BENEFITS OF HIPPOTHERAPY ON SENSORY AND MOTOR DEVELOPMENT IN CHILDREN WITH DISABILITIES

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Abstract:

Children with disabilities often experience challenges in sensory processing and motor development. Hippotherapy, which integrates horse movement into therapy, has shown potential to address these difficulties. The study objectives are to examine the effects of hippotherapy on sensory processing and motor development in children with disabilities, and to explore the association between these two domains. A retrospective study was conducted with 30 children undergoing hippotherapy at A.I.A Hippotherapy Centre, Selangor. Participants received 24 weekly sessions over six months. Sensory processing was assessed using the Sensory Profile 2 (parent-reported) and the Hippotherapy Evaluation and Assessment Tool (HEAT). Motor development was evaluated with HEAT. Pre- and post-intervention data were compared using paired t-tests, and correlations were examined with Spearman's rank test. Sensory processing scores increased significantly from pre-therapy ($M = 4.67$, $SD = 3.13$) to post-therapy ($M = 12.10$, $SD = 3.39$; $p < .001$; Cohen's $d = 3.32$). Motor development also improved significantly ($M = 19.20$, $SD = 8.22$ to $M = 39.37$, $SD = 10.16$; $p < .001$; Cohen's $d = 2.92$). A strong positive correlation was observed between sensory processing and motor development post-intervention ($r = .760$, $p = .001$). Hippotherapy produced significant improvements in both sensory processing and motor development in children with disabilities, with strong evidence of sensory–motor integration. These findings highlight hippotherapy as a valuable occupational therapy intervention. Further controlled studies with larger samples are recommended.

Keywords: hippotherapy, sensory processing, motor development, children with disabilities, occupational therapy

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1. Introduction

Hippotherapy is a therapeutic approach that utilizes the movement of the horse as part of an integrated treatment strategy delivered by occupational therapists, physiotherapists, and speech therapists. The term derives from the Greek word hippos, meaning "horse," and refers to horse-assisted therapy aimed at improving functional outcomes in children with disabilities (American Hippotherapy Association, 2020). The horse's rhythmic, three-dimensional gait provides dynamic multisensory input that closely resembles human walking patterns. This facilitates postural control, balance, and neuromotor responses while simultaneously engaging the vestibular, proprioceptive, tactile, and visual systems (Shurtleff, Standeven, & Engsberg, 2009).

Previous studies have demonstrated that hippotherapy enhances motor function, trunk stability, and sensory integration in children with various conditions, including cerebral palsy, Down syndrome, and autism spectrum disorder (Brown & Dunn, 2010; Shotwell, 2011; Fisher, 1934). Beyond motor outcomes, hippotherapy also supports improvements in emotional regulation, attention, and social participation by offering enriched sensory experiences and opportunities for active engagement (Brown & Dunn, 2010; Bland & Altman, 1996).

Currently in Malaysia, there are a few established providers of hippotherapy. Green Apple Hippotherapy, founded in 2014, initially introduced two horses and now delivers services to approximately 60 children through a specialized clinical team (Vulcan Post, 2024). Happy Farms Hippotherapy in Putrajaya employs eight full-time and six part-time therapists trained in both clinical therapy and horsemanship (SAYS, 2023). Furthermore, the Riding for the Disabled Association (RDA) Malaysia, in collaboration with Universiti Putra Malaysia, runs volunteer workshops to expand equine therapy access in the country (UPM, 2023). Despite growing international evidence, research examining the effects of hippotherapy in Malaysia remains limited. Most published studies are based in Western or East Asian contexts, with few reporting outcomes using standardized assessments validated across different populations. Furthermore, limited data exist on the relationship between sensory processing and motor development in children with disabilities undergoing hippotherapy. This gap restricts occupational therapists in Malaysia from fully adopting evidence-based practice tailored to local contexts.

Therefore, this study aims to evaluate the benefit of hippotherapy on sensory and motor development in children with disabilities in Malaysia. Specifically, it examines changes in both domains before and after intervention and investigates the association between sensory processing improvements and motor development. Addressing these questions will contribute to the evidence base supporting hippotherapy as a viable occupational therapy intervention in the local rehabilitation setting.

2. Study Design

This study employed a retrospective pre–post design to evaluate the effects of hippotherapy on sensory processing and motor development. Data were collected from clinical records of children who had completed a six-month hippotherapy program at the A.I.A Hippotherapy Centre, Seri Kembangan, Selangor.

