

# The Effects of Hippotherapy on the Gross Motor Function Abilities of Children with Cerebral Palsy using Clinical Outcome Measures and Parent/Guardian Reported Outcomes

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## Introduction

- **Cerebral palsy (CP)** is defined as a group of disorders that affect the development of movement and posture due to injury or abnormal development in the fetal or infant brain.<sup>1,2,3</sup>
- Children with CP experience both primary impairments (those apparent at the time of diagnosis) and secondary impairments (those occurring over time). Common primary impairments include abnormalities in muscle tone, postural stability, motor function, and coordination. Common secondary impairments include decreased range of motion, force production, and endurance.<sup>3</sup>
- According to two recent studies, participation and health related **quality of life** is lower in children with CP than compared to children without disabilities.<sup>4,5</sup>
- **Identifying effective rehabilitation services for children with CP associated with positive clinical and patient-reported outcomes is a national priority.**<sup>1</sup>
- **Hippotherapy** is part of a program integrated with other therapies that uses the unique movement of a horse to assist in achieving specific functional goals.<sup>1</sup>
- The warmth and rhythmical movements of a horse have been theorized to help improve circulation, reduce abnormally high muscle tone, and promote relaxation in the rider.<sup>6</sup> The dynamic movement pattern has been shown to mobilize the pelvis, lumbar spine, and hip joint, normalize muscle tone, develop head and trunk postural control, and develop proper equilibrium reactions in the trunk.<sup>7</sup> The resultant development of postural control has been hypothesized to be the foundation for the acquisition of normal gross motor skills.<sup>8</sup>

## Procedures/ Research Questions

- The purpose of this research study is to investigate whether hippotherapy influences gross motor functional outcomes in children between three and thirteen years of age, with a medical diagnosis of cerebral palsy, and a GMFCS level of III or IV.
- **Research Question A:**
  - After a ten-week hippotherapy intervention, is there a change in the pre- and post-intervention GMFM scores for children registered to participate in the hippotherapy program at Bit-By-Bit Medical Therapeutic Riding Center, with a diagnosis of cerebral palsy given by their primary care physician (PCP), between three and thirteen years of age, with a GMFCS level of III or IV?
- **Research Question B:**
  - After a ten-week hippotherapy intervention, do parents/guardians of children registered to participate in the hippotherapy program at Bit-By-Bit Medical Therapeutic Riding Center, with a diagnosis of cerebral palsy given by their PCP, between three and thirteen years of age, with a GMFCS level of III or IV report a difference in their child's gross motor functional abilities?
- **Research Question C:**
  - After a ten-week hippotherapy intervention, what is the relationship between changes in the GMFM pre- and post-intervention scores and the Parent/Guardian Reported Outcome Survey scores for children registered to participate in the hippotherapy program at Bit-By-Bit Medical Therapeutic Riding Center, with a diagnosis of cerebral palsy given by their PCP, between three and thirteen years of age, with a GMFCS level of III or IV?



## Methods

### Participant Flow

- Participants for the study were recruited through the Bit-By-Bit Medical Therapeutic Riding Center hippotherapy program on a voluntary basis if they met the inclusion/exclusion criteria.
- **A pre-post quantitative, quasi-experimental design was utilized to evaluate seven eligible participants using the GMFM, a Child Information Sheet, and a Parent/Guardian Reported Outcome Survey over a ten-week intervention period.**
- After ten weeks of hippotherapy, participants who attended at least 80% of their scheduled visits were reassessed using the GMFM and their parent/guardian was asked to fill out a survey regarding their child's motor skills and quality of life.

### Participant Demographics

- The participants eligible for data analysis included 4 females and 3 males for a **total of 7 children.**
- Participants ranged in age from **4 to 11 years old** with the average age being 6.43 years old.
- **3 participants had a GMFCS level of III, and 4 had a GMFCS level of IV**
- All participants utilized some sort of orthotic and/or assistive device for functional mobility.
- All participants had previously participated in hippotherapy prior to the initiation of the study protocol and additionally participated in outside physical therapy, occupational therapy, and speech therapy.
- 4 of the 7 participants also regularly received botulinum toxin injections for hypertonicity approximately every 6 months.
- **In each session, participants spent an average of 15 minutes performing land-based therapy and 23.57 minutes on a horse.**

## Results

### Gross Motor Changes

- For gross motor function, there was typically an increase in the change scores for each dimension and for the total scores, as initially hypothesized by the researchers.
- A statistically significant ( $p \leq 0.05$ ) positive change was found to have occurred in dimension B (sitting) and the total change score over a duration of ten weeks.

Table 2:  
Aggregate Pre-test/ Post-test GMFM Scores

GMFM Dimension	Pre-Intervention				Post-Intervention			
	Min	Max	Range	Mean	Min	Max	Range	Mean
A (Lying, Rolling)	21	51	30	37.29	27	51	24	42.49
B (Sitting)	17	53	36	36.14	21	60	39	44.43
C (Crawling, Kneeling)	0	35	35	18.43	0	39	39	20.43
D (Standing)	2	29	27	12.29	2	33	31	11.86
E (Walking, Running, Jumping)	3	47	44	19.0	5	49	44	21.29
Total	43	215	172	123.15	75	231	156	144.14

Table 3:  
Aggregate pre-test/ Post-test GMFM Change Scores

GMFM Dimension	Minimum Change	Maximum Change	Range	Mean	Significance
A (Lying, Rolling)	-1	13	14	5.00	0.057
B (Sitting)	-1	23	24	8.29	0.034*
C (Crawling, Kneeling)	-7	15	22	2.00	0.452
D (Standing)	-8	4	12	-0.14	0.774
E (Walking, Running, Jumping)	-6	13	19	2.29	0.328
Total	-11	45	56	21.0	0.038*

