The Effect of Hippotherapy Treatment on Children with Cerebral Palsy: a Literaure Review Study

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Abstract:

This article aims to identify the effectiveness of Hippotherapy (HT) on the affected children by Cerebral Palsy (CP). Electronic databases were used to search for experimental trials of Hippotherapy (HT) on children with cerebral palsy. The study results revealed that Hippotherapy (HT) could improve neuromuscular conditions such as, cerebral palsy through applying physical, emotional, and psychological aspects as well attention. The study has reported that there could be an impact of Hippotherapy (HT) on a physical level through head and trunk controlling, sitting balance improving , muscle strength increasing and walking balance improving. Regarding psychogical levels, it has been believed that Hippotherapy (HT) has a role in improving children's psychological level: HT could improve children's self- esteem and independence.

Keywords: Hippotherapy, horse riding, Cerebral Palsy, therapeutist, thyrap

Introduction:

Cerebral Palsy (CP) *is a term used to* describe a heterogeneous group of disorders, characterized by non-progressive motor weakness, and resulting from a defect or lesion of the developing brain which affecting balance, posture and causing movement impairments. In addition, CP causes epilepsy, hearing , visual and intellectual deficits (Moraes et al., 2020).

It has been estimated that the prevalence of Cerebral Palsy (CP) in various countries is between 2-3 per 1000 livebirth. In addition, it doesn not affect only the motor system, but also neurocognitive and sensory disorders (Kim & Lee, 2020). In general, CP has been associated with spinal defects such as, scoliosis and kyphosis (Elshafey, 2014). Furthermore, symptoms of CP are characterized by spasticity which characterized by lack of a child's ability to move joints in the standard range of motion and sensory impairments.

In addition, children may encounter speech and communication problems (Stergiou et al., 2017).

It is a well-known fact that there is no one cure for Cerebral Palsypalsy. However, there are various types of therapies which can be utilized such as, exercise therapy, orthosis, surgical intervention, Hydrotherapy and Hippotherapy. Generally speaking, the better results could come out when applied the latter interventions (Jang et al., 2016).

1-History of Hippotherapy:

The first part 'hippo' in the term Hippotherapy comes from the Greek word means 'horse'. It was first cited by Hippocrates in 377B.C. In 1670 Lord Thomas Sylenham, a British physician, believed that horse riding may restore health. In 1959, Liz Hartel achieved an Olympic victory and won a silver medal during Olypic Games. He became the first person with a disability who rode a horse in the Olympics (Casady & Nichols-Larsen, 2004).

In the 1960s, HT has become an established protocol and was used as assistant therapy to traditional physical therapy in Sweden, Germany, and Austria. Moreover, during the 1970s, HT was presented to the medical field in the United States and has become standardized by a group of therapists from Canada and America , in 1992 American Hippotherapy Association (AHA) was founded and it has defined HT as "a physical, occupational and speech therapy strategy that utilizes equine movement as part of integrating intervention program to achieve functional outcomes" (Krejčí et al., 2015). Today hippotherapy treatment is combined into physical, occupational and speech therapy treatment plans world-wide (Tinkham 2017).

In order to apply HT, some equipment must be used according to the child's needs and the therapist's experience such as, a saddle which is an equipment used as a seat to sit on a horseback. Moreover, there are surngles and pads which can ne used. HT therapists may place children in different positions over the horse, which aimaiming to simulate multiple groups of muscles. On the other hand, changing child's position may facilitate vestibular and sensory systemthe child's position and facilitate the vestibular and sensory systems.

Some studies estimated that the HT sessions vary from 15-60 minutes. However, the mean average is 30 minutes. This average depends on the child's endurance and acceptance (Martín-Valero et al., 2018). In order to use a horse as a live therapy instrument, the therapist requires a special training

as well as the horse.In US , the training program involves 3 years of training . (Koca, 2016). Theraputic riding programs are more effective if the horses used had previously assumed gymnastic training, as they conver excellent able ability at to become a high-quality therapeutic tool to the patients. However, stride length and tracking distance of the horse could be recognized as gages to enhance stride equality and improve the therapeutic experience of the patients (Martín-Valero et al., 2018)

Although the positive effects have been generally stated , this approach is not estate for many children because of high fees, changeable weather , lack of access to horses and difficulties of some children to integrate with the horse. As a result , some therapists used a dynamic saddle similar to the action of riding horse by creating a three dimension movement (T et al., 2015).

