Horseback Riding as Therapy for Children with Cerebral Palsy: Is There Evidence of Its Effectiveness?

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ABSTRACT. A systematic review of the literature on horseback riding therapy as an intervention for children with cerebral palsy (CP) was carried out. The terms horse, riding, hippotherapy, horseback riding therapy, equine movement therapy, and cerebral palsy were searched in electronic databases and hand searched. Retrieved articles were rated for methodological quality using PEDro scoring to assess the internal

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validity of randomized trials and the Newcastle Ottawa Quality Assessment Scale to assess cohort studies. PICO questioning (Population, Intervention, Comparison, and Outcomes) was used to identify questions of interest to clinicians for outcomes within the context of the International Classification of Functioning, Disability and Health. Levels of evidence were then accorded each PICO question. There is Level 2a evidence that hippotherapy is effective for treating muscle symmetry in the trunk and hip and that therapeutic horseback riding is effective for improved gross motor function when compared with regular therapy or time on a waiting list. No studies addressed participation outcomes.
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KEYWORDS. Hippotherapy, horseback riding, therapy, cerebral palsy

INTRODUCTION

Cerebral palsy (CP) is a nonprogressive disorder of the areas of the developing brain that control movement and posture (Bax, 1964). While CP is not curable, there are known benefits of therapy, education, and assistive devices in increasing functional independence and participation for children with CP (Yamamoto, 2000). In rehabilitation, horseback riding has been suggested as a potentially promising intervention: it can be performed in a natural environment (Campbell, 1997), within the family-centered context of care (Law et al., 2003) and encourages participation of individuals with disabilities (Perleth, Jakubowski, & Busse, 2001). However, it would be important to identify its effectiveness in the treatment of children with CP before recommending its widespread use. Thus, this article summarizes the premise behind the use of horseback riding as a therapeutic intervention for children with CP and appraises the evidence for its effectiveness through a systematic review. Finally, the scientific evidence is placed into the context of daily clinical practice.

International Classification of Function, Disability and Health

The International Classification of Function, Disability and Health (ICF) (World Health Organization, 2001) places function into the context

of health regardless of the presence of disability. The ICF promotes the concept of "states of health" as they apply to all individuals, rather than determining the "consequences of disease" in impaired populations alone. The ICF systematizes and standardizes the dimensions of health at four levels, body functions and structures (body systems), activities (tasks or actins performed by the individual), and participation (involvement in life situations, person-environment interaction) and provides a framework for physical and occupational therapy practice (Palisano, Snider, & Orlin, 2004). Therapy using horseback riding for children with CP would potentially impact on outcomes at all levels of the ICF (Law, 1991). For the purposes of this systematic review, outcomes were categorized as related to body functions and structures, activities and participation.

Family-Centered Services

The strength of the evidence supporting family-centered services has led occupational therapists (OT) and physical therapists (PT) to consider this method of service delivery as an important criterion for "best practice." Several studies have shown that programs adopting a joint focus on the child and the family were the most effective in achieving their goals (King, Stewart, King, & Law, 2000; Law et al., 2003). Favorable outcomes have been reported in areas such as parent-child interaction, cognitive and social development, parental compliance, and family coping skills (Law & King, 1993). Therapeutic riding provides an ideal opportunity for a family-oriented, normalized environment for the provision of therapy.

Therapy in Natural Environments (TINE)

Rather than receiving center-based treatment, the premise of TINE states that interventions with children and their families should take place "in natural settings" including home, day care, school, and in outdoor community settings (Abbott, 1999, 2000). Consistent with the Individuals with Disabilities Education Act in the United States (US Code of Federal Regulations, 1997), TINE promotes children's participation in family and community life. TINE focuses on function and socialization and aims to develop lifelong community supports, thus representing another component of "best practice" for pediatric therapists to incorporate into their interventions (Campbell, 1997). As a conceptual framework, TINE provides a natural fit for the implementation of therapeutic riding.

