Exploring Changes in Postural Balance and Functional Mobility

In Children and Adults with Disabilities Participating in Therapeutic Riding

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How we became involved with research...

- PATH certified instructor
- Experienced with children and equines
- RTT connection with UNE
- Previous research conducted at RTT
Introduction

- Children and adults with physical disabilities face daily challenges including decreases in their functional mobility and postural stability which increase their risk for falls \(^{26}\).

- Therapeutic horseback riding (THR) addresses problems of postural instability and limited functional mobility in pediatric and adult populations.

- Although promising, therapeutic riding research conducted to date has been limited by
  - Investigation of only a limited number of patient diagnoses
  - Small sample sizes
  - Poor measurement responsivity \(^{3, 6, 14, 28}\)
Our goal was to design a study that allowed us to look at the potential benefits of THR using standardized measurements that met the following criteria:

- Adult and Pediatric versions of measurements
- Pre-determined reliability and validity in populations of children and adults with and without disabilities
- Have not been applied in previous studies of Therapeutic Riding
- Captured balance, postural stability, and functional mobility across a continuum from simple to complex
We chose to use 4 measures:

- **Functional Reach (FR)**
- **Timed Up & Go (TUG)**
- **Standardized Walking Obstacle Course (SWOC)**

In addition to these 3 standardized measures we wanted to assess parental/guardian perceptions of participants <17 years of age. Therefore, we created:

- **Customized parent/guardian perception questionnaire (CoMB)**
Measures

Functional Reach (FR)

- Subject begins the test by standing upright with shoulders perpendicular to a yard stick placed horizontally on the wall, feet shoulder width apart, arm extended, hand in a fist.
- Tester notes where knuckle falls on yardstick at start position.
- Subject is asked to reach forward as far as they can without taking a step or leaning against the wall.
- Tester notes where knuckle falls on yardstick at maximum reach distance.
- The difference between the start position and reach position is recorded as the total reach distance.
Measures

Functional Reach (FR)

• **Tests**: Dynamic Standing Balance

• **Modified for children by**:  
  - Including visual target to reach towards

• High reliability and validity for the adult and child population with and without disabilities.  
  - (2, 4, 5, 30)
Measures

Timed Up & Go (TUG)

- The TUG is a test that measures mobility in people who are able to walk on their own and is commonly used as a fall risk assessment.
- The set up of the TUG is a chair with a walk way of 3m, marked with tape on the floor.
- Subject starts the test by sitting in a chair and is given the instructions: “On the word GO you will stand up, walk to the line on the floor, turn around and walk back to the chair and sit down. Walk at your regular pace."
- The time is recorded in seconds. It starts as soon as the subject initiates standing and ends once they are seated again. The subject was asked to perform this test 3 times.
- It has been shown that subjects who take longer than 14 seconds are at a high risk for falling.
Measures

Timed Up & Go (TUG)

- **Tests:** Reaction Time, Proactive and Anticipatory Aspects of Postural Control

- **Modified for children by:**
  - Adjusting Seat Height
  - Providing a Demonstration
  - Visual Target rather than tape as a marker of where to turn

- The TUG has also been shown to have high reliability and validity in children and adults with and without disabilities (5, 16, 26, 22, 31)
Measures

Standardized Walking Obstacle Course (SWOC)

Designed by Old Dominion University and Daemen College to consider issues of body transport, manipulation, directional changes, obstacle negotiation, changes in support surface and response to ambulation in a dimly lit environment

(1, 7, 11, 12, 29)
Measures

Standardized Walking Obstacle Course (SWOC)
Measures

Standardized Walking Obstacle Course (SWOC)

- 39.5ft long and 36 inches wide
- Performed on low pile carpet
- Begins and ends with chair rising and chair sitting
- Navigate the three turns: 30° right, 90° left, 70° right.
- Navigate over an axillary crutch, across a visually stimulation mat, around a trash can and over a shag rug.
- Tested under three conditions:
  - Hands free ambulation
  - Carrying an age appropriate object: lunch tray, laundry basket
  - Simulated dark environment (wearing sunglasses)
- Two trials are performed in each condition
- Record: Time, # of steps, # of stumbles and # of steps off course
Measures

Confidence in Mobility and Balance (CoMB)

- Parental perceptions have been used to measure social validity to determine if changes in a targeted behavior is sufficient to improve quality of life.
- Many different standardized questionnaires have been developed, no single questionnaire focused on balance and mobility.
- A customized parent questionnaire (CoMB) was developed by the researchers based on:
  - Activities-specific Balance Confidence scale
  - Survey of Activities and Fear of Falling in the Elderly
- Tasks progress from simple to complex in ascending order
Measures

Confidence in Mobility and Balance (CoMB)

Questionnaire that parents and caregivers filled out regarding their confidence in their riders ability to perform tasks that challenge balance...