1.1. Types of Hippotherapy:

Riding therapy is divided into two categories Therapeutic horseback riding (THR) and Hippotherapy (HT) (Whalen & Case-Smith, 2012). Therapeutic horseback riding (THR) is a general term that describes a various components of entertained, rehabilitate, and therapeutic activities focused on treat disable children with neuromuscular disorders. It aims to train and teach the child to ride the horse considering his/ her impairements. However, hippotherapy consider a different form of equine-assisted physiotherapy, where certified physiotherapist used the horse as a dynamic tool in traditional physiotheraputic setting,while Horse riding simulator used as advanced indoor exercise tool.

In adition, equine-assisted therapy do not essentially need a certified physiotherapist, but it depends on the effects which migt happen reandomly on the rider by the movements of the horse or artificial horse (Häusler & Heussen, 2020; Hemachithra et al., 2020). Recent literature has showed that horse riding could lead to a progressive results in physical aspects by enhancing lower muscle control, postural balance, develops walking balance and gross motor function (Mutoh et al., 2019). Generally, horse riding must be applied only by a well-training therapist who can deal with . (Stergiou et al., 2017; Zadnikar & Kastrin, 2011) .

The current literature has supported the idea that Hippotherapy is considerd as a method of treatment which aims to facilitate neuromuscular proprioception by using horse as a therapy tool (Krejčí et al., 2015). Therefore, it has been reported that horse movement applied to enhance sensory input and induce greater postural control and motor respons. Regarding

the physical effect aspect, HT can enhance muscle coordination, balance, strength, flexibility, endurance and improving gait. In addition, it has a positive outcomes in the social, mental, and psychological aspects. Moreover, it develops neurological rehabilitation, enhances sensation aspects by developing braincortex, and improves blood circulation, gross and fine motor skills, increase balance control, improve sensory awareness and coordination (De Guindos-sanchez et al., 2020).

In addition, it is used to decrease muscle spasm. It has been demonstrated that it can have a positive effect on respiratory system, blood flow and urinary bladder, digestive system speech, and language skills. As a result, HT can treat various disorders such as, cerebral palsy, Autism, Down syndrome, multiple sclerosis, spinal cord injuries, muscular dystrophy and psychiatric diseases (Koca, 2016).

1.2. Effect of HT on the physical level:

According to (Moraes et al., 2020), postural balance is defined as the ability of keeping a desired position under dynamic and static situations and it is one of many impairments affected by Cerebral Palsy. In addition, a number of factors are associated with this defect such as, mechanical and structural variables in body position, weakness in head control, and musculoskeletal injuries which might inhibit child's visual perception.

The process of improving postural balance depends on three main systems. The first one is the visual system, second is vestibular system which responsible for procedures of data emerging from head activities. The third system is somatosensory which has receptors spread all over the body. During HT children take advantage from equilibrium reactions as they respond to horse movement. The child experience approximately 100 rhythmic impulses in the minute through horse walking. As a result, the impulses may facilitate balance and improve postural control (Casady & Nichols-Larsen, 2004).

Several literature has suggested that a horse could provide a large spectrum of sensory and motor input, the sensory stimulation go through touch and feel of wormth of the horse. Because warmth and heat of the horse transmitt to the child's body, it has a strong effect on his/her muscles and can lead to relaxiation and decrease muscle spasm In addition, touching horse hair can stimulate sensory integration and give a sense of happiness and relaxation, reflecting on the psychological improvements of the child. Therefore, HT promotes modification reorganization of the central nerves through many systems (Krejčí et al., 2015).

1.3. Mechanism of hippotherapy treatment:

DeGuindos-sanchez et al. (2020) stated that hippotherapy is based on two essential mechanisms. The first one is the transmition of horse heat and the second one is the transmission of tree-dimensional movements (forward/ backward, ,left/ right, upward/ downward) with rhythemic, impulses between the horse and child's body. The child's pelvic is stimulated in rhythmic, regular and soft forms, similar to the actions carried out during human walk. This enhances balance reactions, postural balance and trunk straightening. Hippotherapy provides movements in all movements produced from different elevation of back of the horse which originate anteversion/ retroversion, raise /decline, and lateral movemet with rotation. HT provides sensory input and encourages greater postural control and motor response.

