RESEARCH ARTICLE

EFFECTS OF NON MECHANICAL HORSE BACK RIDING ON BALANCE IN SPASTIC CEREBRAL PALSY CHILDREN: A RANDOMIZED CLINICAL TRAIL

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ABSTRACT

Objective: To compare the effectiveness of non-mechanical horseback riding with conventional Physical therapy on dynamic balance within spastic CP children. **Material and Method:** A single blinded randomized clinical trial conducted at THQ hospital Gujar Khan Pakistan. The n=30 spastic hemiplegic CP children with Gross Motor Function Classification scale (GMFCS) level-IV, a score of II on Modified Ashworth Scale (MAS) were included through non-probability convenience sampling technique. The participants were randomly allocated into conventional physical therapy (CPT) group and non-mechanical horseback back riding (NMHBR) group through lottery method. The data was collected at baseline and post 06 months through the General demographic questionnaire, MAS, GMFCS and Pediatric Balance Scale (PBS). For between-group comparison independent samples t-test was used while for within-group analysis paired sample t-test was used. **Results:** The mean age and BMI was 8.36±2.15, 14.5±0.75 respectively. When Comparing both groups, no significant difference was observed in Spasticity *(p=0.130)* and functional independence (*p=0.216*). But NMHBR group showed significant improvement in overall pediatric balance score as compare to CPT group (17±10.24 vs. 26.33±1429, *p=0.049*), after 6 months of intervention. The PBS's task including standing unsupported (*p=0.027*), Standing with eyes closed (*p=0.039*), standing with feet together (*p*=0.021), Standing with one foot in front (*p=0.016*), Standing on one foot (*p=0.039*) and Reaching forward with outstretched arm (*p=0.012*) significantly improved in NMHBR groups as compare to CPT. **Conclusion:** It was concluded that conventional physical therapy and non-mechanical horseback riding both can improve spasticity, functional independence and balance of spastic CP children but NMHBR is more effective than CPT.

Keywords: balance, hippo-therapy, physical therapy.

INTRODUCTION

Cerebral palsy is non-progressive disorder manifested by impairment in movement and posture due to damage of the motor cortex.[1] It is most common neurodevelopmental motor disability as it is prevalent in every 2 to 3 out of 1000 children.[2] The incidence of CP is 2.5/1000 live births.[1] In US, every 1 out of 278 child is diagnosed with CP each year. However, a study in Faisalabad reported 160 cases with the abnormalities in movement, tone, and posture and out of which 75% cases were diagnosed with CP.[2]

It was considered as CP occurs due the result of perinatal asphyxia, but in some recent studies it has been concluded that there are number of factors which cause CP. Injury to the brain could be prenatal, natal, and postnatal.[3] The CP can be classified as spastic, dyskinesia, ataxic, and mixed.[2]

Spastic CP is characterized by jerky movements, muscle tightness and joint stiffness.[4] Growth and effects of gravity increase the movement difficulties in children, which leads to the secondary effects of compensating bones and muscular abnormalities.[5] The most important problem in children with CP is defective control on posture. However, postural maintenance is necessary for daily living activities.[5, 6]

Management of CP includes medications, surgery and rehabilitation. The medications relieve spasticity while surgery may include tenotomy, selective dorsal rhizotomy etc. on the other hand, physical therapy includes different types of exercises like stretching, strengthening, postural stability, balance training, Bobath, PNF techniques.[7] Organization of posture is controlled at two functional levels: direction-specific adjustment & fine-tuning of direction-specific activities. There exist many approaches to improve control of posture and balance.[5, 8, 9] In previous studies it has been concluded that treatments such as Swiss ball training, and hippotherapy is more effective as compared to conventional physical therapy. However, rehabilitation is an important aspect for the management of CP children.[10]

Furthermore, hippotherapy therapy approach, in which movement of horse, is used for patients' benefit.[11] It improves neuromotor and sensory processes and affects many systems of body. The constant rhythmical 3-dimensional (3-D) movement of the horse not only facilitates automatic postural responses and stimulate trunk muscles, joint stability, weight shift but also increases sensory input to the Vestibular, Proprioceptive, Tactile, Cognitive and Motor systems.[12] Therapeutic horseback riding leads to improved coordination, increased head and trunk control and improved gait.[13, 14]

Moreover, hippotherapy helps to improve balance and coordination, muscle tone and strength and range of motion.[15-17] In present study the non-mechanical horseback riding is cost effective, friendly user, cannot be affected by weather and

occupies less space and children enjoy with toy horse. Present study was done to compare the effectiveness of non-mechanical horseback riding versus conventional therapy (NMHBR) on dynamic balance and conventional physical therapy in spastic hemiplegic CP children.

