The Effects of a Five-Day Therapeutic Horseback Riding Program on the Standing and/or Sitting Balance of Children Ages 8-18 with a Wide Variety of Disabling Diagnoses as Measured by the Functional Reach Test and the Modified Functional Reach Test

Richard A. Chaperon  
*Grand Valley State University*

Pamela A. Staszewski  
*Grand Valley State University*

Heather L. Vavrina  
*Grand Valley State University*

Follow this and additional works at: [http://scholarworks.gvsu.edu/theses](http://scholarworks.gvsu.edu/theses)

Part of the [Physical Therapy Commons](http://scholarworks.gvsu.edu/theses)

Recommended Citation

[http://scholarworks.gvsu.edu/theses/414](http://scholarworks.gvsu.edu/theses/414)
The Effects of a Five-Day Therapeutic Horseback Riding Program on the Standing and/or Sitting Balance of Children Ages 8-18 with a Wide Variety of Disabling Diagnoses as Measured by the Functional Reach Test and the Modified Functional Reach Test

By

Richard A. Chaperon
Pamela A. Staszewski
Heather L. Vavrina

THESIS

Submitted to the Department of Physical Therapy at Grand Valley State University
Allendale, Michigan
in partial fulfillment of the requirements for the degree of

Master of Science in Physical Therapy

1998
The Effects of a Five-Day Therapeutic Horseback Riding Program on the Standing and/or Sitting Balance of Children Ages 8-18 with a Wide Variety of Disabling Diagnoses as Measured by the Functional Reach Test and the Modified Functional Reach Test

ABSTRACT

The purpose of this study was to evaluate the effect that a five-day horseback riding program had on the standing and/or sitting balance of children ages eight to eighteen afflicted with a variety of disabling diagnoses. The stated hypothesis is that after participating in a five-day session of therapeutic riding, subjects will show significant improvement in standing and/or sitting balance as measured by the Functional Reach Test (FRT) and the Modified Functional Reach Test (MFRT). The 15 subjects tested using FRT and the 17 subjects tested using the MFRT were all participants of the Cheff Center riding program. Subjects were pre and post tested by one of two testers using the aforementioned balance tests. Using the t-test for paired comparisons, no significance was found with the FRT and significance was found using the MFRT (α=0.05).
DEDICATION

We would like to thank our families and friends for the support, encouragement and understanding they have shown us throughout our educational experience at Grand Valley State University. Thanks, you are the best!

Rich would like to thank Jill for being so patient and supportive over the last three years. Megan and Kevin will have their daddy back. Good Luck to them.

Heather extends her appreciation to Bill, her best friend and husband. I can do anything as long as I know you are a part of my life!

Pam would like to thank her mom, Barb, for being a good friend and support system. I finally made it!
ACKNOWLEDGEMENTS

The researchers would like to thank our entire committee for their time, guidance, suggestions and willingness to participate in this study. Jane Toot, PhD, PT, Dan Vaughn, PT and Neal Rogness, PhD formed an effective committee that was readily available and offered a variety of viewpoints pertaining to our research. We would also like to thank Monica Simon for her timely and friendly help with the statistical analysis. Our deep appreciation also goes to the Cheff Center, Bliss Brown and all of our subjects and their families for their willingness to be a part of this study. We truly enjoyed the time we spent collecting data at the Cheff Center; it was fun and educational.
I Saw A Child

I saw a child who couldn't walk
sit on a horse, laugh and talk
then ride it through a field of daisies
and yet he could not walk unaided.

I saw a child, no legs below
sit on a horse, and make it go
through woods of green
and places he had never been
to sit and stare,
except from a chair.

I saw a child who could only crawl
mount a horse and sit up tall.
Put it through degrees of paces
and laugh at the wonder in our faces.

I saw a child born into strife
take up and hold the reins of life
and that same child was heard to say
Thank God for showing me the way...

- John Anthony Davies (1967)-
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>I SAW A CHILD</td>
<td>v</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vi</td>
</tr>
<tr>
<td>CHAPTER ONE: INTRODUCTION</td>
<td></td>
</tr>
<tr>
<td>Need for the Study</td>
<td>1</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>3</td>
</tr>
<tr>
<td>CHAPTER TWO: LITERATURE REVIEW</td>
<td></td>
</tr>
<tr>
<td>History of Therapeutic Riding</td>
<td>4</td>
</tr>
<tr>
<td>Therapeutic Riding Organizations</td>
<td>5</td>
</tr>
<tr>
<td>Components of a Riding Program</td>
<td>6</td>
</tr>
<tr>
<td>Current Research on Therapeutic Riding</td>
<td>8</td>
</tr>
<tr>
<td>Balance</td>
<td>15</td>
</tr>
<tr>
<td>Functional Reach Test</td>
<td>16</td>
</tr>
<tr>
<td>Modified Functional Reach Test</td>
<td>19</td>
</tr>
<tr>
<td>Operational Definitions</td>
<td>20</td>
</tr>
<tr>
<td>CHAPTER THREE: METHODOLOGY</td>
<td></td>
</tr>
<tr>
<td>Setting</td>
<td>23</td>
</tr>
<tr>
<td>Subjects</td>
<td>24</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>25</td>
</tr>
<tr>
<td>Procedure</td>
<td>26</td>
</tr>
<tr>
<td>Anticipated Problems</td>
<td>30</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>31</td>
</tr>
<tr>
<td>CHAPTER FOUR: RESULTS</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>32</td>
</tr>
<tr>
<td>Interrater/Intrarater Reliability</td>
<td>33</td>
</tr>
<tr>
<td>Functional Reach Results</td>
<td>34</td>
</tr>
<tr>
<td>Modified Functional Reach Results</td>
<td>34</td>
</tr>
<tr>
<td>Summary</td>
<td>35</td>
</tr>
<tr>
<td>Figures</td>
<td>36</td>
</tr>
<tr>
<td>Tables</td>
<td>38</td>
</tr>
</tbody>
</table>
CHAPTER FIVE: DISCUSSION

Introduction ................................................................. 39
Reliability of Measurement Tools ........................................ 39
Limitations and Benefits .................................................. 40
Suggestion for Further Research ........................................ 42
Summary ......................................................................... 42

REFERENCES .................................................................. 44

APPENDIX A
Informed Consent .......................................................... 48

APPENDIX B
FRT/MFRT Pretest Tally Record Form ................................. 50

APPENDIX C
FRT/MFRT Posttest Tally Record Form ............................... 51

APPENDIX D
Information Form ............................................................ 52

APPENDIX E
Human Subjects Review Approval ..................................... 53

APPENDIX F
Breakdown of Subjects’ Diagnoses .................................... 54
CHAPTER ONE

INTRODUCTION

The utilization of horseback riding as a therapeutic agent began in the United States in the 1960's. Therapeutic riding is a large field, which is broken down into more specific programs. These programs include vaulting, riding as sport, hippotherapy, back riding and riding therapy. Participants in this study will be involved mainly in a riding therapy program with some exposure to vaulting and driving. Riding therapy is the type of horseback riding for the disabled that are most commonly associated with physical therapy. It requires the rider to be an active participant in an individually prescribed exercise program. The rider still receives the benefits of passive riding but performs exercises designed to increase coordination, equilibrium and reflex integration (Griffith, 1992).

Therapeutic riding can be utilized to benefit a wide variety of physical diagnoses including cerebral palsy, muscular dystrophy, Down syndrome, spina bifida and mental retardation. Although therapeutic riding has many proposed benefits, few of these are strongly supported with objective research. This study will attempt to objectively measure the effects of therapeutic riding on the standing and/or sitting balance of children with a wide variety of diagnoses.

Need for the Study

“When one is asked if therapeutic riding is effective, the answer from those directly involved is so strongly in the affirmative that it appears obvious that the
movement to expand present programs and begin new ones will continue at an accelerated pace" (Mayberry, 1978, p. 192). In MacKinnon’s (1995b) review of the literature, she found proposed benefits to include improvement in balance and muscle strength as well as increased joint range of motion. Other alleged benefits are better postural alignment, normal movement facilitation, small scale cardiovascular conditioning and the integration of sensory stimulation with motor-planning skills (Freeman, 1984). Most articles addressing the field of therapeutic riding state improved balance as one of the many benefits of this therapeutic agent (Depauw, 1986 & Griffith, 1992).

Balance is maintained when the center of mass is within the base of support. It is defined as “the stability produced on each side of a vertical axis” (O’Sullivan and Schmitz, 1994). An individual’s balance is influenced by musculoskeletal factors, sensory elements that detect body motion and the process of sensory integration (O’Sullivan and Schmitz). It would seem logical that therapeutic riding improves balance since it is proposed to encourage the integration of sensory information from the tactile, auditory, skeletal and vestibular systems. This integration is mandatory to produce the required responses of the body and verbal commands necessary for riding (Freeman). While the literature states the many benefits of therapeutic riding, it adamantly states the need for more research in all areas of therapeutic riding. Authors in two studies (Depauw & Griffith, 1986, 1992) conclude that progress in the field of therapeutic riding research is necessary in several areas. These include the development of effective instruments for evaluating the effects of riding, empirical research proving the effects of riding and increased accessibility to research publications and programs that
currently exist in languages other than English. MacKinnon found that the current literature lacks instruments with known psychometric uses. Literature pertaining to therapeutic riding also tends to focus on non-standardized, subjective observation. Furthermore, these studies used small sample sizes and lack sufficient control groups (MacKinnon, 1995b).

