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# The Effect of Hippotherapy on Sitting Balance in Children with Cerebral Palsy

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THE EFFECT OF HIPPOThERAPY ON SITTING BALANCE  
IN CHILDREN WITH CEREBRAL PALSY

by

Theresa Jurgens  
Bachelor of Science in Physical Therapy  
University of North Dakota, 1997

An Independent Study

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Physical Therapy

Grand Forks, North Dakota  
May  
1998



## PERMISSION

Title            The Effect of Hippotherapy on Sitting Balance in Children with Cerebral Palsy

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This Independent Study, submitted by Theresa Jurgens in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

  
(Faculty Preceptor)

  
(Graduate School Advisor)

  
(Chairperson, Physical Therapy)



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## ABSTRACT

Hippotherapy programs have grown rapidly since 1969, when the first center opened in the United States. Despite the growing enthusiasm for hippotherapy in North America, research regarding the efficacy of hippotherapy is not well documented. Literature that pertains to the therapeutic benefits of hippotherapy consists primarily of descriptive articles containing subjective reports of riding instructors, riders, parents, and therapists. Hippotherapy is proposed to develop neuromuscular control, facilitate posture, elicit righting and equilibrium reactions, provide vestibular input, and improve psychological well-being. While these descriptive articles have identified variables to be empirically studied, few investigators have documented the therapeutic effects of hippotherapy. The purpose of this study is to determine if there is a significant improvement in the sitting balance of children with cerebral palsy (CP) after sessions of hippotherapy.

Six children participated in a six-week study, undergoing assessment with a repeated measures design. Results indicated that sitting balance was not significantly improved. Further study is needed to establish the effectiveness of hippotherapy.

## CHAPTER I

### INTRODUCTION

The horse has been thought of as a healing agent since early Greek mythology.<sup>1-4</sup> By 1900, several physicians had devised mechanical therapies imitating the horse's movement.<sup>1</sup> Since then, many medical writers have maintained that riding can be therapeutic and can be used in the treatment of a number of medical ailments.<sup>1</sup>

In the literature, the terms therapeutic riding and hippotherapy are often interchanged.<sup>5</sup> However, classical European hippotherapy is rare in the United States.<sup>5,6</sup> Hippotherapy literally means "treatment with the help of the horse" and involves the patient passively adapting to the natural movements of the horse's back. This type of treatment focuses on stimulating the patient's automatic righting and equilibrium reactions. In contrast, therapeutic riding is considered a medical model with the principles of hippotherapy, but incorporates other therapeutic concepts such as neurodevelopmental treatment (NDT) and proprioceptive neuromuscular facilitation (PNF).<sup>5,7</sup> Today, hippotherapy in North America has evolved into a broader, more dynamic treatment method than the classical medical use of the horse's motion.<sup>8</sup> Neither of these techniques should be confused with riding for the disabled which is recreational riding for the handicapped.<sup>9</sup>

Modern therapeutic horseback riding was greatly enhanced by Liz Hartel, who despite being confined to a wheelchair due to polio, won the silver medal in the 1952 Olympics for dressage.<sup>1-4,9</sup> Since the 1960s, centers throughout Europe have researched and clinically applied therapeutic horseback riding and hippotherapy.<sup>1</sup> However, it was not until 1969 that the first center for therapeutic horseback riding was established in the United States.<sup>4,10</sup> Since then, therapeutic riding has rapidly grown in popularity with over 500 facilities alone in the United States.<sup>1</sup> These facilities offer a variety of programs ranging from hippotherapy to riding therapy to recreational vaulting.<sup>11</sup>

However, therapeutic riding has progressed at a much slower rate in the United States than in Europe.<sup>5</sup> Riding for the disabled was considered a recreational sport up until the late 1960s. In the early 1970s, physical therapists began to agree that movement and quality of posture were as important as functional riding. European riding therapy became well established in the early 1980s, and at the same time, physical therapists in the United States began to develop techniques not yet used in Europe. One example is the technique of backriding. In backriding, the therapist rides on the back of the horse and attempts to improve the postural control of the patient through handling techniques and movements of the horse.<sup>5</sup> As the use of backriding progressed, more therapeutic techniques used in the clinic were incorporated into riding activities, such as developmental progressions of weight bearing on upper extremities, trunk rotation patterns, and the facilitation of righting and equilibrium

reactions. Gradually, different positions were used in addition to sitting and facing forward on the horse, such as sitting backwards and side sitting.

At the present time, there are two primary therapeutic horseback riding organizations in the United States.<sup>7</sup> They are the National Foundation for Happy Horsemanship for the Handicapped (HHFTH) and the North American Riding for the Handicapped (NARHA). Both groups are nonprofit organizations serving people with disabilities through horseback riding. The goal of each organization is to work with people with a disability using horseback riding as a form of therapy. NARHA has open membership and publishes guidelines for specific disabilities, while the HHFTH is membership by invitation only. HHFTH does not publish guidelines because of their belief that individual differences in disability do not warrant comparison. Both groups have contributed to the development of therapeutic horseback riding in the United States by serving thousands of people with disabilities.