Riding as Therapy

Horseback riding as a therapeutic intervention dates back as far as ancient Greece, where it was prescribed to improve mental and physical well-being. It gained popularity in Europe after World War II when it was prescribed to address mental, physical, and emotional issues (Meregillano, 2004). By the 1960s, therapeutic riding centers began to appear in Canada and the United States with the formation of the Community Association of Riding for the Disabled (CANtra) (Meregillano, 2004). Currently, riding is utilized from both a therapeutic and a recreational perspective to address a wide range of disabilities such as multiple sclerosis, stroke, Down syndrome, spinal cord injury, attention deficits, autism, and CP.

Two types of horseback riding interventions are described in the literature: therapeutic horseback riding (THR) and hippotherapy. THR is typically provided by a trained riding instructor who teaches the disabled rider to control the horse using basic riding skills. In contrast, hippotherapy is commonly provided by a physical therapist (PT) or an occupational therapist (OT), with the goal of using equine movements to improve balance, posture, gross, and fine motor skills. Presently, the North American Riding for the Handicapped Association (NARHA) (NARHA, 2005) and the American Hippotherapy Association (AHA) (AHA, 2003) set program standards and provide training and licensure for hippotherapy. NARHA also provides therapeutic riding instructor certification.

Supporters of horseback riding interventions state that the warmth, shape, and rhythmical, three-dimensional movements of the horse improve flexibility, posture, balance, and mobility of the rider. During riding, the movements produced by the horse approximate the weight shifting of the pelvis during walking. Sustaining these movements with the pelvis and legs, while maintaining the trunk and head upright during riding, is thought to promote righting and balance reactions. In addition, the pelvis, lumbar spine, and hip joints are mobilized. Trunk muscles alternate between an activated and a relaxed state leading to the normalization of muscle tone. From a dynamic systems perspective, the postural perturbations created by the movements of the horse offer the rider multiple opportunities for adjustment (Thelen & Spencer, 1998). Varying the position in which the child is placed on the horse (for example, prone, sitting, side-sitting, and side-lying), the terrain, or the number and direction of turns presents different physical challenges. Requiring more participation on the part of the rider challenges attention span.

In addition, by playing goal-specific games, the therapist can work on cognitive skills such as math, communication, and visual-perception (Bertoti, 1988; Satter, 1978). These sessions are labor intensive. During a typical session, volunteers generally function as "side walkers," walking on either side of the horse to ensure that the rider is safely in proper position with an additional volunteer leading the horse (Meregillano, 2004).

The early descriptive articles about horseback riding as an effective therapeutic intervention for children with CP, primarily in German, place emphasis on the motivational and psychological qualities of riding. Horster, Lippold-von Horde, and Rieger (1976) presented an overview and definition of hippotherapy and THR and discussed the applications to cerebral palsy. The authors suggested that horseback riding has many psychological benefits as it provides the opportunity for experiencing success that may lead to an increase in self-esteem as well as motivation. Physical benefits such as improvements in equilibrium, coordination, muscle tone, posture, and reactions were also alluded to. Four different types of riding therapy and their applications were identified (Satter, 1978): Hippotherapy for more severely disabled clients, horseback riding therapy for moderate to mild CP, therapeutic horseback riding for riders with minimal CP, and riding for the "handicapped" in which a disabled person rides independently. Satter suggested that children with diplegic CP make the greatest gains, citing improvements in equilibrium, coordination, posture, and muscle tone. In addition, the motivational qualities of the activity, and a concomitant increase in self-esteem and participation, were emphasized. However, no data were presented to support the recommendations.

Tauffkirchen (1978) reported on the effects of riding therapy in 27 children with CP. A limited treatment time of 15 to 20 minutes as well as particular exercises and positions were specified. The author stated that 9 children acquired a new function and 12 showed a marked improvement as a result of riding therapy. Improvements in muscle tone, breathing and vocalization, as well as social behavior were observed. No information was presented on how these changes were measured.

Riding in the Context of Evidence-Based Practice

"Best practice" has been defined as the best way to identify, collect, evaluate, disseminate, implement information and, finally, monitor the outcomes of health care interventions for client groups (Perleth, Jakubowski, & Busse, 2001; Podger, 1996; Smith & Sutton, 1998).