**Purpose of the Study**

The purpose of this study is to evaluate the effect that a five-day therapeutic riding program has on the standing and/or sitting balance of children ages eight to eighteen. Balance is one of the most commonly cited benefits of therapeutic riding in the pertinent literature. The stated hypothesis is as follows: After participating in a five-day session of therapeutic riding, subjects will show significant improvement in standing and/or sitting balance as measured by the Functional Reach Test and the Modified Functional Reach Test on children ages eight to eighteen with a variety of disabling diagnoses.
CHAPTER TWO

LITERATURE REVIEW

History of Therapeutic Riding

Therapeutic riding, as an intervention for disability, has been utilized in the United States since the 1960's. Its history as a therapeutic agent has been recorded all the way back to cave paintings created by early man in the Pech-Merle Cave in France. These paintings imply that early man may have believed the horse to have magical powers to protect against disease and danger. Even early mythology tells of the horse being utilized as a healing agent. Aesthculapius, both god and man, is said to have prescribed a horse to ride for those inflicted with unhealable wounds to raise their spirits. Many medical writers also recorded the use of a horse for treatment of disease, including Oribasius of Sardis, 325 A.D.; Galen, 130 A.D.; Quellmaltz, 1735 and Boerhaave, 1776 (Mayberry, 1978). The first systematic study of the horse as a treatment technique occurred in 1875, by Chassaigne in Paris, France. He conducted an experiment in which he prescribed pony riding for a wide variety of diagnoses. From this study it was determined that riding was beneficial in hemiplegia, paraplegia and other types of neurological paralysis. Chassaigne noted improvements in several areas following riding including posture, joint movement, balance and muscle control (Bain, 1965). It was not until the 1950's that therapeutic horseback riding programs were established in Denmark and Norway through the efforts of two women, Liz Hartel and Elsbet Bodker. It was at this time that the value of therapeutic riding became of greater interest to the medical
profession and programs began to spread throughout Europe and beyond (Depauw, 1986).

It was in 1943 that Liz Hartel of Denmark became confined to a wheelchair secondary to contracting polio. This avid horsewoman, in defiance of her impairment, participated in the 1952 Helsinki Olympic Games, claiming the silver medal in dressage. The contraction of polio had a devastating effect on Liz Hartel, but was something of a blessing and inspiration for the field of therapeutic riding. Elsbet Bodker of Norway was the first person to provide "therapy riding" in her country for people with postpolio and cerebral palsy (Depauw, 1986). It was these two events that spurred the spread of therapeutic riding to countries around the world. By 1983, Britain was reported to have at least 40 programs in existence that enabled ten to 400 disabled persons per program to have access to riding as therapy. This field moved into North America in 1965 with the Community Association for Riding for the Disabled in Toronto, Canada. Therapeutic riding moved into the United States under the guidance of two major associations, the National Foundation for Happy Horsemanship for the Handicapped (HHFTH) and the North American Riding for the Handicapped Association (NARHA; Griffith, 1992).

**Therapeutic Riding Organizations**

Maudie Hunter-Warfel incorporated the HHFTH in 1967 in Malver, PA. Participation in this organization is on a voluntary basis only, there are no paid persons involved and membership is extended by invitation. The Foundation functions on the donations from individuals and other sources and provides films and how-to clinics free of charge. Basic training courses consist of the care and handling of equine and adapting these activities for handicapped individuals. The second stage of training is extensive
and includes many areas including familiarization with at least 25 diagnoses, safety, communication with families, therapists, and institutions and fund raising techniques. The HHFTH believes strongly that each combination of therapy and disability requires an individual approach and has consequently avoided the use of written research on therapeutic riding. This organization is making continual advancements that make former techniques “obsolete practically overnight” (Griffith, p.3, 1992). The use of case studies may be a viable research alternative that addresses the individuality of each rider. For this reason they prefer developing tapes and software that give them the ability to constantly change and improve their programs.

The NARHA was established in 1969, in Chicago IL, and became the second major therapeutic riding organization. It consists of centers and instructors, volunteers, physicians, therapists, teachers, researchers, riders and their families. The NARHA has a large budget and a sizable number of personnel, publishes extensively and offers national and regional conferences encouraging the exchange of information. Centers involved with the NARHA vary in size, consisting of anywhere from twelve to 200 riders per week. Having two well-established organizations that support therapeutic riding in this country has facilitated advancements in the field and fostered the creation of new riding programs (Griffith, 1992). It is this organization with which the Cheff Center, in Augusta, is associated. This is the center to be utilized in this study.

**Components of a Riding Program**

Two obvious and important components of therapeutic riding are the horse and the equipment. Horses selected for riding must be patient, tolerant of abuse and comfortable in the presence of wheelchairs and adaptive devices (Freeman, 1984). When
a horse is donated to the Cheff Center it goes through a two-week trial basis to determine the temperament of the horse. The horse must be able to tolerate screaming, a floppy rider and being mounted from an enclosed ramp. Of all the horses donated to the Cheff Center it is estimated that about 50% are inappropriate for therapeutic riding (A. Newman, personal communication, April 9, 1997). Key equipment includes the type of saddle utilized, riding helmet and saddle covers. If a rider requires a good deal of support, the western saddle is chosen. Progression into the English saddle is encouraged as it requires more postural adjustments to maintain balance and it demands that the rider maintain an erect posture. The Cheff Center often uses the Australian saddle for riders unable to maintain their balance in the English saddle. The Australian saddle gives more support than the English and has a similar saddle to the Western, but no saddle horn (A. Newman). Fleece saddle covers are implemented for riders with decreased sensory awareness. Other equipment such as reins, boots and stirrups can be specially adapted as needed for various handicaps (Freeman). Therapy begins once the rider is properly fitted on a well-trained horse.

Riding as therapy is most effective when programs are established to meet the individual needs of the rider. “If the therapist and riding instructor are knowledgeable about each rider’s disabilities, they can design, modify, and assess the exercises with the greatest benefit for the child” (Freeman, 1984, p.22). For instance, hypertonic riders benefit from performing exercises at an unhurried pace, while hypotonic individuals are encouraged to execute the same exercises quickly. A rider with hemiplegia is encouraged to ride the mount in circles with the affected side toward the center of the ring to increase weight bearing on the involved lower limb (Freeman). Although riding programs are
often individualized, the difficulty of all programs is gradually increased in a similar fashion.

Once a rider can maintain sitting balance on an unmoving mount, he/she begins to use the reins to direct the animal. The challenge of riding increases as the horse is allowed to move from a walk to a trot. Maintaining balance, posture and control of the horse in a trot requires substantial physical stamina and is a challenging accomplishment for most riders. From the onset of the riding program, exercises on the horse are incorporated. Examples of these include; standing in the stirrups, trunk rotation with arms out straight and touching alternating stirrups with hands clasped (Freeman, 1984). Other exercises include clapping hands in front and behind, hands crossed over the chest and turning around in the saddle 180° with assistance as needed. Exercises can be performed at a standstill, while walking, trotting or cantering (Haskin, 1974). The frequency at which a rider participates in a therapeutic riding program varies. Children may ride once a week throughout the year or at any other schedule set by the riding center. In this study riders will be involved in a more intense, five day riding program, where they ride approximately twice a day for five consecutive days. Instructors and parents at the Cheff Center reported that they observed more improvement in children that ride twice a day for a week than those who ride once a week over a period of several weeks. (B. Brown, personal communication, December, 14, 1996).

Current Research on Therapeutic Riding

The amount of literature available for therapeutic riding is growing, but much of it is limited to descriptive studies. These studies describe the improvements and benefits associated with therapeutic horseback riding in general terms. With the development of
many therapeutic riding programs over the last two decades, such as the Cheff Center, more quantifiable data improvements are appearing in the literature. To maintain growth with this form of therapy, empirical data is needed to support the benefits of therapeutic riding (Depauw, 1986).

The studies done on rehabilitation seem to support the claim that there is strong support and growth in the field of therapeutic riding. However, according to Biery & Kauffman (1989), most of the support comes in the form of testimonials and case studies rather than empirical data. In the Biery and Kauffman study, the authors attempt to determine the effects of therapeutic riding on balance. They tested eight mentally retarded teenagers and young adults. After the initial six months of no riding, they found that the subjects’ ability to balance decreased. A period of six months of riding followed the interim period. Subjects rode once a week for 24 weeks. They found statistically significant improvements in the subjects’ ability to balance after the six months of riding. The highest scores were on the diagonal and lateral movements assessed in the quadruped balance tests. The tests included: 1) raise right arm, 2) raise right arm & left leg, 3) raise right arm & right leg, 4) raise left arm, 5) raise left arm & right leg, and 6) raise left arm & leg. Biery & Kauffman claimed that the alternating forward and downward movement of the horse simulates the gait cycle, thereby giving sensory input that is partly responsible for improvements in posture, balance and muscle coordination. Unfortunately, the relationship between the human gait cycle and the gait of a horse correlate only from general observations.

