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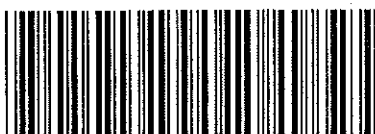
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# Effects of Hippotherapy on Postural Stability, in Persons with Multiple Sclerosis: A Pilot Study

Debbie Silkwood-Sherer, PT, MS, and Heather Warmbier, MPT

**Purpose:** The purpose of this pilot study was to examine the effectiveness of hippotherapy as an intervention for the treatment of postural instability in individuals with multiple sclerosis (MS).

**Subjects:** A sample of convenience of 15 individuals with MS (24–72 years) were recruited from support groups and assessed for balance deficits.

**Methods:** This study was a nonequivalent pretest-posttest comparison group design. Nine individuals (4 males, 5 females) received weekly hippotherapy intervention for 14 weeks. The other 6 individuals (2 males, 4 females) served as a comparison group. All participants were assessed with the Berg Balance Scale (BBS) and Tinetti Performance Oriented Mobility Assessment (POMA) at 0, 7, and 14 weeks.

**Results:** The group receiving hippotherapy showed statistically significant improvement from pretest (0 week) to posttest (14 week) on the BBS (mean increase 9.15 points ( $\chi^2(2) = 8.82, p = 0.012$ )) and POMA scores (mean increase 5.13 ( $\chi^2(2) = 10.38, p = 0.006$ )). The comparison group had no significant changes on the BBS (mean increase 0.73 ( $\chi^2(2) = 0.40, p = 0.819$ )) or POMA (mean decrease 0.13 ( $\chi^2(2) = 1.41, p = 0.494$ )). A statistically significant difference was also found between the groups' final BBS scores (treatment group median = 55.0, comparison group median 41.0),  $U = 7, r = -0.49$ .

**Discussion:** Hippotherapy shows promise for the treatment of balance disorders in persons with MS. Further research is needed to refine protocols and selection criteria.

**Key words:** hippotherapy, multiple sclerosis, postural stability, balance, task-oriented

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## INTRODUCTION

Impairment of postural stability is one of the greatest deterrents to mobility and autonomy in daily activities for persons with multiple sclerosis (MS).<sup>1–5</sup> The causes of poor balance in individuals with MS are well documented and include decreased range of motion, weakness of trunk and lower extremity muscles, spasticity, and fatigue.<sup>3–5</sup> Specific sensory deficits that contribute to postural instability are

dysfunctions of visual, somatosensory and vestibular systems.<sup>4,6–8</sup> Utilizing posturography, Nelson et al<sup>9</sup> confirmed that persons with MS ( $n = 35$ ) have difficulty integrating information from the visual, somatosensory, and vestibular systems. Fifty-eight percent of the 12 individuals whom they classified as having low function balance scores demonstrated either a vestibular dysfunction pattern or a combination of visual-vestibular dysfunction or somatosensory-vestibular dysfunction.<sup>9</sup> Thus, postural instability (or poor balance) in persons with MS often results from a combination of impairments of body functions and structures, making treatment of balance in individuals with MS a challenging task.

In the early 1990s trends in the treatment of neurological disorders began to change from a primary focus on impairments to a more goal-directed retraining of functional tasks, or “task-oriented” approach.<sup>10</sup> Utilizing the task-oriented approach for treatment of balance problems, the therapist attempts to assist the patient in developing the most effective sensory and motor strategies to maintain postural control while practicing under different functional conditions and with progressive degrees of difficulty.<sup>10–12</sup> This task-oriented approach works well for treating balance problems in persons with MS, as the effects of the many impairments are addressed simultaneously in concert with improving functional limitations.

According to Heine,<sup>13</sup> hippotherapy can be considered as one such task-oriented multisystem approach to the treatment of persons with neuromuscular disorders including MS. Movement of the horse promotes a disassociation of the pelvis and trunk that, along with the warmth provided by the horse's body, appears to assist in decreasing tone. Additionally, the horse's movement displaces the subject's pelvis through space in a manner similar to the pelvic movement used during gait, but with greater excursion (see Video 1).<sup>13</sup> Thus greater pelvic displacement increases somatosensory input through the joints and muscles. The movement through space also provides a constantly changing visual flow and increases demands to the vestibular system.<sup>13,14</sup> To maintain balance, the client has to adjust to the pelvic movement as well as process the sensory information, thus stimulating righting and equilibrium reactions.<sup>14,15</sup>

Another advantage of hippotherapy is that while reacting to the movement of the horse, clients learn to “discover” their own solutions to the problems of staying upright on a surface that moves in three dimensions simultaneously. The physical therapist can assist this process by manipulating the environment, thereby randomizing the necessary anticipatory

Graduate Program in Physical Therapy, Central Michigan University, Mt. Pleasant, Michigan

Address correspondence to: Debbie Silkwood-Sherer, E-mail: silkwd1@cmich.edu

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and reactive adjustments for postural control. This manipulation takes the form of changes in speed, direction, the addition of abrupt halts and starts, and asking the client to perform various exercises while atop the moving horse.

Thus a theoretical basis exists for the use of hippo-therapy as an intervention tactic for persons with MS. However, there is sparse research on hippotherapy use in adults with neurological disorders.<sup>16</sup> The majority of published studies and case reports relate to treatment of children with disabilities.<sup>17-22</sup> One barrier to locating literature is a misrepresentation of the term "hippo-therapy". Authors have frequently used the terms "hippo-therapy" and "therapeutic riding" interchangeably. Hippotherapy is provided by rehabilitation professionals (physical, occupational, and speech therapists) as a method of attaining functional goals in their clients/patients.<sup>23</sup> The client does not control the movement or direction of the horse. Therapeutic riding (taught by trained instructors) is focused on teaching riding skills to persons with disabilities.<sup>23,24</sup> Although both interventions have benefits, improper use of these terms in the research literature has made accurate assessment of their outcomes more challenging.

A second problem with hippotherapy research is that early research used small sample sizes, lacked standardized objective measures, and frequently reported results in non-peer reviewed magazines/journals. Recently researchers have utilized the term hippotherapy accurately and been more systematic in their analysis, but the literature is still plagued by small sample sizes. Collectively these studies have demonstrated that hippotherapy has improved trunk alignment and control,<sup>25,26</sup> enhanced symmetrical weight bearing and muscle activity,<sup>15,27</sup> increased endurance,<sup>28</sup> balance,<sup>15,20</sup> coordination and sensory integration, improved motor performance,<sup>29</sup> and decreased abnormal tone.<sup>30</sup>

Only 2 published studies have reported on the effects of using horses as an intervention for adults with MS.<sup>14,15</sup> The earliest study by Mackay-Lyons and colleagues<sup>14</sup> measured the effects of therapeutic riding on postural sway, gait, and changes in scores of the MS Minimal Record of Disability (MRD) and the Symptom Checklist-90-Revised (SCL-90-R). Although the subjects subjectively reported improvements in function, such as increased endurance and balance, the results of the MRD and postural sway assessments were not significant. There was improvement in relative speed and stride length during free walking and the depression/global severity scales of the SCL-90-R.<sup>14</sup>

Utilizing a single-subject experimental design, Hammer et al<sup>15</sup> investigated the effects of hippotherapy on numerous physical functions (balance, spasticity, functional strength, coordination, pain, and activities of daily living) and the psychological well-being of persons with MS. Ten of the eleven subjects demonstrated improvement in one or more of the variables tested. Results indicated that hippotherapy intervention benefited each subject differently with the most consistent improvements observed in balance (8/11 subjects) and the role-emotional domain of the SF-36.<sup>15</sup>

Hippotherapy holds promise for enhancing balance and postural control in individuals with MS, but the efficacy of

this intervention is still unclear. The supporting literature is based on single-subject designs with no control groups. Without this, it is not possible to verify that improvements in balance are due to the hippotherapy intervention and not fluctuations in the subjects' MS symptoms. Therefore, the purpose of this study was to assess the effects of individualized hippotherapy intervention on the balance of persons with MS compared with individuals not receiving treatment. The researchers hypothesized that individuals receiving hippotherapy intervention would demonstrate an improvement in balance, while no change would be observed in a comparison group.

## METHODS

This pilot study was a nonequivalent pretest-posttest comparison group design.<sup>31</sup> It was approved by the institutional review board of the researchers' institution as well as the institutional review board of the therapeutic riding facility. All subjects were required to sign informed consent forms before beginning the study. Signed liability forms from the riding center were also required for subjects in the treatment group.

## Subjects

Subjects for this study were individuals with MS recruited through MS support groups of the Michigan Chapter of the National Multiple Sclerosis Society (NMSS). The inclusion criteria to participate in the study were 1) over 18 years of age, 2) ability to stand with or without an assistive device for one minute, 3) no orthopedic or medical problems unrelated to MS, 4) no previous experience with hippotherapy or therapeutic riding, 5) no allergies or aversions to horses, 6) weight less than 240 lbs, and 7) physician referral. Although we did not exclude prior riding experience (before or after the onset of MS), none of the subjects had enough riding experience to be considered proficient in horsemanship skills.

Subjects were placed into two groups. The intervention group consisted of the first 9 individuals who responded to recruitment flyers and were willing to attend weekly hippotherapy sessions at the therapeutic riding center. Although an additional nine individuals were sought to serve as a comparison group only 6 individuals volunteered. Subjects in the comparison group were offered the opportunity to participate in hippotherapy following the study if they wished. No subjects in either group received other forms of rehabilitation during the study.

## Procedures

To make the study as clinically relevant as possible, valid and reliable clinical measurements of balance that had been used for persons with MS were sought.<sup>32</sup> Criterion for tool selection was the ability to administer the tool in the treatment surroundings (riding facility) and ease of administration. Additionally the tools could not fatigue subjects and needed to allow rest periods without compromising results. Based on these criteria, the Berg Balance Scale (BBS),<sup>33,34</sup> and the Tinetti Performance Oriented Mobility Assessment (POMA)<sup>35</sup> were chosen as outcome measures. The Clinical

Test for Sensory Interaction on Balance (CTSIB)<sup>36,37</sup> was also administered to provide information for intervention on possible sensory adaptation problems of the subjects.

The Berg Balance Test and the POMA were originally designed for assessing balance in the elderly population,<sup>33,35</sup> but have been routinely used in clinics to assess the balance and fall risk for individuals with neurological impairments, such as post stroke and traumatic brain injury.<sup>38,39</sup> The BBS is a 14 item balance performance battery with a maximum score of 56. It provides information on steady state and anticipatory postural control. Research has demonstrated that the Berg has an interrater reliability of 0.98 and an intrarater reliability of 0.97, within these groups.<sup>38,39</sup> Recently, Palta-maa and colleagues<sup>40</sup> reported the test-retest reliability for the Berg to be 0.85, with an interrater reliability of 0.99 when using the Berg for ambulatory persons with MS. For consistency of administration in this study during the tandem stance task it was decided that each person would place both the right and left leg behind with the lowest score recorded. Subjects were also asked to stand on each leg during the single leg stance task, again with the lowest score reported.

The POMA like the BBS provides information regarding steady state and anticipatory postural control. It consists of 16 items divided into subtests of balance and gait with a maximum total score of 28. The gait portion of the tool provides challenges to the subjects' balance not provided by the BBS, in addition to the reactive postural adjustment of the nudge test. Although the reliability of the POMA has not been assessed specifically for persons with MS, it has good test-retest reliability (0.82–0.86), interrater reliability (0.91–0.93), and concurrent and discriminant validity in the elderly.<sup>41</sup> Additionally the tool has good reliability for both novice (students whose *k* coefficients ranged 0.40–1.00 for all test items) and experienced clinicians with minimal training (*k* coefficients 0.40–0.75).<sup>42</sup>

The CTSIB was developed as a clinical tool to simulate the conditions of dynamic posturography developed by Nashner.<sup>36,37</sup> It is utilized to assess the central nervous systems (CNS) ability to integrate the visual, vestibular, and somatosensory systems by altering one or more of the systems during 6 test conditions. Since it has been shown that individuals with MS frequently have difficulty integrating the information from these three systems,<sup>9</sup> it was decided to determine whether subjects in this study might have sensory adaptation problems, such as dependency on a specific sense for postural orientation or sensory selection problems. During each test administration the conditions were presented in the following order: standing on a firm surface, eyes open, eyes closed, and with the dome and then on the foam eyes open, eyes closed, dome. Subjects performed each condition 3 times for 30 seconds. Falls, stepping, opening eyes during eyes closed tests, raising arms to maintain balance, or excessive sway (hip strategies) stopped timing of a condition. Conditions not completed for 30 seconds in all 3 trials were recorded as abnormal. If participants demonstrated a sensory dependency or selection problem, then the environment and tasks were altered during their session to either remove or provide inaccurate information through the sensory modality

in question, thus forcing the subject to rely on their less preferred senses.<sup>12</sup> Results of the CTSIB information for all subjects is included in Table 1 as described by Shumway-Cook and Horak.<sup>12</sup>

Both groups had an initial examination prior to the initiation of hippotherapy treatment, followed by rechecks at 7 and 14 weeks. All assessments were performed by either the primary author (DSS), who has experience in the assessment and treatment of individuals with MS, or the second author (HW) who was a student in the physical therapy program of Central Michigan University. To prevent fatigue from interfering with test results, the intervention group was tested in a barn adjacent to the riding facility prior to a hippotherapy session. The comparison group was assessed in a clinic setting. Although attempts were made to test all individuals at approximately the same time of the day, it was not always possible. This was not a major concern to the researchers, as it has been demonstrated that while fatigue perception in individuals with MS statistically differed between morning and afternoon testing sessions, their balance scores did not significantly differ between times of day.<sup>43</sup>

During the pretest assessments for each group, one researcher administered each standardized test, while the second observed and scored the test. The researchers then clarified any inconsistencies in interpretation of observations in an effort to improve interrater reliability. The 7 and 14 week retests were performed by either researcher, based on their availability.

TABLE 1. Characteristics of Subjects

Intervention group						
Subject	Age	Gender	Type of MS	Years since Diagnosis	CTSIB	Initial Results <sup>12</sup>
1	45	M	RR/SP	15		Sensory selection deficit
2	47	F	RR	7		Surface dependent
3	29	F	RR	0.5		WNL
4	40	F	RR	15		Vestibular loss <sup>+</sup>
5	48	F	PP	11		Visually dependent
6	46	F	Unk	26		Surface dependent
7	31	M	RR	2		Vestibular loss <sup>+</sup>
8	24	M	Unk	2		Surface dependent
9	72	M	PP	11		NT
Comparison group						
1	46	F	PP	15		Visual & surface dependent
2	44	F	RR	10		Visually dependent
3	53	F	RR	15		Visually dependent
4	63	F	PP	25		Surface dependent
5	44	M	Unk	3		Visual & surface dependent
6	36	M	RR	8		Surface dependent

MS, multiple sclerosis; RR, relapsing remitting; SP, secondary progressive; PP, primary progressive; Unk, unknown; NT, unable to complete test as subject unable stand without assistive device.

<sup>+</sup> "means inability to select vestibular inputs for postural control in the absence of useful visual and somatosensory cues."<sup>12</sup>

## Treatment Intervention

Hippotherapy intervention was provided as defined by the American Hippotherapy Association (AHA).<sup>24,44</sup> Subjects were not instructed in riding skills, but were placed on the horse so they could respond to changes in the horse's movement. Horses were led by an experienced horse-handler with two side-walkers for safety. All subjects were required to wear a helmet during each session. In consultation with a certified riding instructor, subjects were matched with a horse whose width and general movement accommodated the subject's available hip range (specifically abduction) and balance abilities. Six subjects began the study using bareback pads and stirrups, while 3 subjects needed the support of a saddle during the first few weeks of riding. Two of these subjects were able to progress to a bareback pad by the midterm evaluations.

Subjects in the intervention group rode one time per week for 14 weeks in an indoor arena at a therapeutic riding center. Each session was comprised of a 5-minute warm-up, a 30 minute treatment session, and a 5 minute cool-down period. The warm up consisted of a slow walk (90–100 steps/min) without stirrups (dependent on subject's ability) to stretch the lower extremities, and progressed to a moderate walk (125–130 steps/min) in a large oval pattern in a right and left direction. The cool down periods reversed this process from a moderate walk to a slow walk.

The 30 minute treatment sessions were individually designed by the primary researcher, an AHA registered therapist in hippotherapy, based on the results of the examination information. Notes were kept on all sessions by the researchers and modifications to activities and exercises were made based on the subject's response to treatment. Although sessions were individualized, similar activities were performed by all participants. For example, all participants began their sessions sitting forward. In this position the subject performed trunk rotation by placing one hand on the horses' shoulders and the other on the hind quarters. This was done in both directions to provide a stretch to trunk and adductor muscles. To practice anticipatory challenges, subjects were asked to raise their arms overhead or out to the side while sitting forward.

All subjects experienced changes in direction, such as weaving among cones, riding 10 and 20 meter circles moving both right and left, serpentine patterns, changing direction on the diagonal, figure 8's, sudden stops and starts, walking over ground poles, as well as changes in speed of the horse, from a slow walk to a medium walk to a trot (150 steps/min), if tolerated. Each time the horse changed direction and/or speed a postural adjustment was required by the subject. Subjects who could tolerate advanced challenges to their postural control were asked to change positions on the horse (see Video 2), such as standing in their stirrups with hands on the horses shoulders (2 point-position), sitting side-ways, and riding backward.

Information from the CTSIB was used to further manipulate the activities by either taking away the sense upon which the subject was most reliant, or providing inaccurate information through that sense. For example subject 5, who

demonstrated visual dependency, would sidebend her trunk to the left whenever she closed her eyes while sitting on the moving horse. To improve her postural control without relying on her visual input we had her close her eyes and made small circles around barrels in a direction that caused her to lean to the right based on the vestibular and somatosensory information she was receiving. This resulted in a correction of her trunk to neutral alignment in a frontal plane (see Video 3). She was also asked to sit sideways on the horse facing the walls of the riding arena. This provided her with visual flow that conflicted with her vestibular and somatosensory information. If the subject was allowed to sit sideways facing the center of the arena, she tended to use a fixed visual point to decrease the conflict, thus continuing to rely upon her visual system. After 6 sessions the subject was able to independently maintain neutral trunk alignment with eyes closed while on a moving horse.

## Data Analysis

SPSS 13.0 statistical software was used for data analyses. Nonparametric statistical tests were utilized due to the small sample size and the ordinal scales of the assessment tools.<sup>31</sup> Friedman's Two-Way Analysis of Variance Test (ANOVA) was used to calculate the pre-mid-post test within group scores for both the Berg and POMA. For the intervention group Wilcoxon's signed-rank test was used to determine when the greatest changes in balance scores occurred. A Mann Whitney U was used to determine between group comparisons of balance, as well as to determine any differences between the groups in relation to age and number of years with MS. Chi-Square analysis was used for the nominal data of gender and type of MS. All statistical analyses were calculated using alpha levels of 0.05.

One-tailed analysis was used when comparing the mid-term and posttest assessments between the groups, since it was expected that the intervention would improve the subjects' balance scores. Two-tailed analysis was used for the pretest and demographic comparisons.<sup>31</sup>

Post test data for one subject in the intervention group was not used in the final analysis because this individual began steroid treatments in week 13. Post test data for a second person in the intervention group was not collected, as this individual did not complete the study due to an exacerbation that began during week 9. Finally one subject in the comparison group did not attend the final testing session. The final number of subjects in the intervention group was 7 with 5 individuals in the comparison group.

## RESULTS

Demographic data for the groups is listed in Table 1. Ages of participants in the intervention group ranged from 24–72 years (mean 42.4, SD = 14.2), while members of the comparison group ranged from 36–63 years (mean 47.7, SD = 9.3). The mean number of years that individuals in the intervention group had been diagnosed with MS was 9.9 (SD = 8.2), and 12.6 (SD = 7.6) years for the comparison group. There were no statistical differences between the groups with regard to gender ( $p = 1.00$ ), type of MS ( $p = 1.00$ ), age ( $p = 0.549$ ), or years with MS ( $p = 0.507$ ).

