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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| In young children (3-12yo) diagnosed with cerebral palsy, what are the benefits of participating in a hippotherapy program compared to more traditional therapies in improving functional gross motor skills including gait, strength, and balance and coordination? |

**AUTHOR**

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**CLINICAL SCENARIO**

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| The family of a 3year old child with a diagnosis of cerebral palsy reported recent participation in a hippotherapy program in addition to his more traditional school based therapies. Due to the scheduling, location, and operating hours of the hippotherapy clinic, this family informed the school based therapist that he was may be absent for part of his school day in his pre-school class on a weekly and regular basis for the beginning of the school year. This raises the question of what exactly are the functional gross motor benefits of participation in this type of therapy and what impact it would have on the more traditional based physical therapist in any setting. Young children with neurological disabilities are often followed by physical therapists who practice in different settings. It is important for physical therapists in any setting to be knowledgeable about the impact that other therapies such as hippotherapy would have on their patient population. This information could help guide therapists in decision making to provide appropriate recommendations to patients and families who are seeking additional therapeutic activity programs and leisure activities to compliment traditional therapies to encourage increased physical activity. Also, understanding the benefits of participation in this type of activity may help the physical therapist in a clinical or school based setting coordinate more traditional based therapies in a way to bridge the two types of therapies to achieve similar therapeutic goals.   |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| * Ten studies were identified that met both the inclusion and exclusion criteria which consisted of 4RCT’s, 2 systematic reviews, 2 meta-analyses, one non-randomized trial, and one single group pre- and post-intervention trial. This resulted in a variety of levels of evidence to review. Two RCT’s and one meta-analysis were chosen to present in this paper that comprehensively addressed the varying significance and benefits of hippotherapy.
* Physical therapy interventions provided on horseback utilizes the rhythmical 3dimensional pelvic movement of the horse and the horse’s warmth to promote decreased tone and spasticity in children with CP which can have an impact on their functional gross motor skills.
* Future studies should include a greater number of RCTs with larger sample size. Cost effectiveness in comparison to more traditional therapies should be an outcome measurement tool that should be included in future research.
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**CLINICAL BOTTOM LINE**

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| The current evidence supports the benefits of hippotherapy as an adjunct therapy service to more traditional therapeutic interventions in the treatment of children diagnosed with cerebral palsy. None of the experimental participants discontinued their participation in their traditional physical therapy interventions during participation in the hippotherapy program. Therefore, the positive effects of hippotherapy could not necessarily be singled out and should be recommended as alternative therapy that does not replace more traditional therapies. Equine Assisted Active Therapies (EAAT) can provide therapeutic benefits as well as an outlet for patient participation in community based leisure activities for increased physical activity. |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Child\*AdolescentsPediatricPaediatricCerebral Palsy | HippotherapyHorseHorseback ridingEquine therapy | Physical TherapyPhysiotherapyExercis\*Train\*Rehabilitation | Strength\*Walk\*GaitBalanceCoordinationPostural control |

**Final search strategy for PubMed:**

1. Child\* OR Adolescent\* OR Pediatric OR Paediatric OR Cerebral Palsy
2. Hippotherapy OR Horse OR “Horseback riding” OR “equine therapy”
3. “Physical therapy” OR physiotherapy OR exercis\* OR train\* OR rehabilitation
4. Strength\* OR walk\* OR gait OR balance OR coordination OR postural control
5. #1 AND #2 AND #3 AND #4
6. #1 AND #2 AND #4
7. #1 AND #3 AND #4

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| PubMedCinahlCOCHRANEPEDro | 74473513 | MeSH terminology, humans, English, revised number of results=54 |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| * Meta-analyses, systematic reviews, randomized controlled trials
* Published in English
* Studies include a pediatric population whose age range is as low as 3yo (preK) and goes up to at least 12yo.
* The subjects in the study have a diagnosis of cerebral palsy
* Subjects are able to walk or take steps with assistance and/or an assistive device (Gross Motor Function Classification System Levels I, II, and III).
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| **Exclusion Criteria** |
| * Studies that include adults
* Studies that cover diagnoses other than cerebral palsy – you may have to end up considering some of these if you have few options.
* Descriptive surveys and case studies
* Subject diagnoses of Gross Motor Function Classification System (GMFCS) for children with CP Levels IV and V.
* Most of the studies reviewed did include children with a GMFCS Level IV diagnosis and this initial exclusion criteria had to be changed.
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**RESULTS OF SEARCH**

**Summary of articles retrieved that met inclusion and exclusion criteria**

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| **Author (Year)** | **Study quality score** | **Level of Evidence** | **Study design** |
| **Davis et al, 20091** | **7** | **1** | **RCT** |
| **Kang et al, 20122** | **6** | **1** | **RCT** |
| **McGibbon et al, 20093** | **8** | **1** | **RCT** |
| **Kwon et al, 20154** | **7** | **1** | **RCT** |
| **Dewar et al, 20155** | **7** | **2** | **Systematic Review** |
| **Tseng et al, 20136** | **8** | **2** | **Systematic Review With Meta-analysis** |
| **Whalen and Case-Smith, 20127** | **6** | **2** | **Systematic Review** |
| **Zadnikar and Kastrin, 20118** | **8** | **2** | **Systematic Review With Meta-analysis** |
| **Kwon et al, 20059** | **20** | **4** | **Non-randomized trial** |
| **Moraes et al, 201610** | **19** | **4** | **Single Group Pre-Post Intervention Trial** |