Much of the literature lacks the quantifiable evidence for therapeutic riding that Biery & Kauffman’s study (1989) possesses. According to Mayberry (1978), therapeutic
riding appears to improve "muscle strength, mobility, balance, coordination and relaxation of spastic muscles" (p. 192). He recognized that the body of knowledge supporting benefits for therapeutic riding was insufficient, so he attempted to justify claimed benefits by using "empirical reasoning and clinical observation." Improved psychological values such as "self-respect and awareness, courage, feelings of euphoria, attention span, self-control, and body image" (Mayberry, p. 192) were other stated benefits.

Wingate (1981) attempted to design a study that demonstrated the effects therapeutic riding has on social and physical factors associated with disabled populations. The study relied on families to report on physical improvements since the study "did not have the breadth to provide the physical evaluation" (Wingate, p. 184) A number of physical improvements were observed by the families. They included improved posture, less falling with walking, improved sitting posture, gain of independence in shower taking, improved head control, decreased tone in lower extremities, and improved gait. These observations are congruent with those made by experts such as Mayberry (1978). The amount of observable evidence of benefits associated with therapeutic riding is plentiful and, for the most part, very similar.

The literature indicates there is a shift toward quantitative research, which has taken place in the last five to ten years. An example is Bertoti's (1988) study of postural changes in children with spastic cerebral palsy (CP) who participated in a therapeutic riding program. The article states that the major aims of therapeutic riding are 1) mobilization of pelvis, lumbar spine and hip joint, 2) normalization of muscle tone, 3) development of head and trunk postural control and 4) development of equilibrium.
Eleven children between the ages of two and nine years old participated in the study. A qualitative evaluation by three experienced physical therapists gave information on the subjects’ alignment, symmetry of body parts and co-contraction of muscles around joints. Bertoti developed a quantitative assessment scale so that objective data could be obtained for statistical analysis. The scale developed assesses head & neck, shoulder & scapula, trunk, spine, and pelvis. Scoring for each was done as follows:

- 3 = good symmetry
- 2 = minimal asymmetry
- 1 = moderate asymmetry
- 0 = severe asymmetry

The subjects rode twice a week for one hour per day in a ten-week program. The activities included riding in different positions to facilitate reduction of postural compensations and spasticity, while promoting weight shifts, rotation through the body axis, and dissociation at the shoulders and pelvis. Results reported a significant improvement in posture. Subjective enhancement in quality of muscle tone, balance and weight bearing were also noted. The major fault of this study is the test used because it was developed for this study and not proven valid or reliable.

McGibbon (1996) evaluated the effects an eight week hippotherapy program had on: 1) energy expended during gait, 2) dimensions of stride length, velocity and cadence, and 3) performance on the Gross Motor Function Measure (GMFM) in five children with spastic cerebral palsy. The sample size is small, nonetheless, an Chi-squared test showed a significant reduction in the energy expended during gait. Also, a significant rise was found on scores in the walking, running platform, and jumping sections of the GMFM.
The results imply that a riding program can improve gross motor function as well as walking energy expenditure in children with CP.

Snir, Dlin, Ayalon, Yazdi, and Inbar (1988) developed a small pilot study to quantify some of the claimed benefits of hippotherapy. Four children with learning disabilities (LD) whose ages ranged from thirteen to fifteen were tested in the following areas: 1) strength, 2) gait analysis, 3) posturography, 4) psychomotor, 5) cardio-respiratory and 6) riding skills. They rode twice a week, but the number of weeks was not specified. There was lack of significant data to show improvements in strength, gait, or posture. As with McGibbon (1996), the sample size was small which may have affected the statistical significance of the results. Differences in improvement of posture and gait may be due to the type of subjects used in each. McGibbon’s subjects were younger and had no learning impairments. The plasticity of their motor pathways may have been more receptive to changes than the older subjects used in Snir et al. The use of a cardiorespiratory treadmill showed improvements in walking efficiency in the four subjects with LD. Psychomotor testing showed significant improvement in body movement imitation and the kinesthesis test demonstrated improved proprioception. The latter two improvements may be linked to improved coordination of the neuromuscular systems (Snir et al.).

Armstrong-Esther, Miller, Myco, and Sandilands (1988) hypothesized that horseback riding is beneficial in terms of balance, spinal joint mobility, behavior & affect and irrespective of medical diagnosis. The population tested included adults with Down syndrome, cerebral palsy, mental impairments, brain injury, multiple sclerosis (MS), stroke, sensory impairment and Alzheimer’s disease (AD). Thirty-nine subjects were
divided into two groups. Group one rode for two six-week sessions at three times a week with a two-week rest between sessions. This group was designated the Continuous Riding Group (CRG). Group two, the Resting Riding Group (RRG), rode for only one six week session. The reason for the different groups was to determine if one session would be enough to see improvements or if a series of sessions was needed. They considered the RRG the control group, although a true control group would not participate in any type of riding. Data analysis showed statistical improvements in left shoulder range of motion and bilateral flexion of ankle, knee and hip, as well as improvement in cognitive function. Improvement in flexion of the lower extremities "should come as no surprise because riding with a saddle maintains a flexed position at these joints" (Armstrong-Esther et al., p. 38).

Fox, Lawlor, & Luttges (1984) measured sitting balance & coordination, and hand, hip, knee, & ankle strength on nineteen children with physically impairments (7-14 years old) in a pilot study. The impairments reported were cerebral palsy, spina bifida, mild to profound mental retardation, and hearing & visually impaired. A complex balance beam developed and built by the Department of Aerospace Engineering Sciences was used to measure balance. The balance beam was used to simulate the horse and a screen would simulate the view and the changes in view that would occur as a result of movement on the balance beam. The similarities between the balance beam and a horse are unclear, so carryover of results to the horse may be questionable. Other measurements taken included the shoulder tilt using a T-square with a bubble level, the lateral spinal curve using a flexible curve, and the spine and shoulder lengths using a tape measure. Three sequential tasks were designed to assess the balance and coordination of
each subject on the balance beam. The first task involved the subject's ability to pull on the reins while sitting on the balance beam. The second activity entailed manipulating the balance beam with the arms and hands to move a pointer on the screen. The third activity entailed the use of legs in balance & coordination. This was done by putting feet in stirrups and moving the pointer on the screen similar to the arms and hands task. The study found improvements in balance, coordination, strength, and posture, but the differences were expressed in percent change from pre-test to post-test. Statistical significance can not be inferred from this type of data.

Several unpublished studies from master's theses studied various benefits of therapeutic horseback riding. One study by Munkacsy-Nastav (1993) studied two children with cerebral palsy to see if therapeutic riding affected their posture and balance in sitting. They were assessed with a timed balance test and observation using a camera and a grid on the wall. The researcher viewed the videotape to determine the amount of shoulder drop and the amount of sway in the torso. Munkacsy-Nastav (1993) used Bertoti's Postural Assessment Scale to assess posture in sitting following the balance test. The results show improvements in sitting balance, riding balance and sitting posture. As stated before, the published study that developed the Postural Assessment Scale (Bertoti, 1988) did not prove the test to be either valid or reliable, so it's use in this study was questionable. Also, the number of subjects in the study by Munkacsy-Nastav was too small to generalize to larger populations.

The second unpublished thesis by Cripe and Schmid (1996) was a case study on a seven-year-old girl with diplegic cerebral palsy at the Cheff Center. They tested her using the Bruininks-Oseretsky Test of Motor Proficiency-Short form. The improvements
found after eleven weeks of riding included increases in balance, bilateral coordination, upper-limb coordination, visual motor control, response speed, and upper-limb speed and dexterity. Because there was only one subject, the results are hard to generalize to other nontested riders. Two other master’s theses found improvements with emotionally impaired adolescents in self-esteem (Krawetz, 1993; & Tillman, 1994).

**Balance**

One of the common threads throughout therapeutic riding research is how balance is affected by this type of therapy. Balance is the ability to maintain one’s center of gravity over one’s base of support (Berg, 1989). Neurophysiologically, balance involves the integration of three sensory inputs.

...balance involves an interaction of sensory information between the vestibular, somatosensory, and visual systems. The vestibular system provides input concerning the position of the head in relation to gravity as well as to motion through linear and angular acceleration of the head. Information concerning movement of body segments with reference to each other is provided through the somatosensory system, by proprioception, cutaneous, and joint input. Lastly, the visual system provides information about the body’s position relative to the environment (Berg, p. 241).

Berg summarizes aspects of balance as they pertain to standing. In response to external forces, the body employs strategies to maintain the center of gravity in the base of support. The two strategies include a hip strategy and an ankle strategy. The ankle strategy “involves shifts of the center of body mass as a rotation about the ankle joint with little movement at the hips, and the hip strategy shifts center of body mass by flexing or extending hips” (Berg, p. 241).

There are a variety of measures to assess standing balance. The Berg Balance Test, the Barthel Index and the Fugel-Meyer are tests developed specifically for elderly and stroke patients (Shumway-Cook, 1995). The Romberg test, performed with feet
close together, the One-Foot test and the tandem test are other tests used to assess balance (Figura, Cama, Capranica, Guidetti, & Pueljo, 1991). These tests “are sensitive, but not very specific for clinical balance problems” (Duncan, Chandler, Studenski, & Weiner, 1990). Also, all of the tests may be too difficult for our subjects to perform.