It addresses a process of decision making and actions based on scientific knowledge and evidence that reflect the most current and innovative ideas available (Dunn, 2000). The use of quality evidence is essential to guide clinicians' decisions in the planning and improvement of evaluations and interventions, and education of consumers to bring about high quality services (Angelo, Buning, Schmeler, & Doster, 1997). The articles previously cited, (Feldkamp, 1979; Horster, Lippold-von Horde, & Rieger, 1976; Satter, 1978; Tauffkirchen, 1978) suggest horseback riding has positive outcomes for children with cerebral palsy; however, the quality of evidence is poor.

In summary, when reviewed in the context of the ICF, TINE (Hanft & Pilkington, 2000), and family-centered care as foundations of "best practice"(Law et al., 2003), horseback riding would appear to have excellent potential as an intervention for children with CP. Yet, not one systematic review has been published until now. MacKinnon's (1995) review of therapeutic riding focused on the use of riding for a large variety of clientele and included only one study specific to children with CP. The objective of this systematic review was to appraise the evidence on the effectiveness of hippotherapy and therapeutic horseback riding on impairments, activities, and participation in children with CP.

METHODS

Systematic Review of the Literature

Electronic databases (MEDLINE: 1966-2005; PsychINFO: 1806-2005; CINAHL: 1982-2005; Current Contents: 1993-2005; ERIC: 1966-2005; and HealthSTAR: 1966-2005) were searched back to the earliest available time using the following terms horse, riding, hippotherapy, horseback riding therapy, equine movement therapy, and cerebral palsy. The search was limited to articles written in English and German since much of the early descriptive work was originally written in German and one author (CK) was fluent. Reference lists of the retrieved articles were scanned to identify others relevant to the topic. In addition, the authors contacted NARHA, CanTRA, and the Federation of Riding for the Disabled International who provided bibliographies and articles that were reviewed to identity additional references that may not have been found in the database search. Considered for inclusion were all randomized control trials (RCTs), quasi-experimental and observational studies related to hippotherapy or THR for children with CP. Only peer-reviewed

articles were considered with abstracts and proceedings excluded. A total of 11 scientific articles were retrieved. Two of these (Kuczynski & Slonka, 1999; Quint & Toomey, 1998) addressed mechanical saddle riding and were thus excluded. The nine studies included three RCTs, four quasi-experimental, and two descriptive studies.

Quality Assessment

The retrieved articles were grouped for review according to intervention, hippotherapy, or THR. Using the PICO format (Guyatt, 2002): (1) Population (children with CP), (2) Intervention, (3) Comparison/control, and (4) Outcome (measurement of change in outcome measures used), questions deemed relevant to clinicians and answerable based on the current evidence in the literature were created.

The following information was summarized for each study: author/date, design, participants, exposure/intensity outcomes and significance, and ICF component assessed. Studies were first classified as either experimental or observational. Experimental studies, which received the highest quality ratings, use comparable control groups, random assignment, and provide safeguards against observer bias through blinding of evaluators, therapists, and subjects and typically report on subject attrition. The RCTs were rated for methodological quality using the Physiotherapy Evidence Database (PEDro, 2004; Verhagen, 1998) rating scale (PEDro) which describes validity and interpretability of a clinical trial according to the following rating out of 10: specification of eligibility criteria (which does not contribute to the total score), random allocation, concealed allocation, comparability of groups at baseline, blinding (therapist, subject, assessor), intention-to-treat analysis, adequacy of follow-up, between-group statistical comparisons, and point estimates of variability. Two reviewers rated each RCT independently and discrepancies in scoring were then discussed between them. When discrepancies could not be resolved, a senior researcher with experience in RCT methodology was consulted to reach a final determination of the PEDro score. Where an RCT already had a PEDro score in the PEDro database, the existing score was used. PEDro scale results of individual studies were interpreted using Foley's (2003) quality assessment where studies scoring 9-10 were considered methodologically to be "Excellent," 6-8 were considered "Good," 4-5 "Fair," and below 4, "Poor."