The rapid growth in using horseback riding as a therapeutic modality has resulted from the enormous amount of enthusiasm of handicapped riders, parents, instructors, therapists, and physicians.<sup>2</sup> This stems largely from observations that people with disabilities who participate in appropriate programs appear to improve in mobility, balance, coordination, muscle strength, and muscle tone.<sup>2,6,10,12</sup> Subjective observations of therapists and parents report that, in conjunction with the gains in physical function, the riders also develop an improved spatial awareness, body image, and self confidence which carries over to the home and school.<sup>2,3,12-14</sup>

Despite the growing enthusiasm for therapeutic riding in Europe and North America, the efficacy of hippotherapy is not well documented.<sup>3,10,11,15</sup> The majority of research has been produced in Europe with only several articles published in the United States by 1986.<sup>5</sup> Literature that pertains to the therapeutic benefits of horseback riding consists primarily of descriptive articles that contain subjective reports of riding instructors, riders, relatives of riders, and therapists.<sup>3,10,11,13</sup> Therapeutic riding is proposed to develop neuromuscular control, facilitate posture, elicit righting and equilibrium reactions, provide vestibular input, and improve psychological well-being.<sup>10,13,14</sup> These articles have identified variables that need to be empirically studied. Few investigators have objectively documented the proposed therapeutic effects of hippotherapy.<sup>15</sup>

The purpose of this independent study is to determine, specifically, if there is a significant improvement in timed sitting balance of children with CP after sessions of hippotherapy. Specific tests from the Gross Motor Function Measure (GMFM) for left and right side sitting, sitting on a mat with arms propped, and sitting on a mat with arms free (item numbers 23, 24, 28, and 29) were used to assess the children.<sup>16</sup> If the null hypothesis of this study can be rejected, hippotherapy may be accepted as an additional therapeutic intervention for children afflicted with CP. Because children are often involved in therapy for many years, it may be a challenge for physical therapists to maintain the children's interest and enthusiasm in therapy. If hippotherapy can be determined to be better or as beneficial as conventional therapy, it could be used as another therapeutic intervention which may assist in maintaining the interest of patients



and improve compliance. Research data will support development of new protocols and provide rationale for reimbursement.

## CHAPTER II

### LITERATURE REVIEW

Although hippotherapy is proposed to aid with a wide range of disabilities, it is proposed to be particularly successful for patients with CP.<sup>6</sup> A large portion of the physical therapy pediatric patient population is made up of children with CP.<sup>10,17</sup> With CP, there is interference with normal development as a result of neurological damage to cortical centers which results in varying degrees of abnormal muscle tone, delayed reflex maturation, and the presence of associated abnormal patterns of posture and movement.<sup>9,10,18</sup> The problems that may occur with CP include spasticity, rigidity, ataxia, paralysis, tremor, and incoordination.<sup>18,19</sup> There may be many combinations of these conditions resulting in a loss of voluntary control, position sense, antigravity reactions, and disturbances of the vestibular and visual systems.<sup>17-19</sup>

When children with CP do not develop normal movement and postural components, abnormal development occurs in the form of compensations, such as postural deviations, asymmetries, or deformities.<sup>10,18,19</sup> Therefore, the goals of physical therapists who work with children with CP are to decrease abnormal muscle tone and facilitate the emergence of normal movement and postural components.<sup>5,10,19,20</sup> Physical therapy intervention is often instituted early, but CP is a chronic disability which may require that the child be involved in therapeutic

activities for many years.<sup>10,18,19</sup> For this reason, it can be a challenge for the physical therapist to keep the child enthusiastic about therapy sessions. A variety of therapeutic activities have been developed including use of the therapeutic pool and hippotherapy. In hippotherapy, the horse is used as a treatment modality similar to the use of therapy balls and bolsters commonly seen in physical therapy clinics.<sup>10</sup>

Hippotherapy uses the movement of the horse as a specific treatment technique.<sup>1,2,5,8</sup> Therefore, the basic premise of hippotherapy is for the child to learn to move in unison with the horse as an exercise machine. The rationale for hippotherapy is that the three-dimensional movement of the horse's back simulates human gait movements.<sup>2,5,10,14,21</sup> As the horse walks, its center of gravity is displaced three-dimensionally with a movement very similar to the action of the human pelvis during gait. During the riding session, that same movement pattern is transferred to the patient, moving the patient's pelvis as normally functioning legs would during gait.<sup>5,13,14,21</sup>

Through the use of film analysis, Baumann studied the similarity of the pelvis movement during gait and while riding a horse.<sup>5,21</sup> Baumann reported that therapy on horseback very closely produces the specific pattern of acceleration and frequency similar to that occurring in normal gait. There are three distinct movements transferred from the horse to the patient's pelvis: rotation, lateral pelvic tilt, and anterior/posterior tilt of the pelvis.<sup>5,21</sup>

According to Baumann,<sup>5,21</sup> there is an acceleration of the body during toe off and deceleration after midswing during normal gait.<sup>5,21</sup> While on the horse,

the patient will experience the same alternating acceleration and deceleration movements. During riding, the rotation occurring in the pelvis and lumbar spine is found to be 35 degrees as compared to 40 degrees during human gait. The rider experiences a 3 cm lateral pelvic tilt while riding, and there is a four-degree pelvic obliquity when walking. The anterior and posterior tilt of the pelvis was 5 degrees during riding and 1.5 degrees during gait. When measuring lateral displacement of the pelvis, the rider experiences a total of 7 to 8 cm lateral displacement and normal human walking shifts the pelvis laterally a total of 5 cm. Baumann<sup>5,21</sup> concluded that the pelvic rotation and lateral displacement during riding and walking are very close to normal gait, but the anterior/posterior tilt is much greater on the horse than in normal human walking.<sup>5,21</sup> Although not identical, the pelvic movements under the two conditions are similar. For patients who are unable to weight-bear through the lower extremities, hippotherapy allows the therapist to stimulate balance reactions and simulate conditions that occur during normal ambulation. At this time, no other modality has been proven to accomplish this task.