METHODOLOGY

A single-blinded, randomized clinical trial was conducted at Makkah Medical Center Saudi Arabia, from June 2018—May 2019, after taking an approval from competent authority of Tehsil Headquarter Hospital (THQ), Gujar Khan Pakistan. The study was initiated after taking an informed consent from parents, and considering the ethical considerations according to declaration of Helsinki.

The children with spastic hemiplegic CP, age range of 5-12 years, who had GMFCS - level IV, a score of 2 on Modified Ashworth Scale and move the affected parts easily, and who had an active hand grip of affected hand were included in the study. However, the children with any acute infection, fever and cognitive impairments were excluded.

The sample was recruited through non-probability convenience sampling technique. The n=30 participants who fulfilled the eligibility criteria were randomly divided into non-mechanical horseback back riding (NMHBR) and conventional physical therapy groups through lottery method and participants were kept blind to the allocated treatment. (Figure 1)

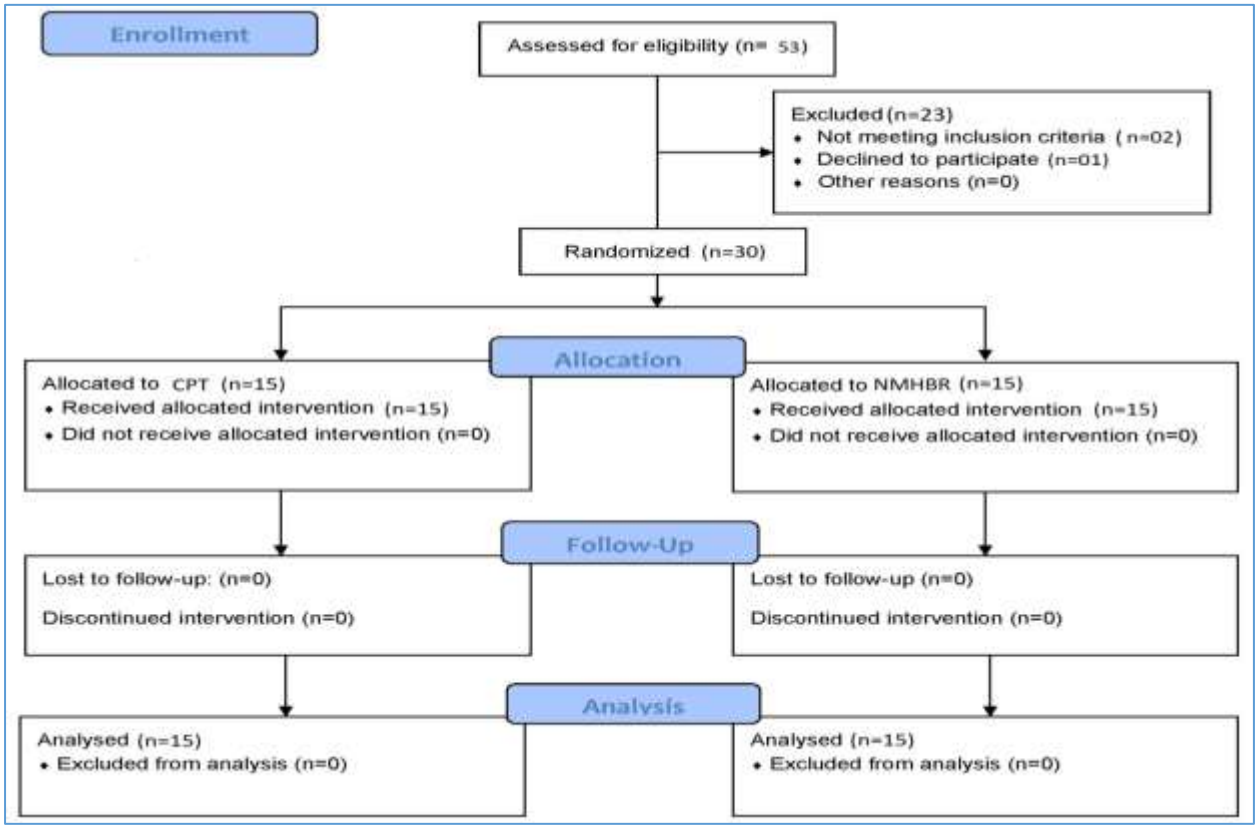

Figure 1: CONSORT Diagram

Figure 2: Custom made wooden horse

In conventional physical therapy group, all participants were treated with the stretching of the tight muscle, positioning, abdominal co activation, rolling and balance training exercises. While in NMHBR group, exercises performed in CPT group, and with the addition of a custom made wooden horse for balance training. The horse was fixed on the floor with spring as shown in Figure 2.

Table 1: Treatment protocol for CPT and NMHBR groups

	CPT (n=15)	NMHR (n=15)
Type of exercises	Stretching of the tight muscle, positioning, abdominal co activation, rolling and balance training etc.	Stretching of the tight muscle, positioning, abdominal co activation; rolling, balance training and non-mechanical horseback riding.
Frequency of sessions	3 times a week up to 6 months	3 times a week up to 6 months and 3 times a week up to 6 months for non-mechanical horseback riding
Duration of session	30 to 40 mint session for CPT	30 to 40 mint session for CPT and 30 mints for NMHR
No. of repetitions	10 to 20 rep within 30 sec	10 to20 rep within 30 sec and one sitting for 30 mint

