiberg et al.,1997:Hippotherapy is used to treat patients with neurological or other disabilities like: Cerebral palsy, Autism, Arthritis, Behavioural disorders, Psychiatric disorders, Stroke, Multiple sclerosis, Spinal cord injury, Head injury, Post traumatic stress disorders[PTSD] and Poliomyelitis.

Granados & Agis,2011: While during riding a horse positioned either backward or forward on horse's back in a consistent & repetitive rhythmical movement can be utilized as a treatment tool to develop strength & balance & to normalize the muscle tone. An individual with hypertonic muscle may experience muscle relaxation as a result horse's fluidity in movement & hypertonic muscle strengthened during faster, more rapid, movement of horse. OTPF (Occupational Therapy Practice Framework): Activities involve emotional, psychological, cognitive & physical aspects of performance. Clients are able to make improvement in their physical health & overall function, which influences life role & participation in activities of daily livings (ADL's) & instrumental activities of daily (IADL's). Movement functions such as muscle tone, power, endurance, joint stability, control of movement & reflexes are components of occupational therapy that facilitated in hippotherapy treatment process. Improving attention, perception, energy, drive, temperament, experience to self. Cole& Howard,2013: The novelty of horse can incite interest & involvement for many individuals who lack motivation to participate in therapy. Granados & Agis,2011: The unique experiences of riding a horse & being in a different environment addresses the sensory functions of proprioception, vestibular, touch,

hearing & vision, horse body provides extra body warmth that can promote rider's musculature by increasing plasticity, reducing spasticity, provide stretch to the muscles, olfactory system responds to wide variety of smells integrated throughout the process of hippotherapy session. The vestibular system is stimulated by change in direction and speed of horse, hippotherapy influence auditory processing, proprioception, coordination between sides of the body, fine motor control, motor planning, ocular control, perception of movement, touch perception & visual spatial perception. Sung, Kim, Yu & Kim,2013: Hippotherapy has influence on symmetric body weight bearing during gait in stroke patients, it can improve asymmetric weight bearing in patients by influencing trunk muscles. Araujo et al.,2012: Concluded that hippotherapy provides significant improvement in balance & lower limb strength. OTPF: The outcomes in hippotherapy process include motor skill as., coordination, grip, manipulate, position, stabilize, calibrate, endure, reach, pace, walk.

Various outcome measures have been used throughout the research such as: PBS, GMFS-66,88, EMG Biofeedback, GAITRite, MAS, BBS, FIS, MMSE, GREAT Postural Scale, SF-36, BDI etc.

There should be need to work more experimentally on hippotherapy in India to provide more researches & literatures world wide, also work on the origination of specific scale for hippotherapy & determine its reliability, & by using the concept of hippotherapy make an cost effective homogenous modality. Mc Gibbon et al., showed that hippotherapy has positive effect on the health of children with cerebral palsy. It should probably be considered as a complementary rehabilitation therapy to conventional treatments. The researches present a solid baseline for whatever hippotherapy is a valid treatment option & what symptoms the therapy can treat.

CONCLUSION

Hippotherapy is a treatment modality and its effectiveness has been confirmed in a large patient group with physical & mental disabilities when applied by an experienced therapist with the aid of horse. Equine assisted therapy is being used widely in many countries world wide like in., USA, Germany, Britain, Turkey, Brazil etc. The purpose of this study was to analyse and investigate the current state of the literatures on hippotherapy in order to determine the intervention's implication for practice. The field of hippotherapy is aware of lack of research and funding & more studies on the effects that patients are experiencing. Lack of scientific documentation of benefits of hippotherapy is a major obstacle which must be overcome. Hippotherapy is used with children & adults who have emotional and behavioural disorders such as in Post Traumatic Stress Disorder (PTSD), Attention Deficit Disorders (ADHD) & mood disorders. It is used to treat neurological and other disabilities like., CP, Multiple Sclerosis, Spinal Cord Injury, Autism, Arthritis, Poliomyelitis etc., The findings in this literature review was that ere is similarity of movement of human pelvis during the human gait and the movement of the human pelvis while on the horse. A consistent finding is that there are combined physical and mental benefits.

Acknowledgement: I would like to express gratitude to my co-authors Dr.Tamanna Chaudhary and Dr.Kritika Thakur.