Several studies suggested that the mechanism of horse movement is similar to the human style of walk, by creating a smooth regular and repetitive outline. The association between the regular action and the heat of horseback can decline spasticity , improve relaxation. and help training muscles and joints. All this initially leads to increase range of motion ,enhances coordination and improves head and trunk control as well as strengthens muscle fibers (Zadnikar & Kastrin, 2011).

Almost 75% of children with Cerebral Palsy have the spastic type of Cerebral Palsy which is defined as increasing muscle tone character by movement difficulties, muscle contractures and joints stiffness. this can result in decrease the range of motion. Several studies reported that horse riding has an effective role in decline spasticity level in spastic children. Moreover, it was demonstrated that horse riding could decrease the spasticity of elbow flexion and knee flexion for CP children and enhance hip joint range of motion (Baik et al., 2014).

Ability of free movement is considered as the most common difficulties children with CP might encounter. Understanding the mechanism of horse movement is seen as the key factor of successful horse training program. Such program is characterized by slow, symmetric steps of horse body movement with assistment of paraspinal muscles. In addition to alternative swing rhythm of horse steps which help in strength and stretch children's muscles on the long term (Mutoh et al., 2019b). Various recent studies have demonstrated that long course of HT may lead to gait improvements by enhancing the step length and increasing the score of Gross Motor Function Measures GMFM of children with CP (Mutoh et al., 2019b).

1.5. Effect of HT on trunk control:

According to (Matusiak-Wieczorek et al., 2020), children with Cerebral Palsy face various movements, posture, and trunk control problems. These impairements caused by the inappropriate transitional of signals between muscles and nervious system, leading to limitation in daily normal activities and independence. Hippotherapy is considered as a treatment by which, and during training on back of the horse, the child obtains impulse from the horse. This facilitates the work of his/her neuromotor, sensory and mental system. Moreover, child trunk control developes when child sitteld on horse back and attempts to obtained the suitable rider position during the walking of the horse. With every minute, the horse sends neuomerous impulses to the rider. Therefore, the child is motivated to react and maintained the position instead of falling down.

1.4. Effect of HT on social and psychological level:

Generally speaking, it has been demonstrated that HT has a positive results not just on physical aspects but also on psychological and social aspects. Some studies reported that applied Hippotherapy twice week can lead to a significant improvements in social activities and facilitate hobbies. Moreover, it can enhance children's self-confidence as well as participattion in social activities (Jang et al., 2016). Several studies valued that enthusiastic and recreation are the most significant psychological advantages of HT by allowing body to release endorphins that create happiness feelings. Moreover, the child's feelings of having the power on the horse may lead to enhance internal and external sense of control(Adamczewska, 2020; Jang et al., 2016; Stergiou et al., 2017).

1.6. Effect of HT on lower limb in spastic CP:

The effect of spasticity inhibits and limits motor function development and is considered as a major cause of histological changes. That leads to irregular muscle tone, decrease range of motion, increase joint contractures and extremity deformities. Moreover lower extremities is affected by spasticity which caused cissoring gait resulting in spastic hip dysplasia, hip subluxiation and hip dislocation, when the hip abductors less than 35 and flexion contracture more than 20 this position increase hip instability (Hemachithra et al., 2020) **.**

Children with CP excessively used extensor muscles to preserve their sitting position, which made musels moved in abnormal positions and resulting from used antagonist muscles. In order to correct this wrong movement, HT provides a position of maintaining 90 hip joints and 90 knee joints to decrease muscle tone and spasticity in children (Baik et al., 2014).