- Rising from a chair
- Single leg stance (standing on one leg)
- Reaching overhead to grab an object off the shelf
- Picking something up off of the ground
- Walking in a crowded area
- Climbing a flight of stairs without a railing
Specific Aims

Dual nature of this study:

1) To determine the test retest reliability and minimal detectable difference (MDD) values of the four functional measurements within the THR population

2) To explore changes in postural stability and functional mobility following 3 months of weekly mounted therapeutic horseback riding activity as measured by the four functional measurements

Hypotheses:

1) We hypothesized that all measurement tools will have high test retest reliability

2) We hypothesized that all measurement tools will detect an improvement in postural stability and functional mobility following 3 months of therapeutic horseback riding activity
Participants

• Sample of convenience recruited through Riding To The Top

• Inclusion criteria: medically stable, understand English, follow verbal/visual directions or demonstration, be able to stand for one minute unsupported (not assisted by a person or adaptive device), partake in one weekly 30 minute mounted therapeutic riding lesson and partake in no other riding activity beyond regular sessions, complete a consent/assent form.

• Riders will be excluded from the study if they have a planned surgery during this studies time frame or they are participating in hippotherapy treatments (horseback riding treatment performed by an OT or PT) \(^\text{(14)}\)
Study Design

• One group pretest post-test quasi experimental design
• Sample of convenience recruited through Riding To the Top

Experiment One (June)

Experiment Two (October)

3 Months of Horseback Riding
Experiment One

Procedures

June data collection

• Test re-test reliability
• Consent/assent and demographic information was gathered
• CoMB questionnaire was given to available parent/guardians
• Standardized tests were performed according to the established protocol for each assessment
• 2 trials of each assessment with a 15 min break between cycles
Data Analysis

Test - retest reliability (Aim 1)

- Intraclass Correlation Coefficients (ICC) or Spearman Rho (ρ) was used depending on data distribution
- Standard error of measurement (SEM) & Minimum detectable difference (MDD) was calculated values for each of the four measures

Results

- 11 total participants
- Mean age of 17.4 years (range of 6.1 to 55.0 years)
- Mean Body Mass Index of 23.14 with a standard deviation of 6.53
- 91% of participants able to complete the TUG
- 81% of participants able to complete the FR & SWOC
### Experiment One Results

#### FR, TUG, and COMB

<table>
<thead>
<tr>
<th></th>
<th>Functional Reach</th>
<th>Timed Up &amp; Go</th>
<th>COMB Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC</td>
<td>0.935</td>
<td>0.988</td>
<td>0.995</td>
</tr>
<tr>
<td>SEM</td>
<td>0.8184</td>
<td>0.6623</td>
<td>1.3133</td>
</tr>
<tr>
<td>MDD</td>
<td>2.2685</td>
<td>1.8358</td>
<td>3.6403</td>
</tr>
</tbody>
</table>

#### Standardized Walking Obstacle Course

<table>
<thead>
<tr>
<th></th>
<th>Hands Free</th>
<th>Carry Object</th>
<th>Sunglasses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>0.916</td>
<td>0.933</td>
<td>0.933</td>
</tr>
<tr>
<td>SEM</td>
<td>1.15</td>
<td>2.56</td>
<td>1.13</td>
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<tr>
<td>MDD</td>
<td>3.2</td>
<td>7.1</td>
<td>3.13</td>
</tr>
<tr>
<td><strong># of Steps</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>0.778</td>
<td>0.882</td>
<td>0.962</td>
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<tr>
<td>SEM</td>
<td>1.63</td>
<td>1.85</td>
<td>0.68</td>
</tr>
<tr>
<td>MDD</td>
<td>4.51</td>
<td>5.12</td>
<td>1.87</td>
</tr>
<tr>
<td><strong># of Steps Off Path</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>0.644</td>
<td>0.782</td>
<td>0.857</td>
</tr>
<tr>
<td>SEM</td>
<td>0.56</td>
<td>0.64</td>
<td>0.46</td>
</tr>
<tr>
<td>MDD</td>
<td>1.56</td>
<td>1.76</td>
<td>1.28</td>
</tr>
</tbody>
</table>
• FR, TUG, CoMB: High test-retest reliability

• SWOC:
  o High test re-test reliability for time
  o Moderate to high for # of steps and # of steps off path