In addition to the simulation of the human gait, the three-dimensional movement of the horse is proposed to stimulate postural control and development.<sup>1,2,5,8,21</sup> Sensory motor skills are those skills that have to do with the stages of normal physical development. The emphasis of each hippotherapy session is to help the client receive and process sensory information and direct it into useful motor responses. It may be possible that through carefully prescribed techniques, quality movement patterns may be achieved.

The more linear, neurophysiological approach to movement is considered beneficial in facilitating the development of more normal movement patterns.<sup>1,2,5,8</sup> According to Spink<sup>8</sup>, practical handling methods derived from the works of Bobath and Rood are used and adapted to the horse in hippotherapy. Bobath outlined an orderly sequence of motor activity development for normal children to describe the development of the neurological system, and through the use of appropriate activities, a child with CP could be stimulated to promote further development. According to Bobath's theory, a prerequisite for treatment is to normalize tone before attempting active motion. Hippotherapy is believed to allow for normalization of muscle tone.<sup>5,6,10</sup> The rationale for hippotherapy is that the horse's movement imparts a precise, smooth, rhythmical pattern of movement to the rider. This movement coupled with the warmth of the horse is believed to promote muscular relaxation and decrease abnormally high muscular tone, especially in patients with spasticity.<sup>5,6,10</sup>

Rood<sup>22</sup> based her system on the concept that motor patterns are developed from fundamental reflex patterns present at birth. These reflexes are the basis for movement and are controlled at subcortical levels. They are utilized and gradually modified by the use of sensory stimulation until the control of movement is transformed to a cortical level. In hippotherapy, the client does not voluntarily control the horse in the early stages of treatment.<sup>5,8,10</sup> Therefore, the patient can react on a subcortical level without auditory cuing. Meanwhile, the patient's body receives somatic effects from the graded movement of the horse. The amount of stimulation from the horse is carefully controlled so that the

patient can respond actively but unconsciously. For example, to improve equilibrium reactions, the horse can be manipulated to specifically displace the patient to achieve the reaction. The patient must respond to adapt to this dynamic challenge. The patient's brain should spontaneously relay a message to seek midline balance without auditory or manual cues.

Hippotherapy uses three basic components of the horse's walk as they relate to functional movement and developmental principles.<sup>8</sup> These three components will be discussed in detail in the following paragraphs. Each component of the horse's walking motion is analyzed and administered to target specific objectives. The components can be specifically applied to elicit automatic reactions within the sagittal, frontal, and transverse planes of the body. This combination of these three horse movement components are the basic foundations for hippotherapy as a modality to promote voluntary motor control.

The three components of movement offered by the horse must be considered simultaneously for proper utilization of postural/movement challenges to occur and for outcomes of integrated function to be possible.<sup>8</sup> These components are always assessed and applied in a progressive fashion. The patient needs to keep the body's center of gravity directly over the horse as the base of support and maintain proper postural alignment. With the pelvis in proper alignment, it can be displaced by the movement of the horse in a pattern that simulates normal human gait.

Spink<sup>8</sup> defined three primary horse-movement components and referred to them as follows: static/dynamic component, simple weight-shift component,

and rotational component. These components closely correlate with the automatic reactions in the three planes of movement in the human body. It must be understood that all three movements in the patient's trunk are occurring simultaneously during the horse's walk. Certain horse movements emphasize specific human trunk control reactions more than others.

The first component that directly affects the patient's sagittal body plane is the static/dynamic component.<sup>8</sup> An example would be walking the horse in a straight line at a steady, low-amplitude pace. This movement is proposed to displace the patient forward and backward, causing an anterior/posterior tilt of the pelvis. This is the basic method for initiating the development of forward/backward reactions or flexor/extensor trunk control. The length of the stride of the horse determines whether the flexors or extensors will respond.<sup>8</sup> Lengthening of the horse's stride elicits a flexor response in the patient's trunk. The patient's muscles, such as the abdominals, should automatically contract to respond to the sensation that the body will be left behind the forward motion of the horse. Shortening the stride elicits an extensor response in the patient's trunk. This occurs because the body responds to right itself due to a sense of falling forward toward the horse's neck. For a higher level of gradation and co-contraction, walk/stop/walk movements are incorporated. According to Reid,<sup>5</sup> positioning of the patient also plays an important part in facilitating reactions of the flexors and extensors. When facing backwards, the patient is more likely to maintain an erect trunk. In that position, the horse's shape promotes increased abduction and external rotation of the patient's legs. This position promotes an

upright pelvis and an erect trunk. When facing forward, the slightly narrower shape of the horse toward the front allows for more adduction and internal rotation. This may promote a more posteriorly tilted pelvis and kyphotic posture.

The simple weight-shift component is performed as the horse performs a balanced working walk.<sup>8</sup> The horse's pelvis rotates and its body shifts from side to side as each hind leg moves forward. The patient receives secondary input from the side-to-side weight shift. This predictable pattern of shifting weight provides automatic, reciprocal elongation and shortening of the patient's trunk. If the horse swings forward with its right hind leg, then its right hip drops. This causes the client's right hip to drop and provides elongation of the right side as well as shortening of the left side. This type of weight shift can also be facilitated in the treatment clinic by shifting the patient's weight on a therapy ball.