The data was collected at baseline and post 06 months after intervention. General demographic data was collected including age, gender, height, weight, BMI (Appendix 1). Pediatric Balance Scale (PBS), which has constructed validity and reliability, was used for the assessment of dynamic balance which consists of 14 items scoring from 0 point (lowest level of function) to 4 points (highest level function) with a maximum score of 56 points.[18] The independent sample t-test was used for between-group comparison while for within-group analysis paired sample t-test was used by using SPSS version 21. The level of significance was set at a $p<0.05$.

RESULTS

The mean age of study participants was 8.35±2.27 years and BMI was 14.8±0.84 kg/m^2. A total of n=14 males and n=16 females participated in the study. Of which n=5 males and n=10 females were in CPT group while n=9 males and n=6 females were in NMHBR group.

Within group analysis showed that spasticity was significantly improved in both groups (CPT=1.86±0.22 vs. 1.40±0.20, *p<0.001* & NMHBR=1.80±0.25 vs. 1.26±0.25, *p<0.001*). But functional independence (GMFCS) was significantly improved only in NMHBR group (3.53±0.51 vs. 3.26±0.88, *p=0.041).* The overall balance score was significantly improved in both groups (CPT=11.60±8.54 vs. 17.±10.24, *p<0.001* & NMHBR=16.53±8.5 vs. 26.33±14.29, *p<0.001*) after six months of interventions. In CPT group most of the tasks of PBS were not significant improved (*p>0.05*) including sitting unsupported, standing with eyes closed, standing with feet together, standing with one foot in front, standing on one foot, turning 360 degrees, turning to look behind, retrieving object from floor and placing alternate foot on stool. While in NMHBR group all tasks were improved significantly (*p<0.05*) except turning 360 degrees (*p=0.055*) and placing alternate foot on stool (*p=0.164*). (Table 2)

While comparing the both group, no significant difference was observed in Spasticity *(p=0.130)* and functional independence (*p=0.216*). But NMHBR group showed significant improvement in overall pediatric balance score as compare to CPT group (17±10.24 vs. 26.33±1429, *p=0.049*), after 6 month intervention. The PBS's task including standing unsupported (*p*=0.027), Standing with eyes closed (*p=0.039*), standing with feet together (*p=0.021*), Standing with one foot in front (*p=0.016*), Standing on one foot (*p=0.039*) and Reaching forward with outstretched arm (*p=0.012*) were significantly improved in NMHBR groups as compare to CPT. (Table 3)