Tests that measure dynamic standing include the Pediatric Clinical Test of Sensory Interaction for Balance, also known as the Foam and Dome (Deitz, Crowe, Richardson, & Westcott, 1996). This test is measured with the feet in the Romberg position, which would be too difficult to perform with our population, secondary to their physical impairments. Other dynamic assessments are the Balance Master (Liston et al., 1996), Wolfson’s postural stress test (Harburn et al., 1995), center of pressure excursion (COPE), and the perturbation tests (Duncan et al., 1990). The platform perturbation test, COPE and the Balance Master require equipment that is beyond the constraints of this study. The postural stress test requires a harness that attaches to a pulley-weight system which is beyond the capabilities of the subjects in our study who are unable to stand (Harburn et al., 1995).

**Functional Reach Test**

The assessment to be used in this study is the functional reach test. Functional Reach Test is the difference between arm’s length and maximal forward reach with shoulder flexed to 90° degrees, using a fixed base of support. It was initially developed as an alternative measurement for assessment of older persons. It measures margin of stability similar to COPE, but using less sophisticated equipment. Duncan et al. (1990) clinically observed that simple reach tasks represent similar excursions within the base of support that are seen with COPE. The three goals of Duncan et al.’s (1990) study
were: 1) to establish that standing Functional Reach’s measure of stability as related clinically to COPE, 2) to test the reliability and precision of functional reach and 3) to evaluate factors that influence functional reach. The study evaluated 128 volunteers with a range in age of 21 to 87 years old. The results show that FRT correlates highly with COPE (r = .71). The authors conclude that standing FRT is a portable and reliable test for balance (Duncan et al.). They warn that the test may be hard to perform on patients with severe dementia, extreme spinal deformities, restricted upper extremity range of motion, and those who are unable to stand (Duncan et al.).

Since the initial study, FRT has been tested on several types of populations. Several studies on functional reach have been done on elderly populations. Duncan et al. (1992) use it to try to predict those who are at risk for falls. The authors found that the functional reach test “has predictive validity in identifying recurrent falls” (Duncan, Chandler, Prescott, & Studenski, 1992, p. 93). It was also studied to establish the test as a marker of physical frailty (Weiner, Chandler, Duncan, & Studenski, 1992). This article reports that the Functional Reach Test is a reliable and accessible tool used to measure balance that can be performed easily by frail elderly (Weiner et al.). They also claim that it may have an increased sensitivity to change since it utilizes continuous data rather than ordinal data used in traditional balance tests (Weiner et al.). The sensitivity to change was tested the following year by Weiner et al. They found that Functional Reach Test was able to detect improvement in balance over time “and therefore an appropriate measure for use in prospective clinical trials” (Weiner et al., p. 796).

The standing functional reach test has also been tested on children with and without disabilities. Donahoe, Turner, & Worrell (1994) designed a study for boys and
girls without disabilities. The purposes of the study included: 1) to determine the reliability of the FRT in children five to fifteen years old, 2) determine age-related values of children five to fifteen years old and 3) determine factors that influence functional reach. The results showed interrater (r = 0.98), intrarater (r = 0.83), and test-retest reliability (r = 0.75) to be acceptable via intraclass correlation coefficients (2,1) (Donahoe et al.). Also, they found that age accounts for 38 percent of variance in functional reach. There is an consistent increase in the mean for age groups up to the age of eleven or twelve years of age (Donahoe et al.). After the age of twelve the mean levels off.

Niznik, Turner, & Worrell (1995) assessed 32 children with lower extremity spasticity using the FRT. The methods were the same as those described in Donahoe’s (1994) study. The level yardstick was taped to the wall at the level of the subject’s acromion process and the subjects stood barefoot. Their feet were traced on a white sheet of paper so that foot placement was consistent for every trial. Safety was ensured by placing a safety belt around subject’s waist as well as having an assistant guarding in case balance was lost. They used the data to determine the optimal number of trials to ensure reliability, to determine if the test is a reliable measurement for children with lower extremity spasticity and to compare mean values with the values obtained in the study by Donahoe et al. (Niznik et al.). They found no significant difference in trials one through six and no significant differences were found in intrarater reliability within a single session (Niznik et al). They concluded that one practice trial and one test trial were sufficient to determine standing functional reach in children (Niznik et al). They also found that the average value in Donahoe’s study of children without disabilities was 40% higher than the average of the children with lower extremity spasticity (Niznik et al).
Two subjective observations in the study stated that the subjects used more of a hip strategy than an ankle strategy and that the non-reaching upper extremity was used to assisted in stabilizing the trunk (Niznik et al).

**Modified Functional Reach**

Lynch (1994) designed a study to determine if the FRT could be modified to be a valid and reliable test for nonstanding populations. Thirty males with spinal cord injuries were divided into three groups based on their level of injury. The groups were as follows: 1) C5-6 tetraplegia, 2) T1-4 paraplegia, and 3) T10-12 paraplegia. The subjects were seated on a mat table with feet supported and back in backboard for trunk support. Three tests were measured in each of the two sessions with a 10-minute break between sessions. Intraclass correlation coefficients (ICCs) were calculated for MFRT scores of each group. The values for the ICCs showed a good test-retest reliability of this test. Lynch concluded that the MFRT can be a reliable and sensitive sitting balance measure.

In their unpublished master's thesis, Baer, Koeninger, & Shah (1997) used the Modified Functional Reach Test (MFRT) to examine dynamic postural control in subjects treated with Nuerodevelopmental Treatment (NDT). The authors tested the subjects reach in six directions. Two of the directions were eliminated because of low interrater reliability. The data was analyzed graphically using a two standard deviation bandwidth method. They concluded that MFRT was a reliable measure for assessing sitting functional reach in individuals who suffered from a stroke. They also found an indirect relationship between the upper extremity and trunk using the MFRT. The two reaches that showed significant upward trends were the anterior overhead and diagonally posterior reaches.
Operational Definitions

1) **Attention Deficit Hyperactivity Disorder (ADHD)**-disorder characterized by varying degrees of developmentally inappropriate inattention, impulsiveness, and hyperactivity; If occurs without hyperactivity, then the term is referred to as **Attention Deficit Disorder (ADD)** (Long & Cintas, 1995).

2) **Autism**-severe communication disorder accompanied by apparent lack of social interaction and varied play skills; frequently associated with self-stimulatory behaviors such as hand-flapping, rocking, or spinning; onset during infancy or childhood (Campbell, 1995).

3) **Back Riding** - A form of riding therapy utilized for a rider who is not able to ride independently for either physical or safety reasons. The rider is provided with an able bodied person who sits behind the handicapped person on the horse. (Depauw, 1986).

4) **Cerebral Palsy** - a non-progressive defect that is the result of single or multiple lesions in the immature brain. It involves one or more limbs and often the trunk. Children often have abnormally high muscle tone, hyperactive reflexes, insufficient force generation, poor selective control of muscle activity and may demonstrate some level of mental impairment (Campbell, 1995).

5) **Deafness**-means a hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification, that adversely affects a child's educational performances (Campbell, 1995).

6) **Down Syndrome**- a disease characterized by hypotonia, hyperflexive joints, congenital heart disease, postural reactions and mental retardation (Campbell, 1995). Some individuals with Down Syndrome have an atlantoaxial instability that could easily dislocate. Individuals with this disease should be evaluated with x-ray before participating in any riding program (Depauw, 1986).

7) **Driving**-an alternate form of therapy that is equine related and utilized with individuals physically unable to sit astride a mount (Griffith, 1992).

8) **Fragile X Syndrome**-chromosomal condition that occurs predominantly in males and is characterized by varying degrees of mental retardation, certain physical features such as large head with long face and large ears, increased testicular size, and behavioral features that may include gaze aversion, anxiety, stereotypic movements, and speech difficulties (Long & Cintas, 1995).

9) **Functional Reach Test**-the difference between arm’s length and maximal forward reach, using a fixed base of support while in standing. This test may be utilized for
detecting balance impairment or a change in balance performance over time. It is portable, inexpensive, reliable, precise and gives a reasonable approximation of the margin of stability (Duncan et al., 1990).

11) Hippotherapy - A form of therapeutic riding in which the rider is a passive participant. The rider sits or is placed in various positions on the mount and the movement of the horse causes progressive therapeutic effects including increased circulation, relaxation and decreased muscle tone. A trained physician and/or therapist should be in charge of this program (Depauw, 1986).

12) Mental Retardation (MR)- This diagnosis requires an IQ of 70 to 75, but a subaverage intelligence must also be combined with related limitations in two or more skill areas. These areas include communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics, leisure and work. Mental retardation must occur before age 18; Educably MR: IQ between 50-75 & Trainably MR: IQ between 25-50 (Campbell, 1995).

13) Modified Functional Reach Test- the difference between arm’s length and maximal forward, using a fixed base of support while in sitting with feet supported. This test is be a reliable and sensitive balance measure for nonstanding populations (Lynch, 1994).

14) Muscular Dystrophy - a progressive neuromuscular disease that is genetically inherited. The continuous loss of myofibrils causes insidious weakness which results in postural malalignment and contractures (Campbell, 1995).