If adjusted to the proper degree of challenge, this weight-shift component facilitates automatic lateral control reactions in the frontal body plane.<sup>8</sup> Eliciting this type of reaction can be exaggerated by moving the horse in a symmetrical figure to increase the degree of reaction in the lateral flexors. A circle is commonly used to achieve this objective. Controlling the size and shape of the figure controls the amount of movement displacement. Performing figures in both directions promotes body symmetry. Varying the size and shape of serpentine and figure-eight patterns is another way to affect specific weight-shift reactions.

The last component is the rotational component. The horse is used to influence postural control within the transverse body plane.<sup>8</sup> This component is



proposed to normalize muscle tone via rotation. It also may help to improve the more refined equilibrium reactions essential for normal functional activities.

Several horse movement patterns, varying from simple to complex, can elicit these reactions. The simplest way to elicit the reaction is the horse's regular, active walk on a straight line. Walking in a straight line provides symmetrical, bilateral rotation which emphasizes elongation and shortening of the lateral flexors, particularly with small unilateral rotations.

Spink<sup>8</sup> concluded the three components of movement offered by the horse must be simultaneously considered in order to properly select postural/movement challenges and to make outcomes of integrated function possible.<sup>8</sup> During the riding sessions, it is necessary to carefully consider the implications of each patient's developmental status when selecting specific movement opportunities offered by the horse.

A review of the literature revealed only a few studies which investigated the proposed effects of therapeutic riding on people with disabilities. The feasibility of implementing horseback riding programs for handicapped children was assessed by Wingate<sup>23</sup> in 1982. In this five-week study of therapeutic riding, seven out of seven subjects demonstrated successful outcomes in terms of attendance and enjoyment. Subjective findings included improved posture, gait, and head control, and a decrease in lower extremity tone. Recommendations for future studies were to quantify and document these subjective findings.

In 1984, Fox et al<sup>24</sup> designed a test instrument, which consisted of a symmetrical balance beam supported by a bearing affixed to an aluminum base,

to objectively quantify the progress of people who participated in therapeutic horseback riding programs. Nineteen children with heterogeneous disabilities and ranging from 7 to 14 years of age were evaluated before and after participating in a riding program. Following the 90 to 120-minute riding sessions, marked improvements were noted for most children for measures of hand, hip, knee, and ankle strength, and for measures of sitting balance and coordination. It was concluded that the range of differences in before and after strength measurements varied considerably between individual subjects; however, results were reproducible for individual subjects. Subjective reports of the investigators, parents, and therapists were consistent with the objective results.

Cawley et al<sup>25</sup> evaluated the effects of therapeutic horseback riding on self-concept in adolescents. Twenty-nine children who were identified by the school system as having special educational needs participated in this study. Self-concept was evaluated through a pre and posttest design using the Piers Harris Children's Self-Concept Scale. A small increase in self-concept was found but not at a statistically significant level except for the Behavior subtest. Younger subjects demonstrated greater improvement than the older subjects. Therefore, the authors felt the program might be more beneficial if it was offered at an earlier age. Recommendations for future longitudinal studies of self-concept were made.

In 1988, Bertoti<sup>10</sup> studied postural changes in 11 children with moderate to severe spastic cerebral palsy after participation in a therapeutic horseback riding program. Three pediatric physical therapists performed posture assessments

using a postural assessment scale designed by Bertoti.<sup>10</sup> The 11 children selected for this study underwent postural assessments with a repeated-measures design. The results demonstrated a statistically significant improvement in posture during a period of therapeutic riding. Subjective improvements in quality of muscle tone, balance, and weight-bearing abilities were found. This was the first objective study to support the efficacy of therapeutic horseback riding on posture in children with cerebral palsy.

In 1989, Biery and Kauffman<sup>26</sup> studied the effects of therapeutic horseback riding on the balance of eight individuals with mental retardation. The subjects were evaluated on four standing and six quadruped balance items. During the next six months, the subjects received no intervention. In this respect, the subjects served as their own control group. After the six months, the subjects were tested again using the same procedure. They then participated in a six-month therapeutic riding program which was designed to provide vestibular input in a variety of ways. Following the riding program, a third identical testing procedure took place. The results of the study indicated significant improvement in standing and quadruped balance after the six-month riding program.

In 1991, Bertoti<sup>20</sup> evaluated the effect of therapeutic horseback riding on weight bearing in a 30-month-old child with hemiplegic CP. Assessment of weight bearing and symmetry was performed at intervals throughout a six-week riding program to document the differences between weight borne through the hemiplegic upper and lower extremities as compared with the uninvolved extremities. A digital scale was used to quantify and compare weight bearing in

addition to administration of a qualitative clinical physical therapy evaluation of the subject's functional abilities. The assessment was done at four intervals with riding occurring only between the second and third intervals.

It was concluded that improved quantity and quality of weight bearing in all four extremities, especially the right extremities, resulted during the period of riding.<sup>20</sup> However, the subject's quantity of weight bearing decreased close to a preriding level after the riding program had been discontinued for six weeks. This may mean that the riding had a significant effect on the child's weight bearing.<sup>20</sup> Perhaps more carryover of this treatment effect would be seen if participation in the riding was for a period of longer than six weeks.

Recommendations for future studies were to focus on the length of time a child should participate in a riding program to improve and maintain improvement. This report demonstrates the possible effectiveness of therapeutic horseback riding in improving weight bearing and symmetry in a child with hemiplegic CP.