Observational study designs typically consisted of quasi-experimental or descriptive pre-post designs (Portney & Watkins, 1993). Types of quasi-experimental designs included nonrandomized pre-test/post-test

designs and repeated measures designs without randomization where subjects acted as their own controls. While these study designs have generally been deemed of lesser quality than the RCT, they are of great value if well designed and rigorously conducted (Grossman, 2005). Cohort and case-control studies were reviewed using the framework provided by the Newcastle-Ottawa Scale (NOS) (Wells, 2005). Based on the selection and comparability of the groups and the method for determination of outcome, the NOS uses a star system (one for each of the selection and outcome criteria and a possible two stars for the comparability criteria). The highest quality study receives nine stars. Repeated measures designs are considered to be of higher quality if a withdrawal phase and a multiple rather than a single baseline is used, although this differentiation does not affect the NOS rating.

Ratings for levels of evidence were based on recommendations by Sackett (2000), which we adapted to include PEDro ratings (see Table 1). For example, if two randomized controlled trials (RCTs) of *high* quality (excellent or good; PEDro ≥ 6) found therapeutic riding to be effective for trunk control, the intervention would receive a "1a" rating. If one RCT of *high* quality found therapeutic riding to be effective for trunk control, the intervention would receive a "1b" rating for improvement of trunk control. One or more *fair* quality RCTs (PEDro = 4-5) that were found to be effective for trunk control would receive a "2a" rating. Lower quality studies (PEDro < 3) and non-randomized trials and strong single subject designs (for example, those with multiple baselines) received a rating of "2b." A consensus by an expert panel or a group of

TABLE 1. Levels of Evidence (adapted from Sackett) (Sackett, 2000)

Level	Description
1a	Two or more well-designed RCTs with similar findings of *high* quality (PEDro ≥ 6)
1b	One well-designed RCT of *high* quality (PEDro ≥ 6)
2a	One or more *fair* quality RCTs (PEDro = 4-5)
2b	Non-Randomized trials and strong single subject designs (i.e., multiple baselines)
3	Agreement by an expert panel or a group of professionals in the field; also applied to the findings of a number of well-designed (pre-/post-) studies showing similar results
4	Conflicting evidence of two or more equally well-designed studies
5	No RCT, no consensus, no studies other than observation

professionals in the field or findings of a number of "pre-/post-" design studies that showed similar results, received a rating of three. Conflicting findings of well-designed studies received a level of evidence of four. Finally, a level of evidence of 5 indicated that there were no research studies exploring the question.

RESULTS

Evidence for Hippotherapy

1. *In children with CP, is hippotherapy more effective than no intervention, placebo intervention, or an alternative intervention for body functions and structure outcomes?*

One "fair" pilot RCT investigated this question and reported positive, significant results including increased muscle symmetry of the trunk and hip abductors and adductors (Benda, McGibbon, & Grant, 2003). Two quasi-experimental studies found positive, significant results–one for energy expenditure (McGibbon, Andrade, Widener, & Cintas, 1998) and the other for posture (Bertoti, 1988). A descriptive study found improvements in kinematic measurements of trunk coordination (Haehl, Giuliani, & Lewis, 1999).

Conclusion: There is Level 2a evidence that a short intervention of hippotherapy is effective for treating muscle symmetry in the trunk and hip when compared with static sitting.

2. *In children with CP, is hippotherapy more effective than no intervention, placebo intervention, or an alternative intervention for activities outcomes?*

No published RCT has investigated this question. However, three quasi-experimental studies found positive, significant results: for the Gross Motor Functional Measure (GMFM)–Dimension C: crawling/kneeling and total score (Casady & Nichols-Larsen, 2004); GMFM–Dimension E: walk, jump, run (McGibbon et al., 1998); Pediatric Evaluation of Disability Index (PEDI)–social sub-scale and total score (Casady & Nichols-Larsen, 2004). Finally, one descriptive study found a positive trend on the PEDI (Haehl, Giuliani, & Lewis, 1999).

Conclusion: There is Level 3 evidence that hippotherapy is associated with positive significant results for gross motor function and functional performance in the home and community.

3. *In children with CP, is hippotherapy more effective than no intervention, placebo intervention, or an alternative intervention for participation outcomes?*

No published studies could be retrieved that addressed the effect of hippotherapy on participation in children with CP.

Conclusion: The evidence for this question is Level 5.