15) Prader-Willi Syndrome-a genetic disorder passed from the father characterized by mild cognitive delay, hypotonia during infancy, short stature, and hyperphagia, which can result in severe obesity (Long & Cintas, 1995).


17) Riding as sport- An exercise program performed on horseback for handicapped people that can increase strength and physical abilities. It may also increase social interaction and improve mental attitudes (Depauw, 1986).

18) Riding Therapy-The rider still receives the benefits of passive riding but performs exercises designed to increase coordination, equilibrium and reflex integration. Most types of riding programs are associated with some type of physical therapy (Griffith, 1992).

19) Seizures-a recurrent paroxysmal disorder of cerebral function characterized by sudden, brief attacks of altered consciousness, motor activity or sensory phenomena (Taber’s, 1989).

20) Sitting Balance- the ability to maintain the body’s center of gravity within its base of support while seated.
21) **Specific Learning Disability (SLD)**—term used for any of a group of disabilities characterized by difficulties in understanding, using, or perceiving language, vision or movement because of processing difficulties that are not the result of mental retardation or other identifiable impairments; affects school performance (Long & Cintas, 1995).

22) **Spina Bifida**—the dorsal protrusion of a defective, open spinal cord. Motor and sensory loss vary from mild to severe. Children with this disease may demonstrate spinal and lower limb deformities, joint contractures, hydrocephalus, brain stem involvement, seizures, spasticity, sensory deficits, paralysis and cognitive dysfunction (Campbell, 1995).

23) **Standing Balance**—In response to external forces, the body employs a hip or ankle strategy to maintain the center of gravity within the base of support (Berg, 1989).

24) **Therapeutic Riding**—A form of treatment therapy where the participant is a rider who is either an active or passive participant in an individually prescribed exercise program which takes place on horseback or in a cart (Griffith, 1992). There are several forms of therapeutic riding that are well defined.

25) **Tuberous Sclerosis**—a syndrome manifested by convulsive seizures, progressive mental disorder, adenoma sebaceum, and tumors of the kidneys and brain with projection into the cerebral ventricles (Taber’s, 1989).

26) **Vaulting**—A form of riding therapy where gymnastic exercises are performed on horseback. Often these activities consist of balance and movement activities (Griffith, 1992).

27) **Visual Impairment (VI) including blindness**—means an impairment in vision that, even with correction, adversely affects a child’s educational performance. The term includes both partial sight and blindness (Campbell, 1995).
CHAPTER THREE
METHODOLOGY

Setting

The Cheff Center for the handicapped in Augusta, Michigan agreed to provide participants for this study. This Center was the first therapeutic riding center established in the United States. The death of Katherine Cheff in 1966 prompted her husband, Ted Cheff, to establish a foundation for horses and young people. This foundation, after much research, made a large donation to the field of therapeutic riding, and the Cheff Center officially opened its doors in 1970 as the largest therapeutic riding facility in the world (Griffith, 1992). The Center has since produced over 500 riding instructors and has contributed to many of the existing riding locations across the nation (Biggs & Gilmore, 1996). It is a 380-acre complex that hopes to be able to house eight handicapped riders during extended programs (Griffith, 1992). Close to 400 riders participate in riding programs at the Cheff Center during the school year and at summer camps. The Center has approximately 40 horses available for riding. The staff at the Cheff Center consists of three riding instructors and one occupational therapist who is a part time employee and who does evaluations of the riders as time allows. The backbone of this riding center is its volunteers; sixty to ninety volunteers are required per week for the center to function effectively (A. Newman, personal communication, April 9, 1997). The Cheff Center is funded entirely by contributions from foundations, corporations and...
individuals. Riders at the Cheff Center have a variety of diagnoses that include physical, emotional and learning disabilities (Biggs & Gilmore, 1996).

Subjects

The riding instructors agreed to provide instruction for the summer camp session. The Program Director was involved with the implementation of this study. Twenty-five subjects, between the ages of 8 and 18 were selected to participate in this study based on their involvement in the Cheff Center's Summer Camp program.

Inclusion criteria for participation in this study were as follows:

1. Diagnoses including cerebral palsy, down's syndrome, hearing-impaired, visually-impaired, blind, deaf, seizures, prematurity, tuberous sclerosis, Prader Willi, fragile X, spina bifida, autism, ADHD, ADD and SLD
2. Past experience in riding is permitted (amount will be documented on subject form filled out by each parent)
3. Past physical therapy is permitted (amount will be documented on subject form filled out by each parent)
4. Ages 8-18
5. Permission of child, parent and Cheff Center
6. Subjects are required to obtain a physician's release, updated yearly, prior to participation, which may consist of a physical exam
7. Child will be able to raise the right arm to 90° of shoulder flexion
8. Child will be able sit unsupported for a minimum of 30 seconds at a time (Modified Functional Reach)
9. Child will be able to stand unsupported for a minimum of 2 minutes at a time (Functional Reach)

Exclusion criteria were congruent with the Cheff Center's policies including:

1. A child with any medical/orthopedic problem that would prohibit riding
2. Uncontrolled seizures
3. Severe MR
4. Excessively fragile skin
5. Emotional distress that would interfere with safety
6. Inability to wear a helmet
7. Progressive neuromuscular disease that would prohibit postural control
8. Symptoms of Chiari II Malformation or hydromyelia
9. Riders with spinal cord lesions above upper thoracic
10. Bone tumors that could increase likelihood of fracture
11. Status-post tendon lengthening surgery
12. Uncontrolled diabetes
13. HTN
14. Severe varicose veins
15. Osteoporosis imperfecta

**Contraindications** also included:
1. Riders with tethered cords
2. Riders with worsening neurological symptoms


**Instrumentation**

The Functional Reach Test and Modified Functional Reach Test were the instruments selected for use in this study. Time, equipment, degree of improvement in five days and sitting/standing balance related to function were all points considered in deciding which test to use in this study. The Functional Reach and Modified Functional Reach are tests of balance related to function. The Functional Reach was developed with the geriatric population and school age children in mind. The Functional Reach was empirically developed and was declared to be valid and reliable by Duncan within the context of the two studies (1990, 1992). Various investigators previously cited in the literature review also demonstrated validity and reliability within the context of each particular study. The Modified Functional Reach Test was claimed reliable and valid by Lynch (1994) with subjects demonstrating spinal cord injuries. Newton’s study (1996) with older adults and Baer’s (1997) with a stroke patient also cited reliability and validity. These two tests can be administered by any professional in the medical field including PT’s, OT’s and MD’s.

The testing environment at the Cheff Center was in a single barn stall in the middle of the barn. The room was lit by a single light bulb. The barn lacked environmental controls such as air conditioning and a quiet testing room. Equipment
consisted of a yardstick, velcro strips, adjustable shower bench, stool, gait belt, large sheets of paper and data recording sheets. The children had on loose, comfortable clothing. All subjects wore their assigned riding helmets during testing.

Procedure

Permission was gained through consent forms that were sent to each parent with the Cheff Center camp packet, which was distributed in May 1997. There was also a letter that explained the purpose of the study, possible benefits and what was expected of the child. It was stressed that participation would not affect the child's riding program or camp involvement. A subject information form was also included. Examples of these forms are located in Appendix A. Parents were given numbers to contact the following if they so desired: Paul Huizenga, Human Subjects Review Board; Dr. Jane Toot, Chair of Committee; and Heather Vavrina, S.P.T. if they had any questions. Written permission by the Human Subjects Review Committee was obtained on May 15, 1997 (Appendix E). Camp dates included: June 16-20, June 30-July 4, July 7-11, July 21-25 and finally July 28-August 1, 1997. A total of 25 children participated in this study. For the breakdown of the diagnoses for this population refer to Appendix F. All children were mentally and/or physically challenged as previously stated in inclusion criteria.

Eight children in the first camp session between June 16-20, 1997 served as the pilot group. The next four camp sessions served as the quasi-experimental group. Program structure, goals, objectives and testing were done in the same manner for all five camp sessions. The staff personnel remained the same across all five sessions, which
included three riding instructors and a physical therapist. There were approximately 60-90 volunteers weekly.

The research design used was the one-group pretest-posttest type. This involved pretest, intervention and posttest. The pilot study included five subjects for the Functional Reach Test and seven subjects for the Modified Functional Reach Test. During the pilot, four of the same subjects were tested for both the FRT and the MFRT. One additional subject participated in the sitting portion and three additional subjects participated in the standing portion of the tests. The actual study included fifteen subjects for the Functional Reach Test and seventeen subjects for the Modified Functional Reach Test. In this portion of the study, the same fifteen subjects were used for the Functional Reach Test and the Modified Functional Reach Test except for the additional two subjects for the Modified Functional Reach Test.