MacKinnon et al<sup>15</sup> studied therapeutic horseback riding using 19 children with mild to moderate degrees of CP. The children were stratified according to their degree of disability. The experimental (riding) group was made up of 10 children who participated in a one-hour per week riding class for six months. The other nine children were put on a waiting list for riding. Using standardized quantitative assessments, all subjects' gross and fine motor function, activities of daily living, personal, domestic, and community living skills, psychosocial outcome variables, socialization, and global behavior were evaluated before and after the riding session. Qualitative results found were similar to previous

studies.<sup>3,8,10,11</sup> Subjective reports of riding instructors, parents, and therapists showed progression in physical and psychosocial functioning. However, the results of the study demonstrated few statistically significant changes in the children.

This review of the literature indicates the need for further research to verify the proposed benefits of hippotherapy and for the development of instruments that are able to measure changes in psychosocial and physical status.

## CHAPTER III

### METHODS

#### Subjects

Six children diagnosed with CP served as the subjects for this study. The group consisted of six boys from the ages of 51 months to 117 months ( $\bar{x}$  = 86 months;  $s$  = 25.36). The children were recruited from Altru Hospital Hippotherapy Program. The diagnostic distribution of the six subjects consisted of three children with spastic diplegia and three children with spastic quadriplegia. All subjects were recruited in accordance with the policies set by the University of North Dakota's Institutional Review Board (Appendix A).

The following inclusion criteria were developed to screen prospective subjects: 1) medical diagnosis of spastic quadriplegia CP or diplegia CP, 2) normal spine and hip x-rays, 3) no other medical complications, 4) hip abduction of 20 degrees or more bilaterally, 5) subjects available to participate two times per week (Appendix B).

#### Instrumentation

The Gross Motor Function Measure test (GMFM), which has documented reliability and validity, was used to assess timed sitting balance. Four test positions were chosen from item B: Sitting - numbers 23, 24, 28, and 29.<sup>27</sup> Subjects were positioned and scored specifically for each test item according to

the following instructions as listed in the GMFM. Refer to Table 1. An ordinal value was used to score each test item (Appendix C).

Table 1.—Specific Scoring Criteria for Each Test According to the GMFM Item B

23. Sitting on mat, arm(s) propping: maintains 5 seconds
0 - does not maintain with arm(s) propping 1 - maintains, < 1 second 2 - maintains, 1 to 4 seconds 3 - maintains, 5 seconds
24. Sitting on mat: maintains, arms free, 3 seconds
0 - does not maintain unless both arms propping 1 - maintains, one arm propping 2 - maintains, arms free, < 3 seconds 3 - maintains, arms free, 3 seconds
28. Right side sitting: maintains, arms free, 5 seconds
0 - does not maintain right side sitting 1 - maintains, both arms propping, 5 seconds 2 - maintains, right arm propping, 5 seconds 3 - maintains, arms free, 5 seconds
29. Left side sitting: maintains, arms free, 5 seconds
0 - does not maintain left side sitting 1 - maintains, both arms propping, 5 seconds 2 - maintains, left arm propping, 5 seconds 3 - maintains, arms free, 5 seconds

### Procedure

A repeated measures design consisting of a pretest and posttest was implemented. The subjects participated in therapy for six weeks, one time per week, for a one-hour session, which consisted of one-half hour on the horse and one-half hour of mat activities. The programs were progressed according to individualized assessment and goals.

Each riding session stressed decreasing postural compensations, increasing muscle flexibility, active co-contraction and facilitating equilibrium reactions. The following mat activities were implemented as appropriate for each subject: stretching, range of motion, strengthening exercises, transfers, mobility, balance, and ambulation. The following are examples of some typical exercises performed on the horse:

1. Prone lying width wise on the horse.
2. Sitting facing forwards, backwards, and bilateral sidesitting with palms flat on the horse or arms reaching up over head.
3. Co-contraction and weight shift through the upper extremities while in an extended arm "prop" position.
4. Quadruped (on hands and knees).
5. Tall kneeling with or without bilateral hand support.

The horse was driven in circles or in a figure eight fashion to activate and to strengthen specific muscle groups. Skilled activities were performed while the horse was walking, such as reaching across midline to place a ring on a stationary pole and tossing/catching of various size balls or beanbags. Completing activities at different speeds were also part of the program.

### Data Analysis

Data from the pretest and posttest are presented in table form in the following chapter. Statistical analysis was not conducted because only two of the five subjects completed the study.



## CHAPTER IV

### RESULTS AND DISCUSSION

Raw composite scores for the timed sitting balance are presented in Table 2. Statistical analysis was not completed on the data since values were only recorded for two out of the five subjects. The results demonstrate that there was not a significant improvement in timed sitting balance after the six-week riding session. This study did not find a statistically significant improvement in timed sitting balance for the two children who participated in the study. Subject #1 obtained the same score for test items #23 and #29 on the pretest and posttest. The child improved on item #24 and regressed on item #28. Subject #2 obtained the same score for items #23, 28, and 29 on the pretest and posttest, but improved on item #24. This study correlated with MacKinnon et al<sup>15</sup> who reported an increase in balance and coordination after a six-month riding program, and with Bertoti,<sup>10</sup> who showed an improvement in postural control following ten weeks of therapeutic riding. However, there were several problems that occurred during the course of this study that will be discussed in the following paragraphs.