**BEST EVIDENCE**

The following 3 studies were identified as the ‘best’ evidence and selected for critical appraisal. Reasons for selecting these studies were:

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| * Zadnikar M, Kastrin A. Effects of hippotherapy and therapeutic horseback riding on postural control or balance in children with cerebral palsy: A meta-analysis. *Dev Med Child Neurol*. 2011;53(8):684-691. doi: 10.1111/j.1469-8749.2011.03951.x [doi].

This meta-analysis did result in a high AMSTAR score of 8. However, it also directly analyzed the impact of hippotherapy on the outcomes of gross motor function such as postural control and balance which is relevant to the initial PICO question that was posed. The review utilized a funnel plot to reduce article bias for the reader. This meta-analysis serves as a reliable tool in clinical decision making regarding the initial PICO question.* Davis E, Davies B, Wolfe R, et al. A randomized controlled trial of the impact of therapeutic horse riding on the quality of life, health, and function of children with cerebral palsy. *Dev Med Child Neurol*. 2009;51(2):111-9; discussion 88. doi: 10.1111/j.146-8749.2008.03245.x [doi].

This study was able to clearly address the specific PICO question by comparing hippotherapy intervention to physical intervention in a population of children with CP. Though PEDRO scores indicate that it is a 7, the value of the study is in its ability to apply directly to the PICO question. The comparison intervention was present in this study and was specifically referred to as “traditional physiotherapy” which was difficult to identify in some of the other RCTs.* Kwon JY, Chang HJ, Yi SH, Lee JY, Shin HY, Kim YH. Effect of hippotherapy on gross motor function in children with cerebral palsy: A randomized controlled trial. *J Altern Complement Med*. 2015;21(1):15-21. doi: 10.1089/acm.2014.0021 [doi].

The comparison intervention or control group received “traditional physiotherapy” as well and was able to specifically compare this to hippotherapy intervention. The term gross motor function was assessed in this study through utilization of the GMFM. This article met the primary requirements and inclusion criteria necessary to answer the PICO question which made it clinically important and not just believable based on it PEDRO score of 7.  |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of Effects of Hippotherapy and Therapeutic Horseback Riding on Postural Control or Balance in Children with Cerebral Palsy: a Meta-Analysis by Monika Zadnikar and Andre J. Kastrin (2011).**

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| **Aim/Objective of the Study/Systematic Review:** |
| The primary aim of the meta-analysis was to summarize the present evidence available on the effects of hippotherapy and therapeutic horseback riding on postural control or balance in children with cerebral palsy. |
| **Study Design** |
| This meta-analysis accessed several databases for information including: Web of Science, PubMed, ProQuest, Current Contents, The Cochrane Library, Cochrane Databases of Systematic Reviews, The Cochrane Controlled Trials Registers, Ovid, Embase, CINHAL, and Google Scholar. The date range of information searched ranged from the initial development of the electronic database up until February 20, 2010 with an update of information performed in May 2010 which did not result in any additions to the data reviewed. Specific terminology that was searched were as follows: ‘developmental riding’ OR ‘riding therapy’ OR ‘riding for disabled’ OR ‘therapeutic horseback riding’ OR ‘riding for disabled’ OR ‘therapeutic horseback riding’ OR ‘hippotherapy’ AND ‘cerebral palsy’ OR ‘posture control’ OR ‘balance.’Inclusion Criteria* Quantitative study designs.
* Studies must address and assess the effects of hippotherapy or therapeutic horseback riding on postural or balance.
* The population or study group must include subjects (children and adults) diagnosed with cerebral palsy (CP).
* A comparison group must be included in each study.