Table 2: Pre-post analysis in CPT & NMHBR (Spasticity, GMFCS & PBS)

		CPT (n=15)				NMHBR (n=15)			
		Mean	SD	MD	p-value	Mean	SD	MD	p-value
Spasticity	Pre	1.86	0.22	0.46	0.000***	1.80	.25	0.53	0.00***
	Post	1.40	0.20			1.26	.25		
Functional Independence (GMFCS)	Pre	3.73	0.45	0.13	0.164	3.53	.51	0.26	0.041**
	Post	3.60	0.50			3.26	.88		
sitting to standing	Pre	2.66	0.89	-1.0	0.000***	3.46	.74	-0.40	0.028**
	Post	3.66	0.48			3.86	.51		
of standing to sitting	Pre	2.60	0.91	-1.00	0.000***	3.33	.72	-0.46	0.014**
	Post	3.60	0.63			3.80	.56		
Transfers	Pre	1.80	1.26	-0.93	0.000**	2.73	.96	-0.66	0.001***
	Post	2.73	1.09			3.40	.82		
standing unsupported	Pre	0.80	1.14	-0.40	0.009**	1.40	1.12	-1.06	0.000***
	Post	1.20	1.56			2.46	1.4		
sitting unsupported	Pre	0.93	1.62	-0.06	0.334	1.06	1.62	-0.80	0.047**
	Post	1.00	1.73			1.86	2.06		
standing with eyes closed	Pre	.00	0.00	-	-	0.13	.51	-0.33	0.019**
	Post	0.000	0.00			0.46	.83		
standing with feet together	Pre	0.066	0.25	-	-	0.20	.56	-1.00	0.026**
	Post	0.06	0.25			1.20	1.78		
standing with one foot in front	Pre	0.00	0.00	-	-	0.00	.00	-1.00	0.023**
	Post	0.00	0.00			1.00	1.51		
standing on one foot	Pre	0.00	0.00	-	-	0.00	.00	-0.46	0.048**
	Post	0.00	0.00			0.46	.83		
turning 360 degrees	Pre	0.26	0.45	-0.40	0.164	0.60	.98	-0.66	0.055
	Post	0.66	1.39			1.26	1.53		
turning to look behind	Pre	0.26	0.45	-0.40	0.164	0.60	.91	-0.73	0.036**
	Post	0.66	1.39			1.33	1.54		
retrieving object from floor	Pre	0.60	1.12	-0.20	0.082	0.80	1.26	-1.00	0.013**
	Post	0.80	1.52			1.80	1.89		
placing alternate foot on stool	Pre	0.00	0.00	-	-	0.00	.00	-0.13	0.164
	Post	0.00	0.00			0.13	.35		
reaching forward with outstretched arm	Pre	1.60	1.24	-0.60	0.007**	2.20	1.01	-1.06	0.000***
	Post	2.20	1.26			3.26	.88		
Total PBS	Pre	11.60±8.54		-5.40	0.000***	16.53±8.5		-9.80	0.001***
	Post	17.±10.24				26.33±14.29			

*Level of significance= p<0.05** & p<0.001****

Table 3: Comparison of CPT & NMHBR (Spasticity, GMFCS & PBS)

	CPT		NMHBR		MD	p-value
	Mean	SD	Mean	SD		
Spasticity	1.40	0.20	1.26	0.25	.013	0.130
Functional independence (GMFCS)	3.60	0.50	3.26	0.88	0.33	0.216
Sitting to standing	3.66	0.48	3.86	0.51	-0.20	0.285
Standing to sitting	3.60	0.63	3.80	0.56	-0.20	0.367
Transfers	2.73	1.09	3.40	0.82	-0.66	0.071
Standing unsupported	1.20	1.56	2.46	1.4	-1.26	0.027**
Sitting unsupported	1.00	1.73	1.86	2.06	-0.86	0.223
Standing with eyes closed	0.000	0.00	0.46	0.83	-0.46	0.039**
Standing with feet together	0.06	0.25	1.20	1.78	-1.13	0.021**
Standing with one foot in front	0.00	0.00	1.00	1.51	-1.0	0.016**
Standing on one foot	0.00	0.00	0.46	0.83	-0.46	0.039**
Turning 360 degrees	0.66	1.39	1.26	1.53	-0.60	0.272
Turning to look behind	0.66	1.39	1.33	1.54	-0.66	0.225
Retrieving object from floor	0.80	1.52	1.80	1.89	-1.00	0.122
Placing alternate foot on stool	0.00	0.00	0.13	0.35	-0.13	0.153
Reaching forward with outstretched arm	2.20	1.26	3.26	0.88	-1.06	0.012**
Total PBS	17.00	10.24	26.33	14.29	-9.33	0.049**