1.5. Effect on attention and memory:

It's a well-known fact that spasticity is caused by a neuromuscular disorder. Such as CP has a role in inhibiting mental function, mainly memorial impairments and attention difficulties. Indeed the development of the musculoskeletal system has an essential role in the development of equilibrium control and individual free movements which result in improving mental and psychological aspects of children with CP (Krejčí et al., 2015)

A Study conducted by Krejici, et .al., (Krejčí et al., 2015) aimed to determine the effect of HT on memory and attention skill . Twenty participants were received horse riding therap. They divided into two groups , A short term group (n =11) who received a daily of 30 minutes long of HT session to one week rehabilitation camp, in addition to horse riding ,this group received sensorimotor training treatment such as Bobath,and Vojta

The second group was a long term group (n =9). The participants received 30 minutes horse riding sessions for 5-6 weeks. The outcomes measured using numeric square test to determine memorial functions, and verbal learning test for attention skills. The study results showed significant improvements in both groups, especially in the group that received long term of HT. The participants showed significant benefits in both memorial and attentions skills. However, differences between the two groups were not statistically significant.

Methodology

Specific key words related on the benefits of HT to treat Cerebral Palsy on electrical data base including, PubMed, Science Direct and Google Scholar (from 2000-2020). Research was undertaken for the following keywords and phrases: *Hippotherapy, horse riding, Cerebral Palsy, horseback riding, therapeutic horse riding* . Studies that did not emphasize on the role of HT were excluded because the purpose of this study was to evaluate the effect of HT as a treatment on CP patients. This study did not review the articles which were not published in English. Scientific Journal articles which did not focus on HT, horse riding benefits were also excluded.

The mention of types of HT and Cerebral Palsy types in the article were inclusion criteria. The study must have used Hippotherapy or horseback riding as an interventions therapy for children with CP and should have

possible explaination of the mechanism and approach in relation to positive effects.

RESULTS:

The study selection flow diagram is shown in figure 1. the researcher identifies 100 potentially relevant studies. Thirteen articles fulfilled all inclusion and exclusion criteria. All identified articles were published between 2000 and 2021in peer reviewed journals. The other 90 articles were not included because they were not available in English, gross motor outcomes did not being studied and the reserach did not have control and intervention groups table 1 shows the studies included in this review.

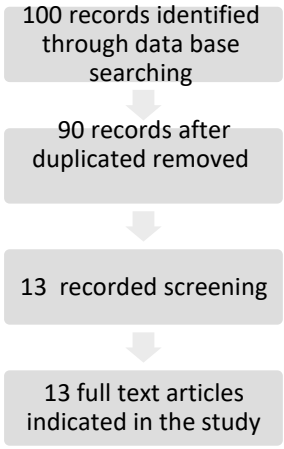

Fig. 1 Preferred Reporting Items for review study

Table 1 studies including in the review

Author	Year	Intervntion
Häusler & Heussen,	**2020**	**Hippotherapy**
Wieczorek et al.,	**2020**	**Hippotherapy**
De Guindos-sanchez et al.,	**2020**	**Hippotherapy**
Casady	**2004**	**Hippotherapy**

Tseng et al	**2013**	**Hippotherapy**
Martin-Valero et al	**2018**	**Hippotherapy**
Ribeiro et al	**2019**	**Hippotherapy**
Matusiak- Wiecozorek	**2020**	**Hippotherapy**
Kreja et al	**2015**	**Hippotherapy**
Mutoh et al	**2019**	**Hippotherapy**
Koca	**2016**	**Hippotherapy**
Park et al	**2014**	**Hippotherapy**
Moraes et al	**2020**	**Hippotherapy**

Discussion:

As HT means treatment with the assistance of horse involves several techniques, including therapeutic riding, static and dynamic horse riding simulator, each technique is utilized for diverse purpose and provides a positive effect. However, horses from several breeds may use in HT. In addition, horses were chosen according to specific terms such as, flexibility, pace, straightness and equilibrium. The main factor of selecting HT horse is being symmetrical when attempting gait activities and wave with rhythm (Casady & Nichols-Larsen, 2004; De Guindos-sanchez et al., 2020) Ten studies which evaluated the effect of HT on children with CP (figure 2) demonstrated that the kind of treatment provides physical and psychological outcomes ,whilst three studies found insufficient evidence to support the statement that long duration of HT provides significant benefits to children with CP (Tseng et al., 2013).