Methods of Data Analysis Two independent data reviewers utilized the Critical Review Form Quantitative Studies by addressing 16 items that assessed the overall study, findings, and conclusions to determine both the internal and external validity. Each item was scored as 1(completely fulfils the criterion) or 0 (does not fulfil the criterion) to total a value of 16 (indicates maximum and excellent study quality). The following categories were assessed for each study: study purpose, literature review, study design, sample, outcomes, interventions, results, conclusions, and clinical impressions. Any disagreements between reviewers were settled through discussions and final agreements on article scores.Statistical Analysis and Meta-analysis performed* Odds ratio (OR) to quantify treatment effects, with a 95% confidence interval.
* P-value of <.05 utilized to indicate statistical significance unless otherwise stated.
* Both fixed-effects model (Mantel-Haenszel method) and the random effects model (DerSimonian-Laird method) were utilized to calculate the combined treatment effects.
* Heterogeneity was assessed by the fixed-effects model Cochran’s Q value (tests the null hypothesis that all treatment effects are equal) to determine if the random-effects model should be applied i.e. if the P value in this scenario is <.10 then heterogeneity was deemed statistically significant and random effects model was applied.
* I^2 metric was utilized to quantify the heterogeneity:
* I^2<25% No heterogeneity
* I^2= 25-50% Moderate heterogeneity
* I^2>50% Large or extreme heterogeneity
* Publication bias was assessed utilizing a funnel plot and the Begg rank correlation method.
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| **Setting** |
| Not specified. However, due to the type of intervention using a farm type animal such as a horse, one may infer that the hippotherapy was provided on a farm or specific horse training facility. |
| **Participants** |
| The selected studies (or “participants”) in this meta-analysis consisted of 10 full text articles that were assessed for eligibility of the study. However, 2 of the 10 articles were excluded secondary to the fact that these articles did not clearly identify a comparison group. Therefore a final 8 studies were assessed which consisted of: 3 RCTs (randomized controlled trials), 4 QED (quasi-experimental design), and 1 PED (pre-experimental design). All of these articles were published in peer reviewed journals between October 1988 and December 2009. |
| **Intervention Investigated** |
| *Control* |
| * Control group activities for 2 of the studies included continued participation in regularly scheduled physiotherapy sessions with no participation in any form of horseback riding real or artificial.
* The other studies included continued participation in traditional physiotherapy sessions with the addition of participation in barrel sitting and artificial saddle sitting (Brunel active balance saddle).
* In 4 of the 8 articles, subjects in the control group were diagnosed with cerebral palsy, the other 4 articles utilized non-disabled peers as subjects. A total of 39 children out of 89 children in the control groups were diagnosed with CP.
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| *Experimental* |
| * Riding interventions in the reviewed studies consisted of hippotherapy and therapeutic horseback riding that lasted anywhere from 4-12 weeks. One study reviewed had an experimental intervention of hippotherapy duration over a 6-month period (26weeks).
* Each individual treatment session ranged from 2x per week for 60min to 1-2x per week for 20-40minutes.
* A total of 86 children were included in the experimental or intervention groups for which all had a diagnosis of CP.
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| **Outcome Measures**  |
| Several outcome measures were utilized in the studies covered by this meta-analysis. The following list of measures were relevant to the outcomes of interest in the original posed PICO question. Note that this meta-analysis did not specify who or where these outcomes were administered. However, the timing of measurements performed occurred before and soon after the interventions were performed. * Peabody Developmental Motor Scales (PDMS): a developmental assessment and standardized test that can be administered to children 0-83months. It is comprised of subcategories that assess reflexes, stationary balance, locomotion, object manipulation, grasping, and visual integration.
* Videography: utilized to record and measure the dynamic movement of the subjects’ head, trunk, and lateral and anterior/posterior movement and tilt of the pelvis, and postural control and coordination during horse riding sessions.
* Photography: utilized to measure the passive range and movement of the subjects’ pelvis.
* Surface EMG. The specific muscle groups that surface EMG was applied to was not specified. However, the studies that utilized them were assessing trunk posture and balance which indicates that they may have surface EMG to trunk musculature.
* Force Plate: utilized to measure postural balance and centre of pressure displacement.
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| **Main Findings** |
| Overall, 77 articles were initially identified as possibly applicable to the authors search strategy. The investigators agreed upon a final 8 out of the 77 articles to be included in the current review and meta-analysis which met all inclusion criteria. General results and findings:* 76 out of the 84 children diagnosed with CP, included in the experimental groups of the relevant 8 articles did show positive effects on postural control and balance.
* Of the 39 children diagnosed with CP (out of a total of 89) in the comparison or control groups, 21 were able to report positive effects from continued participation in their current physiotherapy regimens and the study implemented barrel and artificial saddle sitting.
* The 50 non-disabled peers in the comparison groups had no effects (positive or negative) on balance and postural control.

Meta-analysis findings:* Random effects Odds Ratio (OR)= 25.41
* 95% confidence interval of 4.35,148.53
* Z=3.59
* p<0.001
* Meta-analysis revealed a positive pooled effect size which indicates a statistical significance in the use of hippotherapy or THR in children with CP.
* Significant heterogeneity did exist among all of the articles with I^2=60.7% and p=0.01
* Funnel plot results provided a visual result and examination of potential for bias.
* Upon visual examination the funnel plot did appear asymmetric, therefore additional Begg’s adjusted rank correlation test was applied (z=1.48, p=0.138) which confirmed no publication bias.
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| **Original Authors’ Conclusions** |
| Hippotherapy and THR can be included in a physical therapist’s “toolbox” as a recommendation or type of therapeutic intervention to improve posture and balance in children diagnosed with CP to improve their gross motor function in activities of daily living and their quality of life. |
| **Critical Appraisal** |
| **Validity** |
| Strengths* AMSTAR score= 8/11
* Researchers in this review did indicate article inclusion criteria.
* Two independent researchers conducted the review and utilized discussion and consensus in order to resolve any disagreements regarding their data extraction.
* This meta-analysis utilized several databases and indicated specific search terminology utilized in the review. These resources are listed earlier in this document under the sections Study Design and Search Strategy.
* Characteristics, appropriate scientific studies were included in forming conclusions, and the scientific quality of each study was clearly presented in table form by applying the Critical Review Form-Quantitative Studies scale.
* The random effects model was utilized in cases where heterogeneity was present.
* Meta-analysis also included application of a funnel plot in addition to statistical analysis of the Begg rank correlation to provide a definite identification of a lack of publication bias.