An obvious limitation of this study is the small sample size. I had hoped to have at least five subjects, but one of the problems that occurred was that the four tests chosen for this study were not appropriate for the children who were

Table 2.—Raw Composite Scores for Sitting Balance for Subject 1 and Subject 2

---

<u>NAME: Subject 1</u>	<u>Date:</u>	<u>Date:</u>
<u>TEST ITEM</u>	<u>PRE-TREATMENT</u>	<u>POST-TREATMENT</u>
#23	3	3
#24	2	3
#28	3	2
#29	3	3
<u>NAME: Subject 2</u>	<u>Date</u>	<u>Date</u>
<u>TEST ITEM</u>	<u>PRE-TREATMENT</u>	<u>POST-TREATMENT</u>
#23	3	3
#24	0	1
#28	0	0
#29	0	0

---

diagnosed with spastic diplegia. Three of the five subjects were at a functional level above the level of the four tests chosen and were unable to participate in the study. If I was to repeat this study, I would use two samples consisting of spastic diplegia and spastic quadriplegia and would choose functional tests appropriate for each diagnosis and the functional level of the children.

Another problem was lack of communication between myself and the physical therapist who directed the hippotherapy program prior to the study. This was due to the fact that there was a flood in the city where the study was conducted. Because of the flood, parental permission forms for participation were also delayed, and the children were not assessed until after the hippotherapy program had begun. The hippotherapy program was supposed to begin June 1, 1997, but because of the flood, the program did not start until June 16, 1997. However, both subjects were able to participate for six weeks. Another limitation of this study was the amount of time between the pretest and posttest. A six-week time period may not have been long enough to demonstrate an improvement in timed sitting balance. The results may have been different had the study been conducted for a longer period of time.

Although this study did not show significance in timed sitting balance, the subjective observations were consistent with past studies.<sup>10,12,15,22,23</sup> Interviews of therapists and parents demonstrated that the program was considered to be extremely motivational for the children involved. Subjective observations of therapists and parents suggested improvement in attention, cognitive, and social skills of the children who participated in the program. However, further study is

needed to explore the effects of hippotherapy on range of motion, gait, strength, and functional mobility.

## CHAPTER V

### CONCLUSION AND SUMMARY

This study assessed timed sitting balance in children with CP before and after a six-week hippotherapy program. Although this study did not demonstrate significant improvements in timed sitting balance in children with CP after a six-week riding session, further research should be done to determine the effects of specific therapeutic activities used in hippotherapy. Hippotherapy may offer the therapist a dynamic treatment base to influence trunk antigravity control and to provide a variety of upper and lower extremity weight bearing positions. Hippotherapy allows the movement of the patient to begin at the pelvis which is important since much of gross motor movement should be initiated at the pelvic region. The horse is a versatile modality and can be manipulated by the therapist in ways to assist with joint mobilization, muscle stretching, equilibrium reactions, and muscle strengthening activities with the added motivation of horseback riding.

Although significant, this study constitutes a small step in examining some of the proposed therapeutic effects of hippotherapy. Future studies should focus on the development of instruments that are able to measure changes in psychosocial and physical status. Based from the limitations of this study, I have several recommendations for future studies. A sample size of 30 or more

subjects would be beneficial. Therefore, if subjects could not complete the study, there would still be an adequate sample size. This could be accomplished by recruiting several hippotherapy programs in a given area to participate in a study and establishing inter-rater reliability between the therapists assessing the subjects. To overcome the limitation of choosing appropriate assessment tools for the different diagnoses, it may be beneficial to assess the children using a complete functional assessment, such as the GMFM, to establish each subject's functional level prior to the riding sessions. A full assessment could then be completed at the end of the riding sessions or completion of the study to determine whether the subjects improved in any of the functional categories. Since many studies document subjective suggestions of improvements in cognitive and psychosocial areas, future studies should conduct qualitative surveys using psychological or educational tests to document improvements. It may also be beneficial to continue the study over the longest time period available. In order to eliminate any gaps in communication between experimenters, therapists, subjects, and parents of the subjects, it may be beneficial to plan an informational meeting prior to the study for everyone involved. Subjects and parents could receive information and ask questions about the program and/or study. Parents could then sign the permission forms which would prevent delays in assessment of the subjects.

## APPENDIX A

☒ EXPEDITED REVIEW REQUESTED UNDER ITEM \_\_\_\_ (NUMBER(S)) OF HHS REGULATIONS  
 \_\_\_\_ EXEMPT REVIEW REQUESTED UNDER ITEM \_\_\_\_ (NUMBER(S)) OF HHS REGULATIONS

**UNIVERSITY OF NORTH DAKOTA  
 HUMAN SUBJECTS REVIEW FORM  
 FOR NEW PROJECTS OR PROCEDURAL REVISIONS TO APPROVED  
 PROJECTS INVOLVING HUMAN SUBJECTS**

**PRINCIPAL**

**INVESTIGATOR:** Jim Pitman and Theresa Jurgens **TELEPHONE:** (701) 772-5469, (701) 777-9866 **DATE:** 1997

**ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT:** 2543 Glenwood Drive, Grand Forks, ND, 58201 - 303 Stanford Road, ND 58203

**SCHOOL/COLLEGE:** School of Medicine **DEPARTMENT:** Physical Therapy **PROPOSED PROJECT DATES:** June 1, 1997 - August 15, 1997