The current literature estimated the positive influence of horse riding on improving gross motor functional measure (GMFM), especially in sitting level, by applying HT to children with spastic CP can show progress with reactive sitting control. Moreover, alternative techniques as horse riding simulator (static and dynamic) has a similar role in improvement of sitting control by stretching lower extremities muscles, mainly adductor muscles group, which is characterized by short, tight tendon. When stretching

these muscles for a proximal 30 minutes on horseback, lead to spasticity is decreased and eventually the range of motion is increased (Tseng et al., 2013).

Whalen ,Smith &Valero (Martín-Valero et al., 2018; Whalen & Case-Smith, 2012) further noted that children who participated in actions as a type of therapeutic exercise and managed by qualified riding therapists showed progress on several aspects including sitting ,balance, walking , gross motor function and coordination.

Moreover, HT has a main role in motivate postural reflexes, including dissociation of scapular and pelvic girdles with continuous modifications of muscle tone. The reviewed iterature has showed adequate outcomes of utilizing HT as a therapy for neuromuscular disorder, specially in gross and sensory defects and improving gait jumping and running (Ribeiro et al., 2019).

Sterba et al (Sterba et al., 2002) found that HT has significant improvements in gross motor function in children with mild to severe CP. By using GMFM section E of this instrument therapeutic changes were measured. Activities of walking running and jumping improved by 1.8% ($P < 0.03$) after six weeks of horseback riding.

Krejci et al(Krejčí et al., 2015) measured the effect of short term and long term of HT on memory and attention skills. Numeric square test and verbal learning test were used to assessed the outcomes. Attention was significantly improved in both groups by ($P< 0.01$) the enhancement demonstrated in reduction the average time in numerbric results . In addition, square test was used to assess memorial skills which improved significantly by ($P<0.05$) .

Mutoh & et al (Mutoh et al., 2019b) examined the impact of long term HT on gross motor skills, walking ability and quality of life of children's caregiver. The reserachers conducted a controlled study for 30 participants. All of the children were diagnosised with CP, and selected randomized. The program wasorganized in an open door environment. Children spent at least 30 minutes once a week over 1 year followed with 3 months follow up activities. The horse and children were chosen depending on the size and motor skills of the children. The program aimed to achieve muscle relaxation, especially pelvic and lower extremities and enhance independence sitting by active movements, the outcomes measured using

Gross Motor Function Measure (GMFM) and Quality of Life (QOL). Overall the results, according to GMFM, showed that children developed head and trunk control, significant increase of walking speed, step length and mean acceleration. Meanwhile, QOL showed significant improvements characterized by (positive feelings & self-esteem) in HT group**.** Indeed, the improvements on walking ability reflected on enhancement in psychological levels.

According to Temcharoensuk (T et al., 2015) HT has a high positive effect on developing sitting balance in children with C.P. Moreover, this study showed that dynamic horse riding simulator, as a technique, could lead to similar improvements as horseback riding, especially in cases HT is difficult to applied.

However, another study conducted by Park et al (Park et al., 2014) investigated the effect of HT on gross motor function and functional performance on 34 of CP children who received forty five minutes of HT twice a week for 8 weeks. Results showed no significant differences between control and intervention group in mean standard total scores of GMFM-66, GMFM- 88 . After the 8-weeks intervention, mean GMFM-66 and GMFM-88 scores were significantly developed in both groups which supported the other literature on the positive role of HT on gross motor function.

Contraindications, side effct and percution for applied HT:

Studies estimated that anxiety can be transmitted from children to their horses. Therefore, it is vital to recognize the physical and psychological stress of humans that may impact the horse. However, horseback riding has been identified as a high risk activity which could cause series injuries, such as chest, head and spinal cord injuries. It is significant to provide and use prober protective equibments and follow therapeutic therapist's instructions for safe HT treatment session.(Adamczewska, 2020)

Other barriers made HT difficult to applied for CP children including: lack of availability due to high costs for that type of treatment. Some medical insurance company did not cover the costs and the need for a well training therapist who qualified in that approach. Finally HT is not suitable for all CP cases. Children with poor sitting postures, and those have walking difficulties, uncontrolled seizures, vision defect as well as sever retardation can not be treated by this approach (Kang, 2017).

Conclusion:

This review supports the findings that HT may have significant benefits not just on physical level but also on both psychological and emotional level of children with CP. Although the study has shown a significant amount of literature which were supportive the physical effect of HT, only littele evidence supported its relation to psychological impact.

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