Limitations* This review failed to review grey literature for inclusion in the review. Omission of this type of literature can often be limiting and actually exclude information that could have a profound impact on a search question or topic.
* The full list of included and excluded articles were not referenced in this review making it difficult to replicate it.
* One of the authors of this study was singled out to be represented and supported by a local research agency.
* One of the databases utilized as part of the search strategy was Google Scholar which is one of the weaker databases available in comparison to the other databases listed and is least recommended for research.
* Some of the comparison groups in the individual studies utilized non-disabled peers while the experimental group had a diagnosis of some form of CP. This creates a problem in comparison and results such as comparing apples to oranges instead of apples to apples.
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| **Interpretation of Results** |
| The results of this meta-analysis provide a great example of how statistical significance does not always indicate clinical significance. The outcome of interest in this review was whether or not the application of hippotherapy or THR would have either a positive effect or no effect on postural control and balance in individuals diagnosed with CP. The reviewers chose to quantify the treatment effects by odds ratios with 95% CI. According to the forest plot provided in the meta-analysis, only 3 of the 8 articles reviewed showed statistical significance. In other words, only these 3 articles had CI’s that did not include the midline therefore indicating a positive treatment effect. However, these statistically significant values do have smaller sample sizes as indicated by the smaller boxes on each line. Also, this meta-analysis included a majority of its articles as weaker level 2 category of evidence and only 3 higher level 1 RCTs. Though statistically significant values were not noted in the remaining 5 articles of the meta-analysis, each of the total 8 articles still had some kind of positive effect on the participants in the intervention group. If a patient’s baseline postural control and balance is poor and is therefore limiting to their independence and mobility in their daily functional activities, then any improvement in these areas of impairment is a good thing. Even though this meta-analysis is comparing a positive effect to no effect, this is still clinically significant to the patient because progress in their abilities, regardless of how big or small, is still improvement from baseline and could be considered valuable to the individual patient. These results still show that the use of hippotherapy or THR can have a positive effect and improvement on the balance and postural control in a child diagnosed with CP in comparison to traditional therapies alone. |