Disclosure Statement: The authors declared no potential conflict of interest with respect to research, authorship and publication of this article.

Funding: no funding for this research.

REFERENCE

[1] Koca T T, Ataseven H., What is Hippotherapy? The indications & effectiveness of Hippotherapy. *North Clin Istanbul*,2015,2(3);247-252.

[2] Proven D, Briel A F, Guerino M R., Combination of hippotherapy with technical bobath method in body extensor control of a patient with tetraplegia due to cerebral palsy.*J. Nov Physiother*,2012,2(3);2165-7025.

[3] Cajun – Lopez C S, Correa-Jaurejui J C,Cruz-Gonzalez C A et.al., Mechanical reproduction of the horse movement from a hippotherapy cycle.

[4] Neiberg L.,A literature review of the fundamentals of hippotherapy. *Physical Therapy Scholarly Project*,1997,466.

[5] Ybarbo E L.,The effect of hippotherapy in children & adolescents with autism: a systemic review,2017.

[6] Linton A.,Happy hips for horse & rider. *J.Horse Journal*, 2022.

[7] Bystrom A.,The movement pattern of horse & rider in different degrees of collection. *Acta*

Universitatis Agriculturae Sueciae , 2019, 32:1652-6880.

[8] Michael G Ross, Lindsay A, Farrer., Role and effect of hippotherapy in treatment of children with CP: A systemic review of literature. *Journal of clinical medicine*, 2021,10(12);2589

[9] Priscilla Lightsey, Young hee Lee., Physical therapy treatment incorporating equine movement: A pilot study exploring interactions between children with CP and the horse. *Journal of neuro engineering and rehabilitation*, 2021,18(132).

[10] Faroz ahmad, Md Abdullah, Suria akter etal., Physical effect of hippotherapy on balance and GMF of a child with CP., 2023, 13(4), 2575-9655

[11] Brain A Garner, B Rhett Rigby., Human pelvis motions when walking and when riding a therapeutic horse. *Human movement science*,39c:121-137

[12] Freda Thompson, Carolin j, Eric E hall., Hippotherapy in children with developmental delay: Physical function and psychological benefits., 2014,4(2), 45610

[13] Megan Hilgers, Haley Nielsen., The efficacy of hippotherapy for PT rehab: A systemic review. 2018

[14] Brandon Rhett, Brian A Garner., Comparing the pelvis kinematics of able- bodied children during normal gait and when riding a therapeutic horse.

[15] Benda W Mc Gibbon, N Grant., Improvement in muscle symmetry in children with CP after equine assisted therapy. The journal of alternative and complimentary medicine, 2003, 9(6),817-825

[16] Sayli U, Avci S., Multiple simultaneous approach in lower extremity spasticity surgery. *Journal of musculoskeletal research*, 2000,4(3), 221-229

[17] Liptak G., Complementary and alternative therapies for CP. *Mental retardation and developmental disabilities*,2005,11,156-163

[18] Mc Gibbon, N Andrade, Widener G et al., Effect of an equine movement therapy on gait, energy expenditure and motor function in children with spastic CP: A pilot study. *Developmental medicine and child neurology*, 1998,40, 754-762

[19] CP in children: A clinical overview.,2020, PMID: 32206590,9(1),125-135

[20] Cerebral palsy book, Jamika L, Hallman-Cooper, Franklyn Rocha, Cabrero., *Star pulse publishing , Treasure Island*, 2023

[21] Clayton, Hilary M, Hobbs., The role of biomechanical analysis of horse and rider in equitation science. *Applied animal behaviour science* ,2017, ORCI: 0000-0002-1552-8647

[22] Helen Millar., Can horseback riding help with symptoms of MS?. *Medical News Today*, 27/05/2021

[23] D Debuse, C Gibb and C Chandler., Effects of hippotherapy on people with CP from the user's perspective : A study. *Physiotherapy theory and practice* , 2009,25(3), 174-192

[24] Kemal Yilmaz, Dilek Yilmaz, Gulsen Goncagul., Hippotherapy in pain management: Situation of Turkey. *International journal of health sciences and research*, 2017, 7(4), 2249-9571

[25] Mariane Fernandes, Ribeiro, Ana Paula et al., Activation of lower limb muscles with different types of mount in hippotherapy. *Journal of bodywork and movement therapies* , 2018, 22(1), 52-56

[26] Gustavo Santos de Assis, Tatiane Schlichting, Beatriz Rodrigues et al., Physical therapy with hippotherapy compared to physical therapy alone in children with CP: Systemic review and meta analysis. *Developmental medicine and child neurology*, 2021, 64(2), 156-161.