The FRT is performed by having subjects stand, raise their right arm to 90° of shoulder flexion and reach as far forward as they can without losing their balance or changing their foot position. Subjects stood with their right shoulder adjacent to the wall. At the acromion process, shoulder height was marked on a piece of vertical tape on the wall and measured. A yardstick was attached to the wall with velcro strips and was easily adjusted to each subject’s arm height. The yardstick was adjusted so that it was level with each subject’s arm at 90° of flexion. The distance forward that each subject was able to reach was measured to the nearest quarter inch by a yardstick. Foot position was traced during pretesting onto large sheets of paper with a marker. All subjects were tested wearing shoes. Subjects were allowed one trial each and then performed three measurable reaches that were recorded by the tester using the pretest and posttest data
sheets found in Appendix B and C. Subjects were not allowed to lean against the wall during testing. Gait belts and one assistant were used to ensure safety. The gait belt was worn around the child's waist so that it could be grasped in case of loss of balance.

The MFRT is performed in exactly the same way as the FRT except those subjects are seated with the hips and knees at 90° of flexion. Subjects were seated on an adjustable shower chair and a footstool was used to obtain the correct hip and knee position. The greater trochanter and acromion process were visually aligned using the vertical tape on the wall. Shoulder height and foot position were also measured.

Each child was tested Monday morning before riding and Friday morning either before or after the final ride at camp. Throughout the week of camp each child participated in approximately nine riding sessions between pretest and posttest. The number of riding sessions between pretest and posttest did vary depending on the weather, subject tolerance and time constraints for testing.

Posttesting was done exactly as pretesting except that shoulder height, greater trochanter alignment and foot placement were aligned to match that of the pretest. This was done to control the subject's base of support and posture.

Instructions were given before each test sessions, which consisted of:

FUNCTIONAL REACH TEST

1. Stand with feet flat on the floor.
2. Stand up straight.
3. Reach as far forward as you can with your right hand facing down without falling, touching the wall or stepping forward.
4. Rest.
5. Repeat an additional two times.
MODIFIED FUNCTIONAL REACH TEST

1. Sit on bench with feet flat on the floor, with legs forming an "L" and with hands on lap.
2. Sit up straight.
3. Reach as far forward as you can with your right hand facing down, without falling, touching the bench or wall.
4. Rest.
5. Repeat an additional two times.

Guidelines for test administration were followed closely (Newton, 1996; Lynch, 1994; and Duncan 1990,1992). The design of the pilot study was for all three testers to test every child for both the Functional Reach Test and the Modified Functional Reach Test. All three testers tested subjects unless fatigue or subject tolerance prevented such extensive testing. During the following four weeks of testing only two of the original three testers were utilized. For each of these four weeks a tester was selected based on availability. This individual conducted both the pretest and posttest for that week. The FRT and the MFRT each required the child to reach forward three separate times. During the pilot study when the children were tested by up to three testers the children may have performed a total of nine recorded reaches. Scores were kept separate so as to avoid bias at the posttest. Each child was assigned a number by which to record data. Names were excluded in any discussion and were kept confidential. Subjects did not receive payment for participation.

A typical testing schedule was as follows:

1. After the subjects arrive at camp on Monday, each was pretested using the Modified Functional Reach and Functional Reach in sitting and/or standing by one S.P.T. evaluator, prior to their first riding session.

2. A standard therapeutic riding program was implemented for five consecutive days. This consisted of two forty-minute sessions of riding a day, classroom time involving learning rules, procedures and proper equine
terminology. Hands-on grooming, brushing, leading, tacking, stable management and saddling the horse was also practiced.

3. Posttesting was done on the Friday morning of the last day of camp by the same tester and with the same protocol as on Monday. This same procedure was followed for all five camp sessions.

A typical day:

1. An 8 a.m. feeding of the horses by all children.

2. The group was then split into two groups. One group cleaned stalls and participated in horse care (grooming and brushing), while the other group did journal writing.

3. The groups switched after approximately one hour.

4. The next activity consisted of half of the children riding for 40 minutes and the other half learning stable management. For the riding portion each child was asked to saddle and lead the horse to the arena, with the best of their ability. An effort was to be made with grooming, leading and tacking before the child was allowed to ride the horse. Volunteers were around for safety and to help as the children needed. Assistance was given as the child mounted the horse. A trained therapeutic riding instructor led the children while they were on the horse. Belts were not used, but the volunteers would place their hands on the child's thigh for balance if necessary while riding. Activities included: simple walking, trotting and cantering. Exercises on the horse included: stretches, reaching and two point (stand up leg stance like a jockey). This was dependent on the skill and comfort level of the child. Each child had one opportunity in each camp session to try vaulting and driving. The children were expected to listen, follow simple & complex commands/directions, ride through obstacles, trail rides and games. When the riding was over, each child had to lead the horse to the stall and remove the saddle.

5. The groups then switched.


7. A similar schedule was repeated in the afternoon. (A. Newman, personal communication, April 9, 1997)
**Anticipated Problems**

Anticipated problems prior to data collection included: a variety of diagnoses, anxiety of the rider, medical complications, motivation and behavior of the child and a possible Hawthorne effect. The Hawthorne effect is where a person will want to improve in order to please researchers and riding instructors or just because of the attention. Participants may also be tired on Friday morning due to 5 days of riding and the fact that they had a sleep over on Thursday night. It was expected that approximately 60 children would attend summer camp at the Cheff Center. Although the researchers hoped to have all 60 children participated in the study a smaller number of participants was anticipated. The sample was one of convenience, which included anyone attending the summer camp with a signed consent form.

**Data Analysis**

The pretest and posttest data was collected during all five camp sessions. The parametric data from the four weeks following the pilot study was statistically analyzed using a one-tailed t-test for paired comparisons at $\alpha = 0.05$. The interrater and intrarater reliability was determined using data from the pilot study. The independent variable was a five-day therapeutic riding session. The dependent variables were sitting and standing balance as tested by the Functional Reach and the Modified Functional Reach Tests.
CHAPTER FOUR

RESULTS

Introduction

The quasi-experimental design involves one set of measurements taken on one group of subjects before and after treatment. This one-group pretest-posttest design was used to determine the effect of treatment by comparing pretest and posttest scores of 15 subjects for Functional Reach Test and 17 subjects for the Modified Functional Reach Test. All of the subjects selected were participants in a five-day therapeutic riding camp at the Cheff Center. A total of five groups of children were measured. A pilot study was conducted during the first of the five test weeks. This data was used to determine interrater and intrarater reliability. Data from the following four weeks was combined and analyzed to determine the effect of treatment. A different number of children were tested each week depending on how many children were attending camp that week and eligibility to participate in the study. Subjects were determined to be eligible to participate in this study based on the inclusion and exclusion criteria stated in chapter three. The initial measurements were taken on the first day of the five-day horseback riding program before the subjects were allowed to ride. The scores for each student were based on the average of three measurements taken consecutively for each test. The subjects able to sit and stand were tested using both the Functional Reach and the Modified Functional Reach Test. Those unable to stand independently were tested only
in sitting using the Modified Functional Reach Test. At the end of the five-day riding program, posttest measurements were taken in the same way. This was repeated for four more horseback riding sessions using new subjects each week.

During the pilot study, three testers measured subjects in both sitting and standing. Not all of the subjects were tested by all three of the testers in both sitting and standing secondary to time constraints and subject tolerance. During the following four weeks of testing only two of the original three testers were utilized. For each of these four weeks a tester was selected based on availability. This individual conducted both the pretest and posttest for that week.

**Interrater and Intrarater Reliability**

Interrater reliability was established for the Functional Reach Test and Modified Functional Reach Test using posttest data from the pilot study. The value of the interclass correlation coefficient for the Functional Reach Test for all three testers was 0.91. The correlation among raters was determined to be 0.98 for testers one and two, 0.89 for testers one and three and 0.98 for testers two and three. The interclass correlation coefficient for all three testers for the Modified Functional Reach Test was determined to be 0.96 using posttest data. Correlation among raters for the MFRT was determined to be 0.95 for testers one and two, 0.99 for testers one and three and 0.96 for testers two and three. It was determined that testers one and two would be utilized for the following weeks. Testers one and two each did the pretesting and posttesting for two of the four weeks based on availability. For the FRT intrarater reliability was found to be 0.95 for
Intrarater reliability for the MFRT for tester one was 0.76, for tester two it was 0.63 and for tester three it was 0.65.

**Functional Reach Test Results**

The data from the four weeks following the pilot study was combined and analyzed. During the four weeks a total of 15 subjects participated in the standing portion of the study. The means and standard deviations were calculated for the pretest and posttest values for the FRT. The one-tailed t-test for paired comparisons was used to analyze the difference scores within each pair. When using the t-test for paired comparisons it is assumed that the data follows a normal distribution. The data from this study met this assumption as demonstrated by Figure 1.1 and 1.2. The mean and standard deviation of the paired differences was determined. All of these values are presented in Table 1.1. The alpha value was set at .05 level of significance. The p-value for the FRT was determined to be .156 (t = -1.04, df = 14).

The null research hypothesis for standing balance is as follows: A five-day therapeutic riding program will not have any effect on standing balance as measured by the Functional Reach Test. The alternative hypothesis states: A five-day therapeutic riding program will improve standing balance as measured by the Functional Reach Test. Since the p-value for the FRT was found to be greater than .05 the null hypothesis failed to be rejected. There was no evidence to indicate that a significant improvement in standing balance occurred between pretest and posttest.
Modified Functional Reach Test Results

The mean and standard deviation for the pretest and posttest values of the MFRT were determined. The one-tailed t-test for paired comparisons was used to analyze the difference scores within each pair. Data relating to the MFRT is presented in Table 1.2. The alpha value was set at .05 level of significance. The p-value for the MFRT was determined to be .020 (t = -2.24, df = 16).