**(2) Description and appraisal of *Effect of Hippotherapy on Gross Motor Function in Children with Cerebral Palsy: A Randomized Controlled Trial* by Kwon et al. (2014)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The primary objective of this study was to determine whether or not participation in hippotherapy has a clinically significant effect on gross motor function in children diagnosed with cerebral palsy. |
| **Study Design** |
| This study was designed as a randomized controlled trial with the following attributes:* Randomization was created by an independent statistician.
* Stratification was achieved by utilizing the Gross Motor Classification System (GMFCS) to describe each subject’s level of involvement from level I-IV through computer generated random blocks of 2 or 4.
* Project officers, participants, and participant parents/guardians were all blinded to whether participants were assigned to the hippotherapy or control groups.
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| **Setting** |
| * Hippotherapy interventions occurred at the Samsung RD Center of Samsung Equestrian Team arena in Gyeonggi-do, Republic of Korea.
* The arena was indoors and measured 18m x27m.
* The control group participated in their traditional therapies and exercises as a comprehensive home exercise program perform in their respective home settings.
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| **Participants** |
| * Participants were identified for recruitment by the Samsung Medical Center database.
* A total of 92 children were recruited for this study with the hippotherapy group N=46 and control group N= 46.
* GMFM levels of subjects in each group varied between level I-IV:
* Hippotherapy group participant GMFCS levels were as follows: I N=12, II N=12, III N=11, IV N= 10.
* Control group participant GMFCS levels were as follows: I N=12, II N=12, III N= 12, IV N= 10.
* Types of cerebral palsy also varied in each group as follows:
* Hippotherapy group: spastic= 41, dyskinetic=2, ataxic= 2
* Control croup: spastic=43, dyskinetic= 2, ataxic=1
* One participant did drop out from the hippotherapy group (N=45) and was not included in final statistical analyses.
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| **Intervention Investigated** |
| *Control* |
| * Treatment protocol for the control group consisted of 30minutes of aerobic exercise paired with conventional physiotherapy interventions.
* The conventional physiotherapy interventions were not specified however, aerobic exercise consisted of either walking or cycling activities.
* Therapies occurred at a frequency of 2 times a week over an 8 week period.
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| *Experimental* |
| * Treatment protocol for the hippotherapy (experimental) group consisted of private hippotherapy for 30minutes 2 times per week over an 8 week period for a total of 16 sessions.
* The subjects in this group also continued to participate in their regular conventional physiotherapy sessions.
* Hippotherapy was applied on a one on one basis between hippotherapist and participant.
* Hippotherapies were provided by physical therapists specifically trained in hippotherapy and certified by the American Hippotherapy Association with a level II trainer status.
* In addition to the physical therapist, other members of the hippotherapy team consisted of a leader to walk the horses and two volunteers to serve as side walkers to walk on either side of the participant.
* For improved physical contact between the participants and the horse, a soft saddle made of fleece was used.
* Other equipment for participants included the use of helmets for safety and protection.
* Ponies were matched to participants by size movement patterns to the functional status of each child participant.
* Hippotherapy protocol included the following:
* Muscle Relaxation
* Optimal postural alignment of the trunk, head, and lower extremities
* Independent sitting
* Active exercises including stretching, strengthening, dynamic balance, and postural control.
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| **Outcome Measures**  |
| Primary Outcome Measures:* Gross Motor Function Measure (GMFM-88)
* This is a validated measurement tool that can be utilized with children diagnosed with cerebral palsy and developmental delays.
* The test is comprised of 88 items divided into 5 dimensions with a score of up to 4 points for each item: A) lying and rolling, B) sitting, C) crawling and kneeling, D) standing, and E) walking, running, and jumping.
* Total scores and dimension scores were specifically calculated only for dimensions B-E which were then plugged into the Gross Motor Ability Estimator tool which calculated a final GMFM-66 score.
* The same single blind examiner administered this measurement tool both before and after the intervention.
* Pediatric Balance Scale (PBS)
* The PBS is a criterion referenced 14 item assessment tool that evaluates an individual’s functional balance in everyday tasks in the settings of the home, school, and community.
* This assessment tool has also been validated to use in the population of children with CP.
* The same single blind examiner administered this measurement tool both before and after the intervention.
* No secondary outcome measurement tools were specified or administered in this study.
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| **Main Findings** |
| * A 95% confidence interval was utilized across both outcome measures with a p-value set at <.05 to indicate significance.
* Paired t-tests were used to compare differences within groups and independent t-tests were used to compare differences in outcomes between groups (experimental v/s control) when calculating p-values.
* Hippotherapy Group:
* Baseline and post-intervention outcome measures of the GMFM total scores and individual dimensional scores of sections B-E, showed significant improvements in values with p<.05.
* GMFM score improvement within the hippotherapy group varied depending on the level of involvement of each child diagnosed with CP (GMFCS Levels I-IV) and the specific dimensions (A-E) assessed of the GMFM measurement tool. For example, GMFM-88 scores showed significant improvement for all GMFCS levels (I-IV). However, GMFM-66 scores showed the greatest amount of improvement in the more involved participants with GMFCS Levels II-IV (and not Level I).
* PBS scores from baseline to post-intervention also showed an improvement in scores with a p<.05 in all participants and functional levels (GMFCS I-IV).
* Control Group:
* No significant differences were noted in GMFM values within the control group. P-values ranged from .05 at the least and .99 at the most.
* No significant differences were noted for PBS values within the control group with p-values ranging from .16-.50.
* Effect size was not calculated or specified in this study. However, there was sufficient information provided in both pre and post intervention values both within and between each group to determine the effect size within and between the experimental and control groups. The information is provided below specifically for the total outcomes for the GMFM-66, GMFM-88, and PBS scores:

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| Outcome Measurement ToolTotals | HippotherapyEffect Size Calculation | ControlEffect Size Calculation | Between Group Effect Size |
| GMFM-66  | 63.5-60.8=2.7 | 61.8-61.4=.4 | 2.3 |
| GMFM-88  | 75.7-72.7=3 | 74.3-73.9=.4 | 2.6 |
| PBS | 28.9-25.1=3.8 | 27.1-26.9=.2 | 3.6 |

* Adverse Effects included the fact that two participants fell off of their horses during their intervention times. Both participants received immediate medical attention and examination including radiography to rule out brain injury or fracture. None were indicated. One participant was able to return to the study while the other decided to drop out therefore reducing the hippotherapy participant level to 45 participants. The dropout individual was not included in the statistical analysis or outcome findings of this study.
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| **Original Authors’ Conclusions** |
| The authors of this study concluded that hippotherapy does have statistically significant positive effects on gross motor function and balance in children diagnosed with varying functional levels of CP and can serve as an adjunct to more traditional physio therapy interventions. |
| **Critical Appraisal** |
| **Validity** |
| Strengths* PEDro Scale Score = 7/10
* All subjects were randomly assigned to both the intervention and control groups.
* Allocation was concealed by an independent statistician and all parties involved were blind to the allocation including project officers, participants, and participant parents/guardians.
* Both the intervention and control group participants were similar in their characteristics regarding age, gender, and level of functional involvement (GMFC levels I-IV) at baseline.
* The therapist who administered the outcome measures was the same for both baseline and post-intervention measurements and was blinded to the participants’ allocation.
* Greater than 85% of subjects initially allocated to both groups were analysed for outcome measures. In other words, there was only one drop out from the hippotherapy group that was not included in outcome measurements.
* Between group analysis was reported in outcome measurements.
* Point measures (the means) and variability (95% confidence intervals) were reported for all outcome measurement tools (GMFM-88, GMFM-66, PBS) in this study.