**PROJECT TITLE:** The Effect of Hippotherapy on Lower Extremity ROM and Sitting Balance in Children with Cerebral Palsy

**FUNDING AGENCIES (IF APPLICABLE):****TYPE OF PROJECT:**

☒ NEW PROJECT    \_\_\_\_ CONTINUATION    \_\_\_\_ RENEWAL    \_\_\_\_ DISSERTATION OR THESIS RESEARCH    ☒ STUDENT RESEARCH PROJECT  
 \_\_\_\_ CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

**DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER:** Dr. Peg Mohr

**PROPOSED PROJECT:** \_\_\_\_ INVOLVES NEW DRUGS (IND)    \_\_\_\_ INVOLVES A COOPERATING INSTITUTION  
 \_\_\_\_ INVOLVES NON-APPROVED USE OF DRUG    ☒ INSTITUTION

**IF ANY OF YOUR SUBJECTS FALL IN ANY OF THE FOLLOWING CLASSIFICATIONS, PLEASE INDICATE THE CLASSIFICATION(S):**

☒ MINORS (<18 YEARS)    \_\_\_\_ PREGNANT WOMEN    \_\_\_\_ MENTALLY DISABLED    \_\_\_\_ FETUSES    ☒ MENTALLY RETARDED  
 \_\_\_\_ PRISONERS    \_\_\_\_ ABORTUSES    \_\_\_\_ UND STUDENTS (>18 YEARS)

**IF YOUR PROJECT INVOLVES ANY HUMAN TISSUE, BODY FLUIDS, PATHOLOGICAL SPECIMENS, DONATED ORGANS, FETAL MATERIAL, OR PLACENTAL MATERIALS, CHECK HERE****1. ABSTRACT: (LIMIT TO 200 WORDS OR LESS AND INCLUDE JUSTIFICATION OR NECESSITY FOR USING HUMAN SUBJECTS.)**

Hippotherapy is a passive form of riding in which the patient sits on the horse and allows the horse to move him/her. Since the late 1960s hippotherapy has grown at a rapid rate, with more than 500 centers across the U.S currently in operation. However, the body of literature that pertains to the therapeutic benefits of hippotherapy consists primarily of descriptive articles that contain the observation and subjective reports of observers and participants. While these descriptive articles have been helpful to identify the variables that need to be empirically studied, few investigators have objectively documented the proposed therapeutic benefits of hippotherapy.



The purpose of this 6-8 week independent study will be to determine if there is a significant improvement in lower extremity range of motion consisting of hip flexion, extension, internal and external rotation, adduction and abduction, knee extension and flexion, ankle plantar flexion and dorsiflexion, and/or timed sitting balance using the Gross Motor Function Measure (GMFM) in children with spastic cerebral palsy following participation in hippotherapy.

Human subjects are needed because animal subjects will not provide the necessary information.

**PLEASE NOTE:**

Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

**2. PROTOCOL:** (Describe procedures to which humans will be subjected. Use additional pages if necessary.)

□Subjects: Five children ranging from four to eighteen years old and diagnosed with cerebral palsy will be selected from Rehab hospital pediatric department in Grand Forks, ND, to participate in this independent study. The subjects will continue their normal hippotherapy exercise protocol designed by their physical therapists.

The criteria for this study includes the following: 1. medical diagnosis of spastic quadriplegia CP or diplegia CP. 2. normal spine and hip x-rays. 3. no other medical complications. 4. hip abduction of 20 degrees are more bilaterally. 5. subjects available to participate two times per week.

Experimental Design: A pre-test and post-test using a repeated measure design on the subjects above during the six - eight week study will be used. There will be no control group utilized for this study.

Procedure: Range of motion will be measured passively using a plastic goniometer. Goniometric measuring has been shown to be reliable and have validity in measuring passive range of motion (PROM).

Timed balance test will be assessed using the (GMFM) test consisting of Item B: Sitting - numbers 23, 24, 28, and 29. The GMFM has been found to be valid in measuring changes in gross motor function over time in children with CP.

Theresa Jurgens and Jim Pitman will work closely with the Child Evaluation and Treatment Program (CETP) physical therapists and will also provide the necessary equipment to complete the testing, and will be responsible for performing the pre-test and post-test. The CEPT therapists will be responsible for recommending families to participate in the project, making the initial contact, and passing out the consent forms to the parents. Sally Masilko, director of the hippotherapy program, has approved the proposed project, please see attached letter.

Theresa and Jim will attend sessions of physical therapy with their subjects prior to initiating the study. They will observe therapy sessions and will discuss any precautions for specific subjects with the individuals'

physical therapist. All techniques will be reviewed and approved by a CEPT therapist. A CEPT therapist or a UND PT faculty member will supervise the pre and post testing session.

**3. BENEFITS:** (Describe the benefits to the individual or society.)

If the null hypothesis can be rejected, hippotherapy could be considered an additional therapeutic intervention for children afflicted with CP. Physical therapy organizations could develop protocols and receive third party reimbursement which at present time is in question. Due to the nature of CP, many of the children will be in therapy many years and may become less motivated with the same routine. If hippotherapy can be assessed as better or at least as good as conventional therapy, it may be used as a modality which will assist in keeping the interest of the patient and improve compliance.

**4. RISKS:** (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psycho-logical, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to insure the confidentiality of data obtained, including plans for final disposition or destruction, debriefing procedures, etc.)

☐ Information from this study will be anonymously coded to ensure confidentiality. The subject will not be personally identified in any publication containing the results of the study. All written material from this study will be kept in a locked cabinet in Dr. Peg Mohr office at the physical therapy department and will remain there for 3 years following the completion of the study. Then the data will be destroyed.