\* Change score is statistically significant (p value  $\leq 0.05$ )

- **The parent/guardian reported outcomes were largely positive regardless of the size of the changes identified by the GMFM.**

Table 6:  
Aggregate Parent/Guardian Reported Outcome Survey Results

Survey Question	Minimum Change	Maximum Change	Range	Mean
1. Bed mobility	3	5	2	4.14
2. Supported sit	3	5	2	4.14
3. Unsupported sit	3	5	2	4.14
4. Seated reach	3	5	2	3.86
5. Quadruped crawl	0	5	5	3.00
6. Quadruped reach	0	5	5	3.00
7. Half kneel	0	5	5	3.43
8. Unsupported stand	0	5	5	2.71
9. Single leg stance	0	4	4	1.43
10. Squat	0	5	5	2.71
11. Stand to sit	0	5	5	3.29
12. Standing reach	3	5	2	3.43
13. Walk	3	5	2	4.14
14. Run	0	5	5	3.14
15. Step over obstacle	0	5	5	3.00
16. Kick ball	3	5	2	4.14
17. Jump on two feet	0	5	5	3.29
18. Jump on one foot	0	4	4	1.86
19. Stairs	0	5	5	2.57
20. Overall function	3	5	2	4.14
21. Quality of life	3	5	2	4.57

Table 7:  
GMFM Change Score and Parent/Guardian Reported Outcome Survey Correlation

Survey Question	GMFM A (Lying/Rolling)	GMFM B (Sitting)	GMFM C (Crawling/Kneeling)	GMFM D (Standing)	GMFM E (Walking/Running/Jumping)	GMFM Total
	R(p)	R(p)	R(p)	R(p)	R(p)	R(p)
1. Bed mobility	0.300 (0.513)					
2. Supported sit		0.063 (0.893)				
3. Unsupported sit		-0.764 (0.046)*				
4. Seated reach		-0.233 (0.615)				
5. Quadruped crawl			0.050 (0.916)			
6. Quadruped reach			0.050 (0.916)			
7. Half kneel			-0.088 (0.830)			
8. Unsupported stand			0.687 (0.088)			
9. Single leg stance			0.341 (0.454)			
10. Squat			0.687 (0.088)			
11. Stand to sit			0.168 (0.719)			
12. Standing reach				0.350 (0.442)		
13. Walk					0.252 (0.586)	
14. Run					0.629 (0.130)	
15. Step over obstacle					0.077 (0.870)	
16. Kick ball					-0.140 (0.765)	
17. Jump on two feet					0.374 (0.409)	
18. Jump on one foot					-0.128 (0.785)	
19. Stairs					0.322 (0.481)	
20. Overall function					0.150 (0.748)	

\* Pearson correlation coefficient (R) is statistically significant (p value  $\leq 0.05$ )

### Quality of Life Changes

- The parents/guardians of six out of seven of the participants reported that hippotherapy had an overall positive impact on their child's quality of life

## Data Analysis

- Descriptive statistics were generated for the group of participants.
- Change scores were generated for each dimension in the GMFM and for the resulting total score of the GMFM.
- A paired-t-test was used to compare the mean pre- and post-intervention GMFM scores from each dimension as well as total scores with a  $p \leq 0.05$  level of significance.
- Correlation coefficients were calculated to determine if a relationship existed between the results of the GMFM and the parent/guardian outcome surveys.
- A between-groups analysis was conducted to investigate whether participant age, gender, prior use of Botox, or GMFCS level had any relationship to the results of the study.

## Discussion

- As demonstrated in Table 3, **there was an increase in the aggregate change scores in all but one dimension and the total score.** The exception of dimension D (standing) was likely due to the influence of a single outlying score that the researchers suspect was influenced by an item not accounted for in the data analysis; weight gain
- The relationship between parent reported unsupported sitting improvement and GMFM B (sitting) was the only statistically significant relationship
- The relationships between questions five and six (quadruped crawl and quadruped reach) and dimension C (crawling, kneeling) of the GMFM, questions eight and ten (unsupported stand and squat) and dimension D (standing) of the GMFM, and question fourteen (running) and dimension E (walking, running, jumping) of the GMFM were all identified as strong by having an r-value of greater than .50 but were not statistically significant as identified by a significance of  $p \leq .05$ .
- **Six out of seven of the parents/guardians reported that hippotherapy had a positive impact on their child's quality of life.** The seventh child's parent/guardian importantly reported no change as opposed to either a positive or negative impact.
- **It is plausible that the perceived gross motor improvements are a result of the reported enhanced quality of life if the child is demonstrating improved sense of self-competence with increased participation in activities of daily living after the intervention period.**

## Conclusions

- **Results of this study provide preliminary and limited quantitative evidence that hippotherapy improves gross motor function in children with CP.**
- The Parent/Guardian Reported Outcome Survey supports the benefits of participation in hippotherapy as it indicates **parents/guardians of children with CP perceive benefits both in motor function and quality of life as a result of the intervention.**
- For future research, the authors of this study encourage researchers to consider analyzing results from a longer intervention study period with a similarly stringent homogenous population across multiple locations to create a larger participant pool and increase the likelihood of achieving reproducible results. The researchers also recommend identifying and accounting for physical habitus fluctuations and identifying a control group (ideally consisting of the same population concurrently participating in traditional physical therapy, occupational therapy, and speech therapy, but no hippotherapy) to determine whether all changes are attributable solely to the intervention as opposed to concurrent outside therapies