Limitations* Subjects/participants were not blinded to their treatment protocol as this is difficult to achieve in a rehabilitation study.
* The therapists providing the intervention were not blinded.
* The individual who dropped out of the hippotherapy group was not included in the final results therefore failing to analyse “intention to treat.”
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| **Interpretation of Results** |
| The results of this study indicate both statistical and clinical significance in the application of hippotherapy as an adjunct to more traditional physical therapy interventions. The effect size was not specified in this study but there was sufficient information available to determine the effect size both within each group and between groups. A positive effect size does indicate a positive treatment effect which therefore impacts a study’s clinical significance. This study showed a positive treatment effect in favour of hippotherapy over traditional physical therapy interventions alone in all outcome measures including the GMFM-66, GMFM-88, and PBS tools. These results mean that the application of hippotherapy is favoured over physical therapy alone. However, the participants in both groups continued to receive their traditional therapies at approximately 3hours per week therefore hippotherapy cannot be singled out as a replacement per say for traditional therapies but it is definitely indicated as a beneficial type of therapy to apply to children with varying levels of CP involvement in addition to their regular therapy routine. |

**(3) Description and appraisal of *A randomized controlled trial of the impact of therapeutic horse riding on the quality of life, health, and function of children with cerebral palsy* by Davis et al. (2009)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The primary aim of this study was to determine the impact of therapeutic horseback riding on the physical function, quality of life (QoL), and health function in children diagnosed with cerebral palsy (CP). |
| **Study Design** |
| The design of this study was as a randomized controlled trial with the following design attributes:* Subjects were randomly assigned (or stratified) by age ranging from 4-8yrs old and 9-12yrs old and by their Gross Motor Function Classification System (GMFCS) Levels (I-111).
* In order to avoid an imbalance of subject characteristics in the control and experimental groups, an allocation sequence was constructed to randomly arrange and select blocks of 2 or 4 participants to each group.
* Allocations to the control and experimental groups were implemented by the project’s statistician from the pre-generated sequence and was concealed from all involved project officers.
* All participants including the consenting primary caregivers, subjects, and all project officers were blinded to assignments into the intervention or control groups.
* Pre and post measurements of the Gross Motor Function Measure (GMFM-66) were performed at 1-6weeks both pre and post intervention by a single blinded physiotherapist who was trained and experienced in the administration of this outcome measurement tool.
* Quality of Life measurement tools (questionnaires) were also completed by participants and caregivers at 1-6 weeks pre and post intervention.
* During statistical of outcome measures, the data analyst and senior statistician in the study were not blinded to the treatment groups.
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| **Setting** |
| Two identical indoor equestrian facilities were used as the setting of this study. One was located in a metropolitan area and one in a rural area located in Melbourne, Australia between the dates of July to September of 2007. Each facility utilized horses that were specifically trained in riding with children with various disabilities. About ½ way through the study (August 25th), an outbreak of equine influenza occurred which had a large impact on the ability to transport horses between venues. Therefore, part of the riding had to move to an outdoor rural facility where the therapeutic horses were housed for the last 4 weeks of this study. The metropolitan indoor testing was affected as well, and onsite available horses were utilized (as opposed to the original therapeutic horses) for 3 out of the 10sessions. These horses were assessed for appropriateness for study involvement by looking at their pace, pelvic symmetry, walk/trot, and ability to change tempo. |
| **Participants** |
| * Children with a specific diagnosis of CP ages ranging 4-12yrs old were included.
* Participants were identified by the Victorian Cerebral Palsy Registry: Intervention group N=50, control group N=49
* Participant age and sex were evenly distributed.
* GMFCS levels were distributed as follows: Intervention group: Level I=16, Level II=16, Level III=15, Level IV=3; Control group: Level I=15, Level II=15, Level III=17, Level IV=2.
* Subjects had no history of previous participation in therapeutic horseback riding.
* Note that 6 out of the 85 families chosen to participate in the final, were already on a waiting list to participate in Riding for the Disabled Association of Victoria which did indicated an increased enthusiasm for participation in this study compared to the other families recruited for the study
* A total of 12 subjects were excluded or not involved in final assessments and statistical analysis for the following reasons:
* 5 had a discrepancy on baseline GMFCS classification as indicated by the Victorian Cerebral Palsy Foundation, and were assessed and identified as Level IV classification on this scale. Therefore they were excluded.
* 3 subjects were unable to be reliably assessed with the selected functional outcome measures secondary to severe intellectual impairments and they were then excluded.
* 1 subject was excluded from final follow up assessment secondary to undergoing an emergency surgical procedure.
* 3 children withdrew after participating in the initial assessment procedure.
 |
| **Intervention Investigated** |
| *Control* |
| * Specific treatment and protocols were not specified for the control group.
* The control group was instructed in a general manner, to continue participating in their regular everyday activities and routines, in their typical every day environments, which could include physical therapy or other forms of physical activity over the 10wk period.
* At the end of the study the control group participants were offered to participate in an identical 10week therapeutic riding program.
* No additional information was gathered after the control group participated in their own 10week therapeutic horseback riding program.
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| *Experimental* |
| * The therapeutic horse riding program lasted for 10weeks.
* Participants chose and attended one session per week out of a total of 13 available 30-40minute time slots that occurred over 3different days of the week.
* Horses were trained to provide riding experiences specifically to children with disabilities.
* Therapy occurred in average group sizes of 4 participants though 5 was the maximum number of riders allowed in each group.
* Note that 3 of the sessions only had 1 participant in it.
* Each session included the following participants:
* Level 1 riding coach accredited with Riding for the Disabled Association of Australia and Australian Sports Commission.
* Physiotherapist/hippotherapist.
* Matched number of horse handlers per number of children in each group.
* A side walker for each child in the group and their horse.
* Each included a structured riding program that emphasized forward and upward reaching with forward movement to:
* Activate postural control
* Facilitate trunk strength and balance
* Facilitate trunk and pelvis dissociation
 |
| **Outcome Measures**  |
| Primary Outcome Measure* Cerebral Palsy Quality of Life Questionnaire (CP QoL-Child)
* Parent response version used for children ages 4-12yo. Seven domains of QoL are assessed in this tool including: social well-being and acceptance, feelings about daily functioning, participation, physical health, emotional well-being, services access, pain, feelings about disability, and family health.
* Child self-report version was used for children 9-12yo. This version assesses the same 7domains listed above except for the access to services and family health domains.
* Though this measure is listed as a primary outcome measure, it is not a primary outcome measure that applies to the PICO question at hand.