• High test-retest reliability for all measurement tools
  o Support FR, TUG, SWOC, and CoMB for evaluation of postural stability and functional mobility within this population
  o Low standard error of measure suggest potential responsiveness to change
Experiment Two

Procedures

October data collection

• Examined change
• Identical procedure as June, except there was only 1 round of each measurement

Data Analysis

Change Scores (Aim 2)

• Data from rotation A and rotation B (from June data collection) was collapsed to form a single set of baseline data
• Baseline and follow up data (rotation C, collected in October) was compared using a dependent samples t-test ($\alpha = 0.05$)
• Individual change scores was compared to the minimal detectable difference (MDD)
# Experiment Two Results

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre</th>
<th>Post</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR</td>
<td>6.8(3.3)</td>
<td>7.9(3.4)</td>
<td>-1.71</td>
<td>6</td>
<td>0.14</td>
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<tr>
<td>TUG</td>
<td>12.1(6.7)</td>
<td>13.5(7.1)</td>
<td>-1.95</td>
<td>7</td>
<td>0.09</td>
</tr>
<tr>
<td>SWOC Hands Free Ambulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>13.5(4.4)</td>
<td>14.0(5.4)</td>
<td>-0.78</td>
<td>6</td>
<td>0.46</td>
</tr>
<tr>
<td>Number of Steps</td>
<td>22.1(3.3)</td>
<td>21.2(3.2)</td>
<td>0.90</td>
<td>6</td>
<td>0.40</td>
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<tr>
<td>Steps Off Path</td>
<td>1.2(0.8)</td>
<td>0.4(0.7)</td>
<td>3.68</td>
<td>6</td>
<td>0.001</td>
</tr>
<tr>
<td>SWOC Carry Object</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>21.0(10.8)</td>
<td>19.8(10.2)</td>
<td>0.91</td>
<td>6</td>
<td>0.40</td>
</tr>
<tr>
<td>Number of Steps</td>
<td>27.1(5.1)</td>
<td>24.6(5.8)</td>
<td>2.54</td>
<td>6</td>
<td>0.04</td>
</tr>
<tr>
<td>Steps Off Path</td>
<td>1.8(1.3)</td>
<td>0.6(0.6)</td>
<td>3.71</td>
<td>6</td>
<td>0.01</td>
</tr>
<tr>
<td>SWOC Wearing Sunglasses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>14.5(4.6)</td>
<td>14.1(4.7)</td>
<td>0.43</td>
<td>6</td>
<td>0.75</td>
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<tr>
<td>Number of Steps</td>
<td>22.8(3.0)</td>
<td>22.5(3.4)</td>
<td>0.42</td>
<td>6</td>
<td>0.69</td>
</tr>
<tr>
<td>Steps Off Path</td>
<td>1.4(1.1)</td>
<td>0.6(0.7)</td>
<td>2.37</td>
<td>6</td>
<td>0.06</td>
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<tr>
<td>COMB</td>
<td>76.1(19.9)</td>
<td>79.9(23.6)</td>
<td>-0.88</td>
<td>5</td>
<td>0.42</td>
</tr>
</tbody>
</table>
Responsive to change:
SWOC at the Group level

- Three measures
- Supports the notion of increased trunk stability and balance

This was the first study to demonstrate change using the SWOC\textsuperscript{(22)}.
Responsive to change: FR, SWOC, COMB at Individual level

- 6 yo with Hydrocephalus: CoMB
- 6 yo with Autism: FR, SWOC, CoMB
- 9 yo with Down Syndrome: SWOC, CoMB

Several CoMB questions were responsive to change

6-9 year old participants demonstrated the most significant improvements. This coincides with rapid refinement of balance skills which is typical for this age range.
Important factors that affect improvement in postural stability and functional mobility include:

- Age
- Diagnoses
- Riding Dose
Study Limitations

- Small sample size
- Use of a convenient sample
- Variety of age ranges
- Wide range of therapeutic riding dose
- Varying diagnoses of participants
- Participants involved in other forms of therapy
- Design does not allow inferences of causality

Future Studies

- Examine initial effects of therapeutic horseback riding on new riders
- Schedule data collection dates within the school year
- Participants of similar age, diagnoses, and riding dose
Interested in conducting research???

- Volunteers & parents
- Local universities & colleges
- Local PT & OT clinicians
- Staff & Instructors
- Look for changes or areas of improvement in riders

- READ research articles
- See what's already been tested and what can be developed further
- Starts with an idea
REFERENCES:


