Utilization of Hippotherapy and Therapeutic Riding for children with disabilities as an adjunct to traditional therapies

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Abstract

**Aims:** This study examines evidence regarding the use of hippotherapy (HPOT) and therapeutic riding (THR) for children with cerebral palsy (CP) and autism. **Methods:** A comprehensive database search was conducted to obtain articles on HPOT or THR with children with autism and CP. **Results:** Nine articles were included for CP with all but two demonstrating positive results. Five articles were included for autism with all articles demonstrating positive results. **Conclusions:** Positive outcomes were associated with either HPOT or THR, suggesting that efficacy of THR and HPOT is increasing. However, many of the reviewed articles had methodological design limitations. More randomized studies with larger sample sizes that utilize valid and reliable quantitative and qualitative outcome measures are needed. The Goal Attainment Scale (GAS) was recommended for measuring outcomes. There is a need for data on use of outcome measures for HPOT treatment so as to determine whether hippotherapy is an efficacious treatment strategy.

**Keywords:** hippotherapy, therapeutic riding, Goal Attainment Scale, cerebral palsy, autism, outcome measure
Hippotherapy (HPOT) is a rehabilitation treatment strategy utilized within the scope of occupational, speech, and physical therapy to challenge multiple body systems in the client, help the client reach therapeutic goals, and achieve functional outcomes specific to each of their disciplines (Shurtleff, Standeven, & Engsberg, 2009). Areas targeted with HPOT to improve motor and sensory functions may include balance, coordination, range of motion, strength and muscle tone, motor planning, postural control, and sensory perception and integration difficulties related to sensory awareness and defensiveness (Chang, Kwon, Lee & Kim, 2012). Additionally, HPOT can be used for attention, planning, memory and sequencing to improve executive function.

Hippotherapy is a participatory process and can provide the motivational key for connecting with children and creating an opportunity for engagement. Not only is riding a horse seen as motivating and exciting to a child, the horses gait provides rhythmical, symmetric, and multidimensional movement (i.e., horses walk simulates movement patterns that are similar to the human walk) that can be repeated and sustained consistently throughout a treatment session (Zadnikar & Kastrin, 2011). Movement can then be graded to meet the specific needs of each of their clients. By adjusting the tempo and speed of the equines’ gait (extended walk, half halts, trotting), the terrain that the equine is walking on, and/or change the position of the client, creates opportunities to grade how challenging the movement and/or activity is and creates variability and less predictability (Shurtleff and Ensberg, 2010; Shurtleff et al., 2009). In one 45-minute session, a client can expect to receive approximately 3000 to 5000 repetitions creating an opportunity for massed but variable practice (Shurtleff et al., 2009; Shurtleff et al., 2010).

The physical benefits can also be paired with cognitive and perceptual interventions, as a practitioner will often incorporate a game to improve functional gain. For example, the addition
of reaching (i.e., reaching to place a ring on a pole) while on a moving horse, challenges trunk control, equilibrium and righting reactions, eye hand coordination, and optical righting reactions, as the client must re-align body segments in response to the equine’s movement. The therapist often positions their clients in different developmental positions from sitting forward to sitting backward, side sitting, hand and knees, kneeling, high kneeling, and standing. Each of these positions, on an equine, can provide differing benefits and challenge sensorimotor integration differently (Shurtleff et al., 2010). Practitioners utilize their knowledge of equine movement, the client’s strengths, and their specific goals to design meaningful engagement in client centered treatments.

Another equine related activity that individuals with disabilities may participate in is adaptive riding, a term synonymous with therapeutic riding (THR). Although adaptive riding is the term that is becoming more widely preferred, most prior studies use the term THR, thus the term THR riding will be used throughout this review. THR, much like HPOT, has the potential to improve balance, mobility, coordination, and posture (Bass, Cuchowny, & Llabre, 2009). However, unlike HPOT, THR is taught in a group format by a certified therapeutic riding instructor and is considered a recreational activity. Emphasis is placed on learning horsemanship skills such as proper riding positions and rein skills (Winchester, Kendall, Peters, Sears, & Winkley, 2002). THR has been found to be beneficial for children with neurological disorders, cognitive, motor, and social disabilities (Bass et al., 2009).

Currently there is an abundance of anecdotal evidence for the use of horses with children experiencing motor, sensory, cognitive, social, and language deficits. However, empirical evidence supporting the effectiveness of using horses as a therapeutic intervention is less evident. In this present study the objectives are twofold: (1) Examine the documented benefits of THR
and HPOT for children with disabilities through a literature review, (2) Based on the results of the literature review, provide recommendations for outcome measures to be used by practitioners that utilize HPOT as a treatment strategy.

**Review Process and Databases searched**

A comprehensive literature search including both HPOT and THR revealed the majority of the research available has been completed on children with disabilities, particularly with children who have autism (ASD) and cerebral palsy (CP). In order to draw meaningful conclusions, this review is restricted to HPOT or THR in children with either CP or ASD. Inclusion criteria for studies were, (1) quantitative design, (2) peer reviewed journal articles, (3) use of THR or HPOT as the intervention, (4) participants who were children with CP or ASD between the ages of 3-18. The search strategy comprised a primary search of 3 databases: CINHAL, OTD base, and OVID medicine. The following terms were used alone or in combination: hippotherapy, therapeutic riding, adaptive riding, Cerebral Palsy, Autism, developmental delay, gross and fine motor, social, postural, communication, trunk strength, trunk control, children, equine assisted therapy, and occupational or physical therapy. All selected articles were appraised and received a level of evidence rating according to the traditional single-hierarchy evidence model (Arbesman, Scheer, & Lieberman, 2008). The rating scale is displayed in Table 1. A summary of the appraised articles for this literature review can be found in Table 2.

**Summary of Key Findings for Cerebral Palsy**

Nine articles were critically appraised with five articles receiving a level one rating, three receiving a level two rating, and one receiving a level three rating. Of the nine articles, all but two demonstrated positive results with the use HPOT or THR on gross motor function,
symmetry, and head and trunk stability (Whalen & Case-Smith, 2012; McGibbon, Benda, Duncan, and Silkwood-Sherer, 2009; Benda et al., 2003; Chang et al., 2012; Davis, Wolfe, Raadsveld, Heine, Thomason, Dobson & Graham, 2009; Shurtleff et al., 2009; Shurtleff et al., 2010; Tseng, Chen, & Tam, 2013; Zadnikar et al., 2011).

Research performed by Shurtleff and colleagues (2009) and (2010), objectively quantified changes in head and trunk control. Both studies demonstrated significant gains in head, movement variability in head translation and rotation, trunk, and upper extremity control between pre- and posttests evaluations. The gains made in regards to head control and trunk stability continued during the three-month period when the participants refrained from riding horses. The results of these two studies clearly showed that HPOT improved both the movement of the trunk and head with children with CP, and that gains could be sustained over time. The results of Shurtleff’s two studies were further reinforced by the study performed by Chang and colleagues (2012) that investigated whether HPOT could improve functional performance of school-aged children with CP. The results demonstrated improvement in standing, walking, running, and jumping, providing evidence that HPOT can positively affect complex movement patterns, help to mobilize the pelvis, lumbar spine and hip joint, help to normalize muscle tone, all of which influence the development of head and trunk control.

In two review studies, one meta-analysis and one systematic review, which appraised the effectiveness of HPOT and THR on gross motor function both support that HPOT and THR have positive effects on gross motor function (Zadnikar et al., 2011; Whalen et al., 2011). Contrast to the above studies’ positive results, outcomes of a randomized control trial (RCT) found that gross motor function did not improve with participation in a THR riding program (Davis et al., 2009). Furthermore, this study was unable to verify benefits to either quality of life or health of
the participants. Unfortunately, the measurement utilized to assess quality of life and health benefits has not been demonstrated to be sensitive to change. Moreover, unlike the studies performed by Shurtleff (2009) and (2010) and Chang (2012), THR was utilized and not HPOT, indicating that potentially HPOT may be more beneficial to gross motor function in children with CP than THR, possibly due to being facilitated by a skilled therapist that has extensive training in pediatric disabilities.

In addition to research on head and trunk control, research also indicates that HPOT can positively improve symmetry of muscle activity with children with spastic C.P (Benda et al., 2003; McGibbon et al., 2009). Benda and colleagues (2003) and McGibbon and colleagues (2009) both examined muscle symmetry by comparing HPOT to sitting astride a barrel. In both studies participants were randomized into a group that received HPOT, or sat astride a stationary barrel, to evaluate if sitting astride a moving horse would improve muscle symmetry. Both groups were exposed to their intervention for the same amount of time and electromyography (EMG) was utilized to measure muscle activity immediately after each session. In Benda and colleagues (2009), changes occurred in postural muscle groups, and improvement in symmetry occurred for muscles groups displaying the highest asymmetry prior to the start of the HPOT intervention. The study performed by McGibbon and colleagues (2009), followed a similar procedure with changes to adductor muscles specifically being studied, as well as the long-term effects of HPOT. Results demonstrated that all participants made gross motor gains and improved adductor symmetry while walking after the HPOT intervention and improvements were maintained for 12 weeks post treatment. In both studies no significant changes were reported when sitting astride the stationary barrel. The results from these studies provide strong evidence that the rhythmic movement, provided by a horse’s gait, combined with gentle
strengthening of leg muscles, rather than passive stretching, can help to improve muscle symmetry in children with CP.

The one systematic review and meta-analysis indicated that muscle symmetry and gross motor function were improved following HPOT, and that it specifically reduces asymmetrical hip adductor activity and could improve postural control for individuals with CP that have a Gross Motor Function Classification System (GMFCS) level of less than five (Tseng et al., 2013). However, these studies also showed that beneficial gains were found to be short-term and after long term HPOT or THR no statistically significant effect on Gross Motor Function Measure (GMFM) was observed (Tseng et al., 2013). Of the 14 studies reviewed six were included in this study and all received a methodological quality total rating score that equated to good, very good, and excellent.

Based on the articles reviewed on CP the evidence that HPOT can provide benefits, to children with CP, are encouraging but far from conclusive. Inconsistencies in the methodological design include: small sample sizes, use of short time period for interventions, and wide variability of participants age and GMFCS level, which reduce the generalizability of this work. Studies with larger sample sizes, which include a more homogenous CP group, will increase the chance of significance and will more reliably reflect the potential relationship between treatment response and level of disability. In addition, the outcome measures selected should be scrutinized for reliability and validity so as to insure that the measure selected will be sensitive enough to detect improvements. Although there is research suggesting that HPOT may be an efficacious therapy option for children with CP, there is a need for more rigorous research to be completed.
Summary of Key Findings for Autism

Five articles were critically appraised with three articles receiving a level three rating, two receiving a level two rating, and one receiving a level one rating. All of the articles appraised demonstrated positive results with the use HPOT or THR for children on the spectrum for autism (O’Haire, 2013; Bass et al., 2009; Ward, Whalon, Rusnak, Wendell, and Paschall, 2013; Ajzenman, Standeven, and Shurtleff, 2013; Taylor, Kielhofner, Smith, Butler, Cahill, Ciukaj, and Gehman, 2009).

The systematic review, performed by O’Haire (2013), revealed that the most common outcome of animal assisted interventions for ASD was an increase in social interaction. Of the 14 studies reviewed, six examined the use of either HPOT or THR with children with autism. Bass and colleagues (2009), one of the more rigorous studies included in the systematic review, demonstrated positive effects in social functioning after completion of a 12-week THR program. In contrast to the control group, the experimental group demonstrated improved social motivation and sensory sensitivity, as well as decreased inattention and distractibility. One of the most profound results was the experimental group was found to show an increase in their ability to breakaway from sedentary routines. This is profound since a classic behavior of children with ASD is fixation with objects and the need for rigid routines. The findings of Bass and colleagues (2009) are similar to those of other studies that have demonstrated positive improvements in social communication (Ward et al., 2013; Ajzenman et al., 2013) and sustained level of directed attention and sensory integration (Ward et al., 2013). For example, in the study performed by Ward and colleagues (2013), after completion of 10 weeks of the THR program classroom teachers for 21 students with autism indicated that there was an improvement in social communication, attention, tolerance, and reactions to sensory input in the classroom. However,
improvements were not maintained during the period of the study in which the participants received a break from THR. Only when the THR program resumed did ratings increase again demonstrating that consistent THR may be needed to sustain the beneficial gains.

In addition to social interaction, motivation has been found in the research to be beneficially affected by HPOT and THR. The impairments that haven been previously described with autism (communication, social interaction, and cognitive functioning) often affect a child’s motivation. Motivation is referred to as volition with the Model of Human Occupation and is defined as a child’s interests and self-efficacy to participate in new activities (Taylor et al., 2009). When children become unmotivated, their level of engagement in occupations decreases as well as their ability to learn about the world. The results of the study performed by Taylor and colleagues (2009), found that after a 16-week HPOT program that all the participants demonstrated increased volition from baseline, and showed an improvement in their motivation to engage in everyday activities.

In addition to deficits with attention, sensory management, communication and socialization, motor impairments although not considered a main symptom of ASD occurs with 80% and 90% of children with an ASD diagnosis (Ajzenman et al., 2013). These motor impairments can be subtle; however can adversely affect a child’s communication, social interactions, and the ability to efficiently and effectively perform daily living tasks. Exploration and engagement in play is pivotal for children to gain the necessary skills set for motor control development. Motor skills in neurotypical children are fine tuned through trial and error, where new movements are learned and perfected so that motor skills can become automatic (Ajzenman et al., 2013). Postural control, which is associated with language, social engagement, play skills, and academic abilities has been reported to be delayed in children with ASD (Ajzenman et al.,
Postural instability can affect gross motor control but also fine motor control, hand manipulation, and motor sequencing (Ajzenman et al., 2013). According to sensory processing theories, children with ASD have difficulty regulating sensory input, which can affect postural control and proximal stability, thus affecting fine motor control. It is theorized that children with neurological impairments, during functional tasks, have poor postural control and behavioral responses because sensory signals from somatosensory, visual, and vestibular systems do not interact in the proper manner preventing sensory information from getting correctly interpreted causing limited adaptive responses from occurring. The study performed by Ajzenman and colleagues (2013) hypothesized that improvements in postural control might improve adaptive behaviors and increase participation. The results of the study found, that after a 12-week HPOT program, children with autism demonstrated increased adaptive behaviors with an increase in participation in low-demand leisure activities and social interaction. Improvements in receptive communication, specifically listening and following two-step and if–then instructions, were found and was hypothesized to be a result of improved postural control and social interactions (Ajzenman et al., 2013).

The combination of all of these findings demonstrates the use of HPOT and THR might provide beneficial gains to children on the autism spectrum for social interaction, motivation, participation and adaptive behaviors.

**Clinical Bottom Line: HPOT or THR for Cerebral Palsy and Autism**

Efficacy of THR and HPOT is continuing to increase and is becoming more reliable. This literature review demonstrates that there are positive outcomes associated with the use of HPOT and THR for children with disabilities. Most of the research presented in this literature review provides support for the use of HPOT and THR for children with CP and autism as an adjunct to
traditional therapies. The movement of the horse in THR and HPOT has been shown to improve gross motor functions. The horse’s gait provides rhythmical movements that can mirror the human pelvis, causing the pelvis to move in different directions, which translates to improved gross motor functions for children with physical disabilities. In addition, the use of the horse has been found to provide a multi-sensory environment with activities targeted at increasing language, participation, and social interaction. Although the results of this literature is encouraging, there are still more gains to be made in terms of establishing HPOT and THR as an evidence based intervention for children with disabilities as more rigorous research with control groups and larger sample sizes are needed.

**Implication for more Research**

The results of this literature review focused on the utilization of HPOT and THR for CP and autism. When searching for articles it was discovered that little research has been devoted to other disabilities. Consequently, there is a need to expand research to examine the effects of HPOT on children with other conditions that have been sited to be appropriate for HPOT. Additionally, there are few systematic reviews and meta-analysis that examine exclusively HPOT. HPOT and THR are different, and should be treated that way when examining the efficacy of motor outcomes with children and adolescents. Furthermore, there is a need for a higher standard of methodological rigor in research designs in order for HPOT and THR to become an evidence-based practice for autism and CP. For both CP and autism, follow up research needs to be conducted to ascertain the duration and frequency required of HPOT so that participants can benefit from the intervention. All studies, regardless of diagnosis, call for follow up to be performed to determine if the therapeutic benefits gained during HPOT and THR are sustained over time, over multiple contexts, and during involvement in multiple occupations i.e.
school. This literature review highlights the need for the transparency of hippotherapy with outcome measures.

**Outcome Measure Recommendations**

Outcome measures allow a clinician to understand how things went with their clients and the effects of their intervention (Colquhoun, Letts, Law, MacDermid, and Edwards, 2010). The outcome measures for CP, used in the studies in this review, included but were not limited to the GMFM, Pediatric Balance Scale, electromyography, and Quality of Life questionnaire. For autism, the outcome measures utilized included the Vineland Adaptive Behavior Scales-II, Child Activity Card Sort, Pediatric Volitional Questionnaire, Social Responsiveness Scale and Sensory Profile. There is limited information if these same assessments are used in clinical practice with clients receiving therapy services that use a hippotherapy strategy. Most of these assessments are geared toward understanding if body functions and/or performance components specific to impairments have improved using HPOT. Therefore, there is a need to identify outcome measures that reflect functional outcomes and which measures are currently being used with a hippotherapy treatment strategy.

Implementing a measurement process within a practice that uses nontraditional strategies such as HPOT can be challenging due to the heterogeneous patient populations served and the need for the measure(s) to be appropriate for the different disciplines utilizing HPOT (occupational therapy, speech language pathology, and physical therapy) within the rehabilitation setting. It is often recommended that practitioners use both standardized assessments and collect qualitative data. Standardized assessments are important since they are reliable and valid and provide objective and trustworthy data so as to provide evidence of the effectiveness and efficiency of the service. However, standardized assessments alone do not provide the whole
picture and therefore practitioners also need to understand client-centered practice and meet the needs of the individual. In synchrony with this approach would be to use goal-attainment scaling to both impose a level of standardization and include functional/specific goals that can include behavioral responses.

Most facilities that have a hippotherapy program are a non-profit organization with limited funding. Facilities can greatly vary with regards to the tools and resources available. Often facilities, that use HPOT as a treatment strategy, have time constraints, limited space to perform assessments, and have little to no access to standardized assessments. Therefore, when deciding on what outcome measure to be used to measure client progress and demonstrate the effectiveness of HPOT, the following questions were considered for clinical utility:

- What is the cost of the outcome measure?
- Can all disciplines utilize the outcome measure?
- Does the outcome measure have evidence of reliability and validity?
- How long does the outcome measure take to administer?
- How easy can the outcome measure be administered, scored, and results interpreted?
- Does the outcome measure have the capacity to measure client progress?
- What ages and diagnoses is the outcome measure appropriate for?
- What space is required to administer the assessment?

Taking into consideration the above questions, the Goal Attainment Scale (GAS) would be an appropriate measurement to use by practitioners with the pediatric population receiving the treatment strategy of hippotherapy.
The GAS is an individualized criterion-referenced measure of change useful for evaluating functional outcomes and measuring individual progress toward goals. Goal setting using this tool is a collaborative process involving many individuals, such as the child’s parents and/or caretaker, to ensure that the goals are clinically meaningful and relevant. The GAS methodology is as follows (1) Goals are discussed and agreed upon with the client and/or the client’s family; (2) A weight is assigned to goals based on priority (optional step); (3) Goal(s) (1-3 goals are recommended) are written to be specific, measurable, achievable, and realistic; (4) A 5-pt scale for achievement is used for rating performance (Much less than expected outcome (-2), Somewhat less than expected outcome (-1), expected outcome (0), somewhat more than expected outcome (+1), and best expected outcome (+2)); (5) Specific criteria are assigned to each point on the scale for scoring; (6) After an intervention period, performance is reviewed to determine final rating (McDougal & King, 2007).

Based on review of the literature on the GAS, the positive attributes that make it a worthy choice for practitioners are as follows: (1) It is a free measurement tool; (2) Administrators are not required to take part in standardized or accredited training; (3) Flexibility, there are no predetermined activities leaving parents/guardians of children free to identify anything as a potential goal, making it an appropriate assessment for family-directed goals; (4) Diversity, allows for more unique goals to be made which would be difficult to assess with standardized assessments for clients who are more physically involved. Additionally, it is appropriate for a heterogeneous population; (5) Children with different goals can be compared on their success with achieving them; (6) Multidisciplinary: all therapists can use this measure; (7) Efficient in terms of time needed for re-test and scoring (Cusick, McIntryre, Novak, Lannin, & Lowe, 2006).
While there are some limitations in using the GAS, it is likely that the benefits far outweigh the challenges. To reduce bias, at initial implementation of the GAS a systematic approach for goal writing and scaling should be developed so the scaling increments are consistent and congruent. Use of the GAS Scaling checklist found in the manual is optimal and the use of independent raters without a personal investment in the outcome is ideal (McDougal and King, 2007; Schlosser, 2004).

Despite these limitations the GAS is a practical tool to use with therapy programs that utilize a non-traditional treatment approach such as HPOT. To make further recommendations on outcome measures, there is a need for more information on current trends in assessment and outcome measures used for clients participating in therapy that uses a HPOT treatment strategy, so as to aid therapists in establishing evidence based measurement processes within their practice.
Table 1

Level of Evidence Rating Scale of articles selected for appraisal

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Research Design/Methodology</th>
<th>Number of Articles</th>
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<tbody>
<tr>
<td>I</td>
<td>Systematic Reviews, Meta analyses, randomized controlled trials</td>
<td>6</td>
</tr>
<tr>
<td>II</td>
<td>Two groups, nonrandomized studies (cohort, case-control)</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>One group, nonrandomized (before and after, pretest and posttest)</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>Descriptive studies (single-subject design, case series)</td>
<td>0</td>
</tr>
<tr>
<td>V</td>
<td>Case Report and expert opinion that include narrative literature reviews.</td>
<td>0</td>
</tr>
<tr>
<td>Author, Year</td>
<td>Study Purpose</td>
<td>Study Design/ Participants</td>
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<tr>
<td>-------------</td>
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</tr>
<tr>
<td>Whalen &amp; Case-Smith, 2012</td>
<td>Examine the efficacy of HPOT and THR on motor outcomes in children with C.P.</td>
<td>Systematic Review. Databases were searched and articles were selected that had to meet specific criteria.</td>
</tr>
<tr>
<td>McGibbon Benda, Duncan &amp; Silkwood-Sherer, 2009</td>
<td>Examine the immediate effects of HPOT on symmetry of adductor muscles and determine the long term effects on adductor activity, gross motor function and self-concept in children with C.P.</td>
<td>RCT with Pretest/posttest plus clinical follow up.</td>
</tr>
<tr>
<td>Authors</td>
<td>Study Title</td>
<td>Design Description</td>
</tr>
<tr>
<td>------------------</td>
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<td>-------------------------------------------------------------------------------------</td>
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<tr>
<td>Benda, McGibbon &amp; Grant, 2003</td>
<td>Examine the effects of HPOT on muscle activity of children with spastic CP and to compare effects of symmetrical sitting on a horse vs. a stationary barrel.</td>
<td>Pretest/Post test control group</td>
</tr>
<tr>
<td>Tseng, Chen, &amp; Tam, 2013</td>
<td>Evaluated the research on the effectiveness of EAAT on gross motor function with children with CP.</td>
<td>Systematic Review and meta-analysis</td>
</tr>
<tr>
<td>Chang, Kwon, Lee, &amp; Kim, 2012</td>
<td>Examined the effects of HPOT on children with spastic CP.</td>
<td>Within subject control study. Each participant served as his or her own control.</td>
</tr>
</tbody>
</table>
GMFM was used to assess gross motor function and the Pediatric Balance Scale (PBS) assessed balance. Evaluation occurred two times before the start and at the end of the HPOT intervention. HPOT sessions occurred 2x/week for 8 weeks and lasted 30 min.

<table>
<thead>
<tr>
<th>Study</th>
<th>Objective</th>
<th>Design</th>
<th>n</th>
<th>Intervention Details</th>
<th>Outcome</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shurtleff, Standeven, &amp; Engsberg, 2009</td>
<td>To quantify changes in head, trunk control and functional reaching so as to support the efficacy of HPOT.</td>
<td>Pretest / Posttest with 12 to 14 week post intervention follow up.</td>
<td>II</td>
<td>n=11 with spastic diplegia cerebral palsy, n=8 children without disabilities</td>
<td>45 minutes on a horse once per week for 12 weeks. Test was performed 2 weeks before the intervention, within 2 weeks post intervention and 12 to 14 weeks post-intervention. Data was collected via video motion capture with a use of a mechanical barrel.</td>
<td>Short intervention time, lack of pre-intervention baseline assessments. For the functional reach test participants did not reach during a functional task but rather reached toward a target.</td>
</tr>
<tr>
<td>Shurtleff &amp; Ensberg, 2010</td>
<td>Examined efficacy of HPOT to improved head/trunk control in children with CP.</td>
<td>Pre/Post test measure of children with C.P compared to the control, neurotypical children.</td>
<td>II</td>
<td>n=6 children with spastic diplegia, n=6 children without a disability</td>
<td>Data of trunk and head mobility was collected using a motorized barrel and video motion capturing before and after the 12-week 45 min/week HPOT intervention.</td>
<td>Significant reductions in head translation and rotation were found indicating improvement in trunk and head movements in response to pelvic movement. Follow up was not performed to establish if benefits associated with HPOT was sustained over time.</td>
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### Utilization of Hippotherapy

<table>
<thead>
<tr>
<th>Study</th>
<th>Objective</th>
<th>Methods</th>
<th>Findings</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davies, Wolfe, Raadsved, Heine, Thomas, Dobson, &amp; Graham, 2009</td>
<td>Examined the effects of THR programs on physical function, quality of life (QoL), &amp; health of children with C.P.</td>
<td>Randomized control trial with pre/post assessment.</td>
<td>Children with a Gross Motor Function Classification System level of I-III, n= 50 THR, n=49 control</td>
<td>Completion of a 10-week THR program did not increase the gross motor function, health, or QoL of children with C.P. Quality of life measures utilized have not yet been proven to be sensitive to capturing change in children with C.P. Primary caregivers and children had up to 6 weeks to complete the self-report and functional assessments, therefore changes to functional status may have not been captured and inability to recall impact on quality of life may have influenced outcome measures.</td>
</tr>
<tr>
<td>Zadnikar &amp; Kastrin, 2011</td>
<td>To summarize and evaluate the research on the effectiveness of HPOT and THR on balance and postural control in children with C.P.</td>
<td>Meta-analysis Databases were searched and articles were selected that met specific criteria.</td>
<td>8 articles were reviewed. Inclusion criteria: quantitative design, research on HPOT or THR on postural control or balance, &amp; participants included adults or children.</td>
<td>All studies demonstrated a positive effect after treatment with HPOT or THR on postural control and balance with only 3 articles Small sample size of articles critically appraised.</td>
</tr>
<tr>
<td>Author, Year</td>
<td>Study Purpose</td>
<td>Study Design/ Participants</td>
<td>Level of Evidence</td>
<td>Sample Size</td>
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<tr>
<td>Ajzenma, Standeven &amp; Shurtleff, 2013</td>
<td>To examine if HPOT increases function and participation in children with ASD.</td>
<td>Pre/Post measure with children with ASD.</td>
<td>III</td>
<td>n=6 children with ASD ages 5-12</td>
</tr>
<tr>
<td>Taylor, Kielhofner, Smith, Butler, Cahill, Ciukaj &amp; Gehman, 2009</td>
<td>Determine the effects of a HPOT program on volition in children with ASD.</td>
<td>Single subject A-B-B design. Subjects served as their own control.</td>
<td>III</td>
<td>n=3 children with autism</td>
</tr>
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</table>
same protocol after the first 8 sessions then after the last HPOT session. The Pediatric Volitional Questionnaire was utilized during each video tapping to measure motivation by evaluating the way the participants interact with their environment.

| Ward, Whalon, Rusnak, Wendell, & Paschall, 2013 | Examined the effectiveness of a THR on social communication and sensory processing with children with autism. | Single group quasi-experimental interrupted time series design. | n=21 children with autism n=15 males n=6 females | Participants were separated into groups of four and all participants received 6 weeks of THR then a 6 week break, 4 weeks of THR, 6 week break, and 8 weeks of THR. The participant’s schoolteachers using the Gilliam autism rating scale II and the sensory profile school companion measured autism characteristics and sensory processing. Participant’s behaviors were ranked based on their functioning in the classroom not during THR. | Results indicate that THR can be an effective intervention for children with autism. After 10 weeks of THR ratings indicate that there was improvement in social communication, attention, tolerance and reactions to sensory input in the classroom. However during the breaks when THR was not received improvements were not maintained. After THR resumed ratings again showed | Small sample size and lack of control. Data collected for this study was generated from a single source, teacher reports. |
### Utilization of Hippotherapy

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>Results</th>
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</thead>
</table>
| Bass, Duchowny, & Llabre, 2013 | Examined the effects of THR on social functioning in children with autism. | Participants randomized into either experimental/control group with pre/post test measures. | n=34
n=19 experimental group
n=15 control group | Treatment group received THR session for 1 hour/week over 12 weeks. Social Responsiveness Scale and Sensory Profile were utilized to assess social functioning and pre and post-interventions. | In comparison to the control group experimental group significantly increased between pre and post testing. Improvements were seen in areas of sensory integration, directed attention, social motivation, and sensory sensitivity. In addition, participants showed a significant change in their ability to break away from sedentary routine in favor of active activities. |

| O’Haire, 2012 | Purpose was to present a comprehensive overview of empirical research on Animal Assisted Interventions for Autism. | Systematic Review | 14 studies published in peer-reviewed journals were included. Six of the articles used equines for either HPOT or THR. | Articles included were published between 1989 and 2012, were published in English, and empirically evaluated animal assisted interventions for autism spectrum disorders. | Social interaction was the most common outcome of animal assisted interventions reported in 9 of the 14 studies. Of the studies that looked at the use of equines all showed positive results for the specific skills. |

No information was provided on medications that participants may have been taking as well as no information was provided as whether participants in either the control or experimental group were receiving any additional therapies or self-help classes.
assessed. Below are different aspects of autism assessed by equine articles:

**Behavioral increases in social interaction:** 4 of the 6 studies found positive results

**Language and Communication:** 3 of the 6 studies found positive results

**Decrease in ASD severity:** 3 of the 6 found positive results

**Stress and Well being:** one article examined this and found inconclusive results

**Motivation:** 1 article had positive results
Reference