Secondary Outcome Measures* Gross Motor Function Measure (GMFM-66)
* Though this measurement tool is listed as a secondary outcome measure of this study, it is one of the primary outcome measurement tools that applies to the original PICO question.
* GMFM is made up of 66 items that are organized into 5 dimensions that assess gross motor skills and function including 1) lying and rolling, 2) sitting, 3) crawling and kneeling, 4) standing, and 5) walking, running, and jumping.
* Each item is scored up to 4 points.
* This assessment tool was administered by one physical therapist who had training and experience in its administration.
* The physical therapist was also blinded to the randomization of groups when obtaining baseline and follow-up information.
* Measurement were obtained 1-6 weeks prior to interventions and then 1-6 weeks post intervention for follow up measurements.
* Testing was performed at the Royal Children’s Hospital.

Other secondary outcome measures, were not necessarily pertinent to the PICO question, included the Child Health Questionnaire (CHQ) that assessed each child’s overall well-being and health status. Also, a Life Events questionnaire was given to each family to determine if any significant changes occurred in the family’s life during the course of this study that could have impacted results in any way. |
| **Main Findings** |
| * GMFM-66 scores after the 10week intervention period for the intervention (experimental) and control groups showed no significant difference.
* Statistical analysis and measurements collected at baseline and follow-up for intervention group n=35, control group n=37.
* Mean baseline GMFM scores with standard deviations (SD) at baseline were as follows:
* Intervention Group: Score =70, SD= 16
* Control Group: Score= 72, SD=17
* Mean follow up measurements and GMFM scores and SD values were as follows:
* Intervention Group: Score= 73, SD =17
* Control Group: Score= 74, SD= 18
* A 95% confidence interval with a p-value=.05% was utilized.
* The differences between the intervention and control groups had a p-value =.45 indicating no statistical significance between the two groups.
* There were adverse effects as a result of this study. One child did fall off of the horse toward the opposite side of the horse from where the side walker was located. However, the child did not sustain an injury and was able to remount the horse and finish out the session. No further report or concern was noted by the child’s family after the incident. A second child did withdraw during the course of the study secondary to the fact that the movement and positioning on the horse during intervention, exacerbated pain from a pre-existing hip condition.
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| **Original Authors’ Conclusions** |
| The authors concluded that the therapeutic horseback riding intervention did not have a statistically significant effect on the gross motor function in children with CP in comparison to their control group counterparts who participated in their typical routines and more traditional therapeutic interventions.  |
| **Critical Appraisal** |
| **Validity** |
| Strengths* PEDro Scale Score= 7/10
* All participants were randomly assigned to intervention and control groups.
* The allocation of participants to the intervention and control groups was concealed by the project statistician from the project officers, participants, and participant primary caregivers.
* Both groups had similar baseline characteristics including age, sex, and GMFCS levels.
* There was one physiotherapist who performed the GMFM outcome measure used, who was blind to the randomization of participants to intervention or control groups at both the baseline and follow up measurements.
* This study does provide results and comparisons of outcome measures both within group and between group values.
* Point measures (means) and variability (95% confidence intervals) were reported for the physical function measurement tool (that applies to the PICO question) the GMFM-66.