The null research hypothesis for sitting balance is as follows: A five-day therapeutic riding program will have no effect on sitting balance as measured by the Modified Functional Reach Test. The alternative hypothesis states: A five-day therapeutic riding program will improve sitting balance as measured by the MFRT. As the p-value for the MFRT was found to be less than the alpha level .05 the null hypothesis is rejected and there is support for the alternative hypothesis.

Summary

Data from the pilot study demonstrated that the FRT and the MFRT had a high interrater reliability. Intrarater reliability for the FRT was above 0.90 for all three testers but ranged from 0.63-0.76 for the MFRT. The results from this study indicate that the children who participated in this five-day program of therapeutic riding demonstrated a statistically significant improvement in sitting balance as measured by the Modified Functional Reach Test. An improvement in standing balance also occurred but was not found to be statistically significant.
Distribution of Difference
Standing Test

Figure 1.1

Std. Dev = 1.74
Mean = .5
N = 15.00

Difference (inches)
Figure 1.2

Distribution of Difference
Sitting Test

- Std. Dev = 1.99
- Mean = 1.1
- N = 17.00

Difference (inches)

Number of Subjects

-4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0
## Functional Reach Test Data  Table 1.1

<table>
<thead>
<tr>
<th></th>
<th>Number of Pairs</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Average</td>
<td>15</td>
<td>21.2167</td>
<td>5.177</td>
</tr>
<tr>
<td>Posttest Average</td>
<td>15</td>
<td>21.6833</td>
<td>4.626</td>
</tr>
<tr>
<td>Paired Differences</td>
<td>14(n-1)</td>
<td>-0.4667</td>
<td>1.741</td>
</tr>
</tbody>
</table>

## Modified Functional Reach Test Data  Table 1.2

<table>
<thead>
<tr>
<th></th>
<th>Number of Pairs</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Average</td>
<td>17</td>
<td>23.5392</td>
<td>1.505</td>
</tr>
<tr>
<td>Posttest Average</td>
<td>17</td>
<td>24.6176</td>
<td>5.962</td>
</tr>
<tr>
<td>Paired Differences</td>
<td>16(n-1)</td>
<td>-1.0784</td>
<td>1.97</td>
</tr>
</tbody>
</table>
CHAPTER FIVE

DISCUSSION

Introduction

Much of the literature relating to therapeutic horseback riding is limited to descriptive studies in the form of testimonies and case studies as opposed to empirical data. In the last five to ten years there has been a shift toward quantitative data. Literature shows that therapeutic horseback riding improves balance, coordination, muscle strength, ROM, flexibility, posture and ambulation and decreases spasticity.

The purpose of this research study was to evaluate the effect that a five day, intense therapeutic riding program had on the standing and/or sitting balance of children ages eight to eighteen with a wide variety of disabling diagnoses as measured by the Functional Reach Test and the Modified Functional Reach Test. The stated hypothesis was: After participating in a five-day session of therapeutic riding, subjects will show significant improvement in standing and/or sitting balance as measured by the Modified Functional Reach Test and the Functional Reach Test on children ages eight to eighteen with a variety of disabling diagnoses. After an extensive search, we believe this study is the first to test both standing and sitting balance, for therapeutic riding with children, as measured by the Functional Reach Test and the Modified Functional Reach Test.

Reliability of Measurement Tools

Duncan (1992) has shown a high interrater reliability for the Functional Reach Test. Weiner et al. (1992) showed the Functional Reach Test to be reliable and sensitive
to changes over time. Donahoe, Turner, & Worrell (1994) showed interrater, intrarater and test-retest reliability in children without disabilities ages five to fifteen. Niznik, Turner, & Worrell (1995) showed that one practice trial and one test trial were sufficient to determine standing functional reach in children with disabilities and that the Functional Reach test was reliable. Lynch (1994) designed a study that determined the Modified Functional Reach Test reliable and a sensitive sitting balance test. Baer, Koeninger and Shah, in an unpublished master’s thesis, (1997) show a high interrater reliability \( \geq 0.97 \) for the Modified Functional Reach Test. They tested the anterior shoulder reach, anterior overhead reach, lateral shoulder reach, diagonally anterior reach and diagonally posterior reach on a single stroke patient. This study has shown a .98 interrater reliability for the Functional Reach Test and a .95 interrater reliability for the Modified Functional Reach Test for the testers used.

**Limitations and Benefits**

There were many factors that limited this study. The first being that the anticipated sample size was sixty, but only twenty-five children qualified. A few of the reasons for this small sample size included inappropriate age, lack of signed permission slips, inability to perform pretest and posttest and a decrease in camp attendance at the Cheff Center for the summer of 1997. Although a wide variety of diagnoses were anticipated, there were fewer physically challenged subjects and more behavioral diagnoses than predicted.

Environmental controls presented another factor. Although, all the children were tested in the same room for all pretest and posttest, the lack of environmental control of the room itself and its surrounding area may have played a factor. The only room
available was a barn stall. The room was not very well lit and the temperature varied depending on outside temperature. There was a high degree of background noise in other stalls by the horses and in the walkway with people and machinery being operated. The noise alone of the horses and machinery distracted the children. The stall door was closed during the testing, but the children were still very distractible.

A huge limitation was the fact that the subjects reported they were fatigued during posttesting. They had an overnight the Thursday night before the final testing on Friday. This was a party night and many of the children stayed up late and were tired on Friday morning. Also contributing to the fatigue factor, was the fact that testing was done the last day of camp. These children had been riding, approximately twice daily, for four days straight. For some of these children this was probably a dramatic increase in exercise and activity level. They were just not “up to testing again on Friday”. On the Monday testing, the children were fresh and this was new and exciting, but by Friday they were ready to return home.

Even though the tests were simple and straight forward, some children had difficulty performing them for a variety of reasons. Reasons may have included decrease attention span, lack of concentration on the task, temperament, difficulty following directions, lack of understanding of the task and anxiety of being tested. It is difficult to ascertain if a maximum amount of effort was given for each trial. Some of the children wanted to please us and tried extra hard, while others had a difficult time giving a maximal effort.

Other limitations included several different issues. The fifth week of the study was shortened. Instead of the five days of riding and being tested on the morning of the
fifth day, children were tested on the morning of the fourth day. The number of rides that each child completed between pretest and posttest varied depending on the week of camp attendance, the weather conditions and availability for testing. The variance in number of rides was another example of the researchers inability to control all of the parameters within the study. In addition, this was not a blind study. Two of the researchers were the testers. However, pretest and posttest data sheets were kept separate to decrease any bias. Also, this study did not include a control group. The researchers focused on the effect therapeutic horseback riding had on pretest and posttest scores. The focus was not to compare therapeutic horseback riding to subjects that did not receive the intervention. Finally, balance screening was not done prior to this study on these subjects, therefore, in retrospect, it was difficult to show statistical significant improvements on subjects that may or may not have had pre-existing balance deficits.

Benefits of this study include the fact that statistical significance was shown with the Modified Functional Reach Test. There are limited studies that include this test. The design of the study adds to the available research bank.

**Suggestions for Further Research**

Suggestions for further research could include: 1) checking balance improvements six months and twelve months after intervention using this design, 2) using the Functional Reach Test and/or the Modified Functional Reach Test over a longer period of therapeutic intervention time, 3) utilizing a particular population with more control of environmental factors, 4) using a larger sample size with a control group, 5) repeating the same study with pre-determined balance deficits.
Summary

Data from the pilot study indicated that the FRT and the MFRT had high interrater reliability (0.91) with all three testers. Intrarater reliability was found to be above 0.90 for all testers for the FRT and ranged from 0.63-0.76 for the MFRT.

The Functional Reach Test and the Modified Functional Reach Test are reliable tools that can easily be implemented in the clinic for a measurement of balance. Although this study did not show statistical significance in the Functional Reach Test, it did show improvement. The Modified Functional Reach Test did show that a statistically significant improvement occurred for sitting balance.

The researchers feel that even though the data from the MFRT was statistically significant the implications of this study are limited. The assumption going into the study was that the majority of the population would have balance deficits in standing and/or sitting. However, the majority of the subjects did not appear to have noticeable sitting balance deficits when observed by the researchers. One reason may have been that many of the subjects were not physically challenged. It appeared to the researchers that many of the subjects’ sitting forward reach was limited only by their anatomical limits and not by decreased balance. Therefore, it is difficult to explain how sitting balance can improve significantly. It would be advisable for future research to focus on subjects with noted balance deficits in sitting.

This is only one piece in an area of much needed research. Further research is needed on the effect of therapeutic horseback riding with the Functional Reach Test and the Modified Functional Reach Test. More research could establish stronger reliability and validity of these tests with children with a variety of diagnoses.
REFERENCES


Dear Parent/Guardian,

The Cheff Center for the Handicapped has an exceptional program of therapeutic horseback riding. Your son or daughter will soon become involved in their summer program. One of the suspected benefits of such a program is an increase in standing and/or sitting balance. There is much research that supports this claim, but not in such a limited amount of time, such as a five-day summer program or in relationship to function. For this reason, we are conducting a study entitled, “The effects of a five-day therapeutic horseback riding program on the standing and/or sitting balance of children ages 8-18 with a wide variety of disabling diagnoses as measured by the Functional Reach Test and the Modified Functional Reach Test”.