The details of the five studies of hippotherapy are summarized in Table 2. Specifically, Benda, McGibbon, and Grant (2003) conducted an RCT pilot study to evaluate the effect of hippotherapy on muscle activity. Significant differences were found in the experimental group with improved muscle symmetry of the trunk and hip abductors and adductors versus the control group. The authors suggest that while these are limited findings on a small sample size they are sufficiently encouraging to recommend a full RCT.

McGibbon (1998) used a repeated measures within-subjects design to study the effects of hippotherapy on gait, energy expenditure, and gross motor function. Pre- versus post-test comparisons indicated significant improvements in energy expenditure and GMFM scores for Dimension E. While the sample size was small and assessors were aware of the intervention are major threats to internal validity, the findings warrant further study of hippotherapy.

Bertoti (1988) used a repeated single subject series design to study the effect of riding therapy on posture in children with moderate to severe spastic CP. Significant pre-post improvements were found in posture, trunk control, balance, and quality of weight bearing. Subjective findings as reported by each child's physical therapist included an increase in self-confidence, a decrease in fear of movement and position change, as well as a decrease in spasticity, and an improvement in weight bearing and functional balance skills. There was a large difference between the two baseline data points, confounding interpretation of changes during hippotherapy. In addition, the psychometric properties of the primary outcome measure were not reported and a lack of blinding of the evaluator, places the results at a lower level of evidence.

Casady and Nichols-Larsen (2004) examined the effect of hippotherapy on functional development. Significant differences between groups on the GMFM Dimension C (crawling/kneeling) and total score, and the PEDI social sub-scale and total score, were found between the second pre-test and the first post-test. While positive conclusions were drawn about the value of hippotherapy for gross motor function as well

TABLE 2. Summary of Studies on Hippotherapy

Author (Date)	Design	Participants	Exposure and Intensity	Outcome Measures and Significance*	ICF Component
Bertoti, 1988 NOS = 5	Repeated single subject series	Moderate to severe CP, mean age 5.5; n = 11	1 hour twice weekly for six months	Bertoti Posture Assessment Scale (+) Qualitative information	Impairments
McGibbon et al., 1998 NOS = 5	Repeated measures within subjects	Diplegia and Hemiplegia, mean age 9.1 yrs; n = 5	Hippotherapy– 30 minutes, twice weekly for eight weeks	Energy expenditure (+) Gait (velocity, cadence, average stride length) (−) GMFM (Dimension E) (+)	Impairments Impairment Activities
Hael, Giuliani,& Lewis, 1999	Descriptive case studies	CP (n = 2), 4 yrs and 9.6 yrs; normal (n = 2) (novice [7 yrs] and expert rider [9 yrs])	Hippotherapy– 12 weekly sessions One subject = 20 minutes, other subject = 40 minutes	Trunk coordination (kinematics) (−) PEDI (−)	Impairment Activities
Casady & Nichols-Larsen, 2004 NOS = 6	Repeated measures Pre-/Post-test × 2 Pilot study	CP–2.3-6.8 yrs; mean age 4.1 yrs; n = 10	Hippotherapy– 45 minutes/once weekly for 10 weeks	GMFM • Crawling/ Kneeling (+) Total score (+) PEDI • Social (+) Total Score (+)	Activities Activities
Benda, McGibbon, & Grant, 2003 PEDro = 5	Pre-/Post-test RCT Pilot study	Spastic CP–4.0-12.0 yrs; n = 15	Hippotherapy– 8 minutes/Once	Trunk AB/Adductors (EMG) • Muscle symmetry (+)	Impairments

CP: Cerebral Palsy; GMFM: Gross Motor Functional Measure; PEDI: Pediatric Evaluation of Disability Index; EMG: electromyography; RCT: Randomized Clinical Trial; NOS: Newcastle-Ottawa Scale; ICF: International Classification of Function.
*Significance = (+); Non-significance = (−).

as functional and social skills in children with CP, the limitations of this study include the lack of blinding of assessors and a small sample size.

Finally, Haehl, Giuliani, and Lewis (1999) investigated the effects of weekly hippotherapy sessions on postural control, coordination, and functional performance in two children with CP, using a pre-post design. The results suggest that hippotherapy resulted in improved coordination during riding between the rider's upper and lower trunk as well as between the rider's lower trunk and the horse's back. One subject improved in functional mobility. While the evaluators were blind to the purpose of the study, the design was not sufficiently rigorous to enable conclusions to be made.

Evidence for Therapeutic Horseback Riding (THR)

1. *In children with CP, is THR more effective than no intervention, placebo intervention, or an alternative intervention for body function and structure outcomes?*

One "fair"-quality RCT found no significant changes in muscle tone (Cherng, Liao, Leung, & Hwang, 2004). One "low"-quality RCT found positive significant results for the Peabody Developmental Motor Scales (grasping) but no significant results for posture, self-esteem, or global behavior (MacKinnon et al., 1995). A descriptive study found improvements in kinematic measurements of trunk coordination (MacPhail et al., 1998).

Conclusion: There is Level 2a evidence that THR is no more effective than other therapies for improving muscle tone in children with CP and 2b evidence that it is no more effective than no intervention for posture, self-esteem and global behavior. There is 2b evidence that THR is effective for improving grasp.

2. *In children with CP, is THR more effective than no intervention, placebo intervention, or an alternative intervention for activities outcomes?*

One "fair"-quality RCT found positive, significant changes on the GMFM Dimension E (walk, jump, run) (Cherng et al., 2004). One quasi-experimental study also found associated positive, significant results for the GMFM Dimension E (walk, jump, run) (Sterba, Rogers, France, & Vokes, 2002).

Conclusion: There is Level 2a evidence that THR is effective for improved gross motor function (walk, jump, run) when compared with

regular therapy or time on a waiting list. There is Level 2b evidence that THR is no more effective than no intervention for activities of daily living and psychosocial outcomes.

3. *In children with CP, is THR more effective than no intervention, placebo intervention, or an alternative intervention for participation outcomes?*

Conclusion: No published studies could be retrieved that addressed the impact of THR on participation in children with CP. Thus, the evidence is currently at Level 5.

The details of the four studies of THR are summarized in Table 3. Specifically, Cherng et al. (2004) used a randomized cross-over design to investigate the effectiveness of THR in a group of children stratified according to severity of CP. Analysis showed a significant main effect of THR on GMFM scores (Dimension E: (walk/run/jump) and total score) but no significant main effects or interaction of THR on muscle tone. Because of a disproportionate dropout rate between the first and second intervention period, internal validity was jeopardized: 5 of 10 subjects in the second group did not complete the second 16-week intervention period. There was some evidence to suggest that the effect of THR persisted, as the first group's scores did not change significantly between the second and third test points following THR.

MacKinnon et al. (1995) studied the effects of riding on posture, fine and gross motor skills, and performance in activities of daily living, socialization, self-perception, and global behavior. Nineteen children were stratified by severity (mild or moderate); then randomly allocated to a THR or control group. With the exception of an improvement in grasping skills among the moderately involved children, and self-perception for mildly involved children, there were no differences between the two groups suggesting that teaching functional riding skills did not impact on the child's performance. Reports by the instructors, therapists, and parents suggested improvement in riding skills, physical, and psychosocial performance. The small sample would have required a large effect size to demonstrate statistically significant differences.

MacPhail et al. (1998) used a cross-sectional, descriptive design to examine the effects of horseback riding on trunk postural reactions in six children with cerebral palsy and seven children without motor impairments using kinematic measurement. Children with diplegia were more likely to respond with normal equilibrium reactions to the pelvic displacement of the horse (65% to 75% of the time), while children with quadriplegia demonstrated a lower frequency of normal responses (10%

TABLE 3. Summary of Studies on Therapeutic Horseback Riding (THR)