The risk posed to the children while assessing timed sitting balance are limited to falling over. Risks will be minimized by performing the assessment on a mat on the floor, and an assistant will also be positioned behind the patient to prevent injury should any loss of balance occur.

The risks are minimal to the subjects with proper use of the goniometer and goniometer measuring is an established evaluation procedure. The researchers have demonstrated competence in completing these measurements.

5. **CONSENT FORM:** A copy of the **CONSENT FORM** to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no **CONSENT FORM** is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur.

Describe where signed consent forms will be kept and for what period of time.

Copies of resulting data and Consent Form will be kept in a locked cabinet in Dr. Mohrs office at the University of North Dakota at Grand Forks, Physical Therapy Department. The Consent Forms will be held from July 15, 1997 through July 15, 2000.

6. For **FULL IRB REVIEW** forward a signed original and thirteen (13) copies of this completed form, and where applicable, thirteen (13) copies of the proposed consent form, questionnaires, etc. and any supporting documentation to:

Office of Research & Program Development  
University of North Dakota  
Box 8138, University Station  
Grand Forks, North Dakota 58202

On campus, mail to: Office of Research & Program Development, Box 134, or drop it off at Room 101 Twamley Hall.

For **EXEMPT** or **EXPEDITED REVIEW** forward a signed original and a copy of the consent form, questionnaires, etc. and any supporting documentation to one of the addresses above.

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The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University's policies and procedures governing the use of human subjects.

**SIGNATURES:**

**DATE:**

\_\_\_\_\_  
Principal Investigator

**DATE:**

\_\_\_\_\_  
Project Director or Student Adviser

**DATE:**

\_\_\_\_\_  
Training or Center Grant Director

(Revised 8/1992)

## APPENDIX B

## INFORMATION AND CONSENT FORM

**TITLE:** The effect of Hippotherapy on Lower Extremity ROM and Sitting Balance in Children with Cerebral Palsy.

You are being invited to participate in a study conducted by Theresa Jurgens and Jim Pitman, physical therapy students at the University of North Dakota. The purpose of this study is to determine if there is a significant improvement in lower extremity range of motion consisting of hip flexion, extension, internal and external rotation, adduction and abduction, knee extension and flexion, ankle plantar flexion and dorsiflexion, timed sitting balance using the Gross Motor Function Measure in patients with CP after a six week hippotherapy program.

The children have been picked for this study by the following criteria: 1. medical diagnosis of spastic quadriplegia CP or diplegia CP. 2. normal spine and hip x-rays. 3. no other medical complications. 4. hip abduction of 20 degrees are more bilaterally. 5. subjects available to participate two times per week.

Your child will have passive range of motion in their lower extremities and timed sitting balance measured in a pretest and a post test.

The testing will be done at the Child Evaluation and Treatment Center (CEPT) riding center. There will be a CEPT therapist or a UND PT facility member present while measurements are taken during the pretest and the post test.

Your name or your child's name will not be used in any reports of the results of this study. Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission. The data will be identified by a number known only to the investigator. The investigator or participant may stop the experiment at any time if the participant is experiencing discomfort, pain, fatigue, or any other symptoms that may be detrimental to his/her health. Your decision whether or not to participate or let your child participate will not prejudice your future relationship with the Physical Therapy Department, the University of North Dakota, or CEPT. If you decide to participate or let your child participate, you are free to discontinue participation at any time without prejudice.

The investigators involved are available to answer any questions you have concerning this study. In addition, you are encouraged to ask any questions concerning this study that you may have in the future. Questions may be asked by calling Theresa Jurgens (701-777-9866) or Jim Pitman (701-772-5469) or Dr. Peg Mohr (701-777-2831). A copy of this consent form is available to all participants in the study. Medical records related to this study may be made available to the Medical Park Institutional Review Board as they may need to inspect the study records.

If there are questions regarding patient's study rights, I should contact Dr. Ricardo Alvillar, Chairman of the Medical Park Institutional Review Board, at (701)780-6161.

**ALL OF MY QUESTIONS HAVE BEEN ANSWERED AND I HAVE BEEN ENCOURAGED TO ASK ANY QUESTIONS THAT I MAY HAVE CONCERNING THIS STUDY IN THE FUTURE. MY SIGNATURE INDICATES THAT, HAVING READ THE ABOVE INFORMATION, I HAVE DECIDED TO PARTICIPATE OR LET MY CHILD PARTICIPATE IN THE RESEARCH PROJECT.**

I have read all of the above and willingly agree to let my child participate in this study explained to me by Theresa Jurgens and/or Jim Pitman.

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Participant's Signature

Date

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Subject Signature

(If child is in 5th grade or higher)

Date

---

Parent or Guardian

Date

---

Witness (not the scientist)

Date



## APPENDIX C

**Timed Sitting Balance Evaluation Form****Patient name:****Date:**

23. Sit on Mat, Arm(s) Propping: Maintains, 5 seconds..... 0\_\_ 1\_\_ 2\_\_ 3\_\_
24. Sit on Mat: Maintains, Arms Free, 3 seconds..... 0\_\_ 1\_\_ 2\_\_ 3\_\_
28. R Side Sit: Maintains, Arms Free, 5 seconds..... 0\_\_ 1\_\_ 2\_\_ 3\_\_
29. L Side Sit: Maintains, Arms Free, 5 seconds..... 0\_\_ 1\_\_ 2\_\_ 3\_\_

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