Limitations* Subjects/participants were not blinded to their treatment protocol as this is difficult to achieve in a rehabilitation study.
* The therapists providing the intervention were not blinded.
* This study failed to follow through with “intention to treat” secondary to the fact that results for individuals who dropped out during the study were not included in the final analysis.
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| **Interpretation of Results** |
| The statistical evidence that is indicated by this study, shows a very large p-value of 45 for the GMFM-66 outcome measurement tool results between the control and intervention groups which shows no statistical proof or evidence of a positive treatment effect in favour of therapeutic horseback riding. According to the study, the GMFM-66 was implemented 1-6 weeks prior to interventions for baseline measurement and was again administered 1-6 weeks post-intervention to gather information. This indicates poor consistency in timing of outcome measurements and creates a large window (a full 6weeks) for outside factors or lack of lasting treatment effect to have an impact on the participant’s GMFM-66 outcomes. The fact that there was such a large range in timing of administration of follow up measurements fails to consider the immediate effects of therapeutic horseback riding versus a longer lasting effect. Also, the results from this study did not break down GMFM-66 performance outcomes by dimensions i.e. A-E. It would have been interesting to see the changes in scores for each individual dimension of the GMFM-66 to identify any positive effects or progress within each individual participant. Any progress from baseline measurements in the specified dimension areas could have indicated a positive effect of therapeutic horseback riding on that particular skill for that individual and not necessarily show up as statistically significant.  |

**EVIDENCE SYNTHESIS AND IMPLICATIONS**

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| Clinical Practice ImplicationsBased on the current evidence available, there are some discrepancies in studies regarding the statistical significance of the effects of hippotherapy on various gross motor functions, strength, gait, and balance and coordination in children with cerebral palsy. However, general positive effects of equine assisted therapies in the population of children with cerebral palsy were reported across all of the evidence. Equine assisted activities and therapies (EAAT) is a term that includes both therapeutic horseback riding and hippotherapy which were both presented in this review. Therapeutic horseback riding can occur in groups and is led by a PATH (Professional Association of Therapeutic Horsemanship International) certified individual which can focus on the rider achieving individual riding goals11-13 as well as benefitting from the positive physical effects of horseback riding. Hippotherapy is led by a licensed professional such as a physical therapist, occupational therapist, or a speech therapist. 12,14 Riding sessions with hippotherapy may focus more on therapeutic goals and are presented in a one on one fashion and not in a group setting.12,14 As a physical therapist, it is important to understand the differences between the two types of EAAT to determine what would be the best recommendation for a specific patient. The evidence presented by Kwon et al, showed both significant statistical and clinical significance specifically for the use of hippotherapy in the population of children diagnosed with CP. Improvements in gross motor function and balance were successfully documented in this study. The Davis study focused on therapeutic horseback riding in groups which did not result in any statistically significant improvements in gross motor function. However, the families of the participants in this study were able to report feelings of improve self-confidence and increased happiness in their children which was not an objective measurement mentioned in the initial PICO question. However, these improvements still have value to our patient population. Therefore, it is important for the clinical physical therapist to know which type of therapy to refer to depending on therapeutic goals and the patient’s personal goals.All of the current evidence includes the participation in traditional therapeutic exercises in both the experimental and control groups. In other words, application of hippotherapy was never isolated in any case. Therefore, hippotherapy can be deemed a great adjunct to traditional physical therapy services and not necessarily a replacement for it. What this means for the traditional treating therapist is that there should be communication between both types of therapists to ensure that all treatment goals are complimentary to each other. If a patient is involved in both types of therapies, it would be of benefit for the traditionalist to gear some of their treatment activities to simulate the outdoor horseback riding activities such as mounting and dismounting a large peanut or bolster or facilitation of trunk rotation and reaching past midline activities. These are just a few examples of ways a traditional therapist may apply their clinical therapies to compliment EAAT.Future Research ImplicationsFuture studies should consider using a larger sample size which could show greater effect and statistical power to support hippotherapy effectiveness. Additional information would be appreciated regarding the lasting effects on the outcomes in question after the therapeutic intervention is finished. For example in the Davis et al study, there was a large and varying window of time where outcome measurements were performed anywhere from 1-6 weeks after the intervention was completed. This leaves too much room for error from outside factors on performance which also makes it difficult to discern what the lasting effects of the intervention was.None of the body of evidence reported in this paper examined the cost effectiveness of participating in EAAT. Additional research and comparisons would be beneficial to compare the cost effectiveness of participating in therapeutic horseback riding versus hippotherapy versus the cost of traditional therapies.Also, the meta-analysis by Zadnikar pointed out that simulated horseback riding using the Brunel active balance saddle also had positive effects on postural control and balance. This prompts the question of whether or not interventions using a live horse could have more of an impact than an artificial dynamic saddle on the functional skills of a child diagnosed with CP. Future studies revolving around comparison of the benefits of hippotherapy versus artificial saddle interventions may provide useful information for therapists and patients in a community that may not have access to a live horse facility or who may not have the finances to cover hippotherapy. Facility availability and individual child preferences, motivation, and tolerance to working with a live horse should be taken into consideration when making this type of recommendation.  |

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