Author (Date)	Design	Participants	Exposure and Intensity	Outcomes and Significance*	ICF Component
MacKinnon et al., 1995 PEDro = 3	Pre-/Post-test RCT Stratified for severity	Spastic CP (4.0-12.0) n = 19	THR– 1 hour/week × 6 months	GMFM (−) Bertoti Posture Assessment Scale (−) BOTMP (−) PDMS grasping (+) VABS ADL (+) VABS-Socialization Harter CBC (+) (activities)	Activities Impairments Impairments Impairments Activities Activities Impairments Activities
MacPhail et al., 1998	Descriptive case studies	CP (n = 6), mean age 6.7 yrs; non-disabled (n = 7), mean age 8.1 yrs	1 session × 1	Kinematic analysis by peak 5 motion analyzer Trunk postural reactions in children with diplegia (+) Trunk postural reactions in children with quadriplegia (−)	Impairments
Sterba et al., (2002) NOS = 6	Repeated measures within subjects	CP mean age 9.10 n = 17	1 hour weekly for 18 weeks	GMFCS WeeFIM (−) GMFM (Dimension E) (−)	Activities Activities Activities
Cherng et al., (2004) PEDro = 4	Cross-over design (within-participant, repeated-measures)	Spastic CP (3.1-11.5), n = 14	THR– 16 weeks; 40 minutes, twice/week	GMFM (Dimension E) (+) Modified Ashworth Scale (hip adductors) (−)	Activities Impairments

CP: Cerebral Palsy; GMFM: Gross Motor Functional Measure; GMFCS: Gross Motor Classification System; WeeFIM: Functional Independence Measure for Children; CBC: Child Behavior Checklist; PDMS: Peabody Developmental Motor Scales; Harter: Harter Self-Perception Scale; VABS: Vineland Adaptive Behavior Scale; BOTMP: Bruininsks-Oseretsky Test of Motor Proficiency; RCT: Randomized clinical trial; NOS: Newcastle-Ottawa Scale.

*Significance = (+); Non-significance = (−).

to 35% of the time). The authors concluded that children with diplegia could benefit from THR, as it seemed to facilitate postural reactions of the trunk and equilibrium reactions leading to improved posture.

Sterba et al. (2002) used a repeated measures design to investigate the effects of THR on gross motor function. Results following treatment showed that scores for Dimension E (running, jumping, walking) of the GMFM increased significantly. The authors concluded that riding improves gross motor function in children with CP, but that improvement was not sustained once intervention was withdrawn. The sample size was larger than in most other studies. Standardized outcome measures with known validity and reliability were used. In addition, the authors indicated that assessing therapists were not aware of children's previous scores.

DISCUSSION

While early publications on the use of hippotherapy and THR consisted largely of case reports or nonrandomized observational studies, recent investigations have addressed these interventions with more methodological rigor including the use of randomized designs and standardized outcome measures. The systematic review included all research designs, not only RCTs, in recognition that other results of well-conducted studies using other designs contribute to knowledge about the effectiveness of rehabilitation interventions. A critique of each of study reviewed was provided based on the perspective that all the available evidence should be appraised in a systematic review (Bigby, 2001; Grossman, 2005). Indeed, there is emerging evidence suggesting that for children with CP, THR and hippotherapy may be beneficial for improving body functions and structure and activities. However, all studies reviewed had small sample sizes and subjects may not be representative of the population of children with cerebral palsy, limiting the ability to generalize findings. Because of the large variation in abilities among children with CP, the effectiveness of specific types of riding therapy must be investigated for subgroups of children grouped by age and gross motor abilities.

Of particular interest in this systematic review was the finding that no studies addressed participation as an outcome. This is in contrast to the International Classification of Functioning, Disability and Health (World Health Organization, 2001) in which participation is an important component of functioning and health. Therapeutic riding is an intervention that potentially offers not only remediation of impairments

but enables community participation. Further research is recommended to examine child and family satisfaction and the effect of therapeutic riding on participation. The Children's Assessment of Participation and Enjoyment and Preferences for Activities of Children (King, Law, King, Hurley, Hanna, Kertoy, Rosenbaum, & Young, 2004) is a potential outcome measure.

CONCLUSIONS

The results of the systematic review indicate there is Level 2a evidence that hippotherapy has short-term positive effects on muscle symmetry in the trunk and hip and that therapeutic horseback riding is no more effective than other therapies for improving muscle tone in children with CP. There is Levels 3 and 2 evidence that hippotherapy and therapeutic horseback riding have positive effects on activities. Outcomes for participation have not been reported.

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