[27] M. A. Shahiri, A. R. Arshi, A. Kazemi et al.,Kinesiological description of hippotherapy as a treatment modality. *International journal of engineering*,2020,33(11),2347-2355.

[28] Heather Brand., The physical therapeutic benefits of hippotherapy on children with physical disabilities. *Culminating projects in special education 66*, 2018.

[29] William Benda, Nancy H Mcgibbon, Kathryl L Grant., Improvement in muscle symmetry in children with CP after equine assisted therapy. *Journal of alternative and complementary medicine*, 2003,9(6), 817-25.

[30] Mariane F R, Ana Paula E, Jessica A T., Activation of lower limb muscles with different types of mount in hippotherapy. *Journal of bodywork and movement therapies*, 2018,22(1),52-56.

[31] Ji Hyn Lee, Chang-Kyo-Yun., Effect of hippotherapy on the thickness of deep abdominal muscles and activity of daily living in children with intellectual disabilities. *National library of medicine*,2017,29(4),779-782.

[32] Sanna M R, Mika V, Heta R., The impact on physical performance, pain and psychological wellbeing of chronic low back pain patients during 12-weeks of equine- facilitated therapy intervention, *Frontiers in veterinary science*,2023, 10, 1085768.

[33] Priscilla L et al., Physical therapy treatments incorporating equine movement: A pilot study exploring interactions between children with cerebral palsy and the horse, *Journal of neuro engineering rehab*, 2021.

[34] Maria J M R, Mar Sevilla M, Juan C S., Effect and role of hippotherapy in the treatment of children with cerebral palsy: A systemic review. *National library of medicine*, 2021, 10(12), 2589.

[35] Julio R, Silvia A C, Kamila G J et sl., Neuromuscular activation analysis of the trunk muscles during hippotherapy sessions. *Journal of bodywork and movement therapies*, 2020,24(3),235-241.

[36] Matisiak- Wieczorek, Elzbieta D Z, Marek S et al., The influence if hippotherapy on the body posture in a sitting position among children with CP. *International journal of environmental research and public health*, 2020,17, 6846.

[37] Lucena A, Ignacio R R, Jose A., Effects of a hippotherapy intervention on muscle spasticity in children with CP:A RCT. *Complementary therapies in clinical practice*,2018,31,188-192.

[38] Champagne, Corriveau & Dugas., Effect of hippotherapy on motor proficiency & function in children with CP who walk. *Physical & occupational therapy in paediatrics*,2017, 37(1).

[39] Lakomy G, Jozefowicz K, Langer et al., The impact of hippotherapy on the quality of trunk stabilization, evaluated by EMG biofeedback, in children with infantile CP. *Polish annals of medicine*,2017,24(1),9-12.

[40] JamiV, Lic L P, Urbano S C et al., Hippotherapy application in children with cerebral palsy, 2016,20(5), 1025-0255.

[41] Venesa W, Marion D, Sabine S., Study of effectiveness of hippotherapy on the symptoms of multiple sclerosis- outline of a randomised controlled multicentre study, 2016,3, 6-11.

[42] Robin L G, J. Am A C et al., Brief report: The effect of equine assisted activities on the social functioning in children & adolescence with autism spectrum disorder.2016,46, 3344-3352.

[43] Rodriguez, Laiseca & Lerma C., Effect of hippotherapy on muscle tone of CP patient, 2015,2(1), 64-68.

[44] Eun Sook P et al., Effect of hippotherapy on gross motor function and functional performance of children with CP. *National library of medicine*, 2014.

[45] Reyes Domingues., Opening level of the angle of movement in hip adduction muscle in children from 2-12 years of age with moderate spastic CP through equestrian therapy at children rehab. Centre of the secretory of defence,2013.

[46] Mc Gibbon et al.,Immediate and long term effects of hippotherapy on symmetry of adductor muscle activity and functional activity in children with spastic CP. *Achievers of physical medicine and rehabilitation*,2009,90(6), 9662-74.