*Level of significance= p<0.05** & p<0.001****

DISCUSSION

The primary objective of the study was to compare the effectiveness of non-mechanical horseback riding with conventional physical therapy on spasticity, functional independence, and dynamic balance within spastic CP children.

In this study, it has been seen that the spasticity is significantly improved on MAS in both groups which is in the support of previous finding that hippotherapy can significantly reduce the muscle tone in spastic hemiplegic CP children.[19] And physical therapy such as continuous stretching exercises helps in reducing spasticity by addressing the muscle shortening.[20]

Furthermore, functional independence on GMFCS was also significantly improved which is in the coherence of the previous study that, hippotherapy is an effective approach for the improvement in functional independence in spastic hemiplegic CP children. The shape of the horse, and the 3-D and rhythmic movement also influence the mobility, gross motor function, and functional activities of the CP children.[21]

Between groups comparison showed significant improvement in the total score of PBS after 6 months of intervention in both NMHBR and CPT group, while within group comparison showed significant improvement in the NMHBR group. Benda et al. did a pre posttest study and concluded that hippotherapy improved symmetry of muscle activity rather than passive stretching supporting the results of present study. [22] It has also considered that 3-D and rhythmic movement of horse also improve balance and posture in CP children.[21]

Additionally, between groups comparison showed significant improvement in sitting to standing, standing to sitting, transfers, standing unsupported and reaching forward with outstretched arms in CPT group. While all items including sit to stand, stand to sit, transfers, standing unsupported, sitting unsupported, standing with eyes closed, standing with feet together, standing with one foot in front, one foot standing, turning to look at back, picking any object from floor, and forward reaching with outstretched arm showed significant improvement in NMHBR group. In some previous literature it has been discussed that the maintenance of balance depends on muscle activity and posture control. Horse movement provides a precise, smooth, rhythmic, and repetitive pattern of movement.[16, 22] Hence, such repeated adjustments improves the strength of pelvic, abdominal and lumbar area and maintain balance and upright posture. Different studies have been done to assess effectiveness of horseback riding.

In present study when both groups were compared, significant improvement was observed for standing unsupported, standing with eyes closed, standing with feet together, standing with foot in front, standing on one foot, and placing alternate foot on stool in NMHBR group. In a previous study the effectiveness of hippotherapy on balance was observed in CP children and PBS showed major improvements in balance.[23] Furthermore, in another study, children having mild to moderate balance problem were treated with hippotherapy for 45-minute two times in a week till 6 weeks. The results supported that hippotherapy can improve balance and performance of daily activities for children with mild to moderate balance problems.[24]

Moreover, Shurtleff et al. determined that hippotherapy improves stability of head/trunk and reaching activities of upper extremity (UE) in spastic diplegia cerebral palsy (SDCP) children. A human performance laboratory with six camera video motion capture systems was used and showed significant improvements in stability of head/trunk, improved reaching/targeting and reach/path ratio with hippotherapy.[14] However, the result of current study showed the hippotherapy improved reaching activities of UE in hemiplegic CP children. Furthermore, study done by Bertoti, showed significant improvement in posture and functional skills due to improved muscle tone and balance in CP children who were treated with therapeutic horseback riding program.[16]

CONCLUSION

It was concluded that conventional physical therapy and non-mechanical horseback riding both can improve balance, spasticity and functional independence of spastic hemiplegic CP children but NMHBR is more effective than CPT. It is recommended to conduct multi centered study

with larger sample size as well as with different types of topographical and physiological CP.

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