Participation is not required for your child to attend the camp, but compliance to serve in this study will greatly help to improve the much needed research in this field and be deeply appreciated. This could have impact on future insurance coverage of such a program. The test will take about fifteen minutes to administer and is a very simple, safe test. Testing will be done on the Monday the child arrives and the Friday before the child leaves. All testing will comply with the Cheff Center testing procedure and is being reviewed by the Human Subjects Review Board at Grand Valley State University. Initiation of the study will indicate approval by the Human Subjects Review Board at Grand Valley State University.

The purpose of study is to determine the effectiveness of a five-day therapeutic horseback riding program as a means of improving standing and/or sitting balance as it is related to function. Results of the study are intended to promote this activity as a means of helping children with handicaps overcome their disabilities. All information will be kept confidential, but will be available to you at your request.

All children whether they participate in the study or not will be treated equally. There will be no differences in their riding programs, except for the two testing times. (Monday upon arrival and Friday before departure). Further information is included in the consent. If there are any questions regarding this study, please feel free to call Dr. Jane Toot, Chairman of Thesis the Committee at Grand Valley State University, Paul Huizenga, Chairman of Human Subjects Review Board at Grand Valley State University, at or Heather Vavrina, S.P.T./researcher.

Please place only the following two pages in the attached envelope and return by June 4, 1997. Please return forms regardless of your decision for your child to participate. All other camp information should be returned to the Cheff Center or as otherwise indicated in the camp packet.

Sincerely,

Pamela A. Staszewski, S.P.T.
Heather Vavrina, S.P.T
Rich Chaperon, S.P.T.
Grand Valley State University  
Department of Physical Therapy  
Principal Members: Pamela A. Staszewski, Heather Vavrina, Rich Chaperon  
Thesis Committee Members: Dr. Jane Toot, Dan Vaughn, Neal Rogness

I understand that my child has been invited to participate in a research project entitled, "The effects of a five-day therapeutic horseback riding program on the standing and/or sitting balance of children ages 8-18 with a wide variety of disabling diagnoses as measured by the Functional Reach Test and the Modified Functional Reach Test". The purpose of this study is to determine the effectiveness of a five-day therapeutic horseback riding program as a means of improving standing and/or sitting balance. I further understand that the purpose of this project is to fulfill graduate level physical therapy research for Pamela A. Staszewski, Heather Vavrina and Richard Chaperon.

I understand that participation is optional and will have no effect on my son or daughters therapeutic horseback riding program. I understand that my child will be administered the 'Functional Reach Test and the Modified Functional Reach Test' in standing and/or sitting depending on prior level of function as determined before coming to camp. Distance that your child can reach forward in standing and/or sitting will be measured using a yardstick. The child will be asked to reach forward several times during the test. No child will be asked to perform beyond their functional level and their safety will be held in the highest regard. This test will take approximately fifteen minutes and will be administered by the same evaluator both times. The evaluator will be one of the above mentioned student physical therapists. All testing will be within the Cheff Center and Human Subjects Review Board guidelines. Each child will be assigned a number by which to record data. Names will not be included in any discussion and will be kept confidential. I understand that I will not be paid for participation in this study. I also understand that I may obtain results of my child's test and/or the study upon request. I must request this from the researchers and provide postage.

I understand that the only anticipated risks may include mild stress and anxiety. Two assistants will be present to ensure safety. I understand that all usual testing measures will be maintained to minimize discomfort and unforeseen risks to my child. No compensation or treatment will be made available to me unless otherwise specified.

I understand that I may withdraw my child or that my child may withdraw from this study at any time without any negative consequences on the therapeutic horseback riding summer camp program. If I have any questions or concerns regarding this study, I will contact Dr. Jane Toot, Chairman of Thesis Committee at Grand Valley State University, or Paul Huizenga, Chairman of Human Subjects Review Board at Grand Valley State University.

My signature below indicates full understanding and permission for ________________ (child's name) to participate and be pre/post tested with the 'Functional Reach Test and/or the Modified Functional Reach Test'. I give permission for the results of this test on my child to be included in the thesis and possible publication of thesis entitled, "The effects of a five-day therapeutic horseback riding program on the standing and/or sitting balance of children ages 8-18 with a wide variety of disabling diagnoses as measured by the Functional Reach Test and The Modified Functional Reach Test".

Guardian's Signature __________________________ Date _______________

Child's Signature (Optional) __________________________ Date _______________
# APPENDIX B

**Functional Reach Test and Modified Functional Reach Test Tally Record Form for the Pre-test**

| Child Number: | __________________________ |
| Date: | __________________________ |
| Session: | __________________________ |
| Evaluator Name: | __________________________ |
| Assistant: | __________________________ |
| Chair Height: | __________________________ |
| Acromion Height: | __________________________ |
| Stool: | low | high |

### Function Reach Test Distance (in.)

<table>
<thead>
<tr>
<th>a. Trial 1</th>
<th>Pre-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Trial 2</td>
<td>___</td>
</tr>
<tr>
<td>c. Trial 3</td>
<td>___</td>
</tr>
<tr>
<td>d. Mean</td>
<td>___</td>
</tr>
</tbody>
</table>

### Modified Functional Reach Test Distance (in.)

<table>
<thead>
<tr>
<th>a. Trial 1</th>
<th>Pre-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Trial 2</td>
<td>___</td>
</tr>
<tr>
<td>c. Trial 3</td>
<td>___</td>
</tr>
<tr>
<td>d. Mean</td>
<td>___</td>
</tr>
</tbody>
</table>
APPENDIX C
Functional Reach Test and Modified Functional Reach Test
Tally Record Form for the
Post-test

Child Number: ________________________________

Date: ________________________________

Session: ________________________________

Evaluator Name: ________________________________

Assistant: ________________________________

Chair Height: ________________________________

Acromion Height: ________________________________

Stool: low high

Functional Reach Test Distance (in.)
   a. Trial 1 ________________________________
   b. Trial 2 ________________________________
   c. Trial 3 ________________________________
   d. Mean ________________________________

Modified Functional Reach Test Distance (in.)
   a. Trial 1 ________________________________
   b. Trial 2 ________________________________
   c. Trial 3 ________________________________
   d. Mean ________________________________
APPENDIX D
Information Form

Child Name: ___________________________________________________

Diagnosis of Child: _____________________________________________

Child’s Date of Birth: __________________________________________

Race of Child: ________________________________________________

Gender of Child: ______________________________________________

Past Medical History: __________________________________________

Past Surgical History: __________________________________________

Able to stand without any assistive device or support for at least 2 minutes: Yes / No (Circle one)

Able to sit unsupported for at least 30 seconds at a time: Yes / No (Circle One)

Able to lift one arm in front of them to shoulder level (90° of flexion): Yes / No (Circle One)

Previous types of therapy including dates, time & frequency: ________________

________________________________________________________________________

Past therapeutic horseback riding experience: __________________________

________________________________________________________________________

Any other pertinent data from physical exam: ____________________________

________________________________________________________________________
May 21, 1997

Richard Chaperon, Pamela Staszewski,
and Heather Vavrina
1047 Chatham #2
Grand Rapids, MI 49504

Dear Richard, Pamela, and Heather:

The Human Research Review Committee of Grand Valley State University is charged to examine proposals with respect to protection of human subjects. The Committee has considered your proposal, "The Effects of a Five Day Therapeutic Horseback Riding Program on the Sitting and/or Standing Balance of Children Ages 8-18 With a Wide Variety of Disabling Diagnoses as Measured by the Modified Functional Reach and Functional Reach Tests", and is satisfied that you have complied with the intent of the regulations published in the Federal Register 46 (16): 8386-8392, January 26, 1981.

Sincerely,

Paul Huizenga, Chair
Human Research Review Committee
## APPENDIX F
### Breakdown of Subjects’ Diagnoses

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th># of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spina Bifida</td>
<td>2</td>
</tr>
<tr>
<td>Cerebral Palsy</td>
<td>6</td>
</tr>
<tr>
<td>Educably Mentally Impaired (EMI)</td>
<td>1</td>
</tr>
<tr>
<td>Seizures</td>
<td>3</td>
</tr>
<tr>
<td>Attention Deficit Hyperactivity Disorder (ADHD)</td>
<td>8</td>
</tr>
<tr>
<td>Premature Birth</td>
<td>1</td>
</tr>
<tr>
<td>Deafness</td>
<td>1</td>
</tr>
<tr>
<td>Visual/Hearing Impairment</td>
<td>1</td>
</tr>
<tr>
<td>Blindness</td>
<td>1</td>
</tr>
<tr>
<td>Autism</td>
<td>1</td>
</tr>
<tr>
<td>Fragile X Syndrome</td>
<td>1</td>
</tr>
<tr>
<td>Specific Learning Disability</td>
<td>1</td>
</tr>
<tr>
<td>Prader-Willi Syndrome</td>
<td>1</td>
</tr>
</tbody>
</table>

*some of the children had more than one diagnoses*