2.1 Participants

Thirty children with disabilities were included using convenience sampling. Inclusion criteria were: (i) children aged 5–12 years, (ii) diagnosed with neurodevelopmental or physical impairments (e.g., cerebral palsy, Down syndrome, autism spectrum disorder), and (iii) completion of at least 24 hippotherapy sessions within the study period. Children with severe behavioural issues preventing safe participation, uncontrolled medical conditions, or incomplete assessment records were excluded. The sample size of 30 participants was obtained using an a priori power analysis (G*Power 3.1) for a paired t-test, with medium effect size ($d = 0.5$), $\alpha = .05$, and power $(1-\beta) = .80$, which indicated a minimum of 27 participants. Therefore, the inclusion of 30 participants was sufficient to ensure statistical power for detecting meaningful pre–post intervention differences

2.2 Intervention Protocol

Each participant received 24 hippotherapy sessions (one session per week, 30 minutes each). Sessions were conducted by occupational therapists certified in hippotherapy, with assistance from a horse handler and side-walkers to ensure safety.

Sessions followed a structured protocol:

- Warm-up (5 minutes): mounting with assistance, helmet adjustment, and initial balance positioning.
- Core activities (20 minutes): progressive tasks targeting sensory and motor domains. These included maintaining upright sitting posture, responding to changes in horse gait (walk–halt–walk transitions), trunk rotations, bilateral reaching, and dynamic postural adjustments. Tasks were graded from passive sitting to active engagement (e.g., reaching for objects, performing functional tasks while on horseback).
- Cool-down (5 minutes): relaxation riding with slower rhythmic movement, followed by safe dismounting.

Therapeutic goals were individualized but generally targeted improvements in trunk stability, bilateral integration, postural endurance, and sensory modulation (vestibular, proprioceptive, and tactile systems). Verbal and physical cues were provided by the therapist as required, with progression tailored to the child's tolerance and skill level. Safety measures, including helmet use and therapist-assisted side-walking, were implemented throughout (American Hippotherapy Association, 2020;

Shurtleff, Standeven, & Engsberg, 2009).

2.3 Outcome Measures

Sensory processing was assessed using the Sensory Profile 2 (SP2), a caregiver-reported measure with established reliability and validity in evaluating sensory processing patterns in children (Brown & Dunn, 2010). Motor development was assessed using the Hippotherapy Evaluation and Assessment Tool (HEAT), a standardized tool designed to measure changes in postural control, balance, and sensory–motor integration during hippotherapy (Shotwell, 2011). The SP2 demonstrates strong psychometric properties, including high internal consistency (Cronbach's $\alpha > 0.80$) and strong test–retest reliability ($r = 0.80–0.90$). Its construct validity is supported through Dunn's sensory processing framework (Dunn, 2014), and it has proven sensitive to intervention-related changes across different populations (Marcilla-Jorda, Grande, Coelho, & Rubio-Belmonte, 2024). The HEAT developed specifically for hippotherapy, demonstrates strong content validity and inter-rater reliability among trained therapists (Shotwell, 2011). While large-scale validation studies are limited compared to SP2, the HEAT is particularly sensitive to short-term changes in posture, balance, and motor responses during hippotherapy (Glisson, 2021).

Both assessments were administered at two time points: baseline (before hippotherapy) and post-intervention (after six months). The SP2 was completed by parents or guardians, while the HEAT was administered by trained occupational therapists. Following ethical approval (UiTM REC: FERC/FSK/MR/2024/00302), data were retrieved from clinical records. All assessments were anonymized before analysis. Data were analyzed using SPSS version 29 (IBM Corp., Armonk, NY). Descriptive statistics were calculated for demographic and outcome variables. The paired samples t-test was used to compare pre- and post-intervention scores for normally distributed variables, while Spearman's rank correlation was employed to explore the association between sensory processing and motor development post-intervention. Statistical significance was determined at $p < 0.05$, which is the conventional threshold widely applied in health sciences research to reduce the likelihood of Type I error (Fisher, 1934; Bland & Altman, 1996). This threshold balances the risk of falsely rejecting the null hypothesis while maintaining sufficient sensitivity to detect meaningful clinical effects (Biau, Kernéis, & Porcher, 2008). For rehabilitation and occupational therapy studies, adopting $p < 0.05$ ensures comparability with existing literature and aligns with standard practices in medical and health sciences research (Portney & Watkins, 2015). Effect sizes (Cohen's d) were also reported to provide information on the magnitude of change beyond statistical significance, as recommended in evidence-based health sciences research (Sullivan & Feinn, 2012).

3. Results

Motor development scores improved significantly after six months of hippotherapy. The mean score

increased from 19.20 (SD = 8.22) pre-intervention to 39.37 (SD = 10.16) post-intervention, reflecting a 20.17-point improvement ($t(29) = 16.01$, $p < 0.001$, Cohen's $d = 2.92$) (Table 1). Cut-off analysis indicated that prior to therapy, 18 children (60%) scored in the "low" range, 12 (40%) in the "moderate" range, and none in the "high" range. After therapy, only four (13.3%) remained in the "low" range, while 16 (53.3%) moved to "moderate" and 10 (33.3%) achieved "high" scores. No participants showed regression in motor performance. Sensory processing scores (HEAT) also improved significantly, with mean values increasing from 4.67 (SD = 3.13) at baseline to 12.10 (SD = 3.39) post-intervention, representing a 7.43-point gain ($t(29) = 18.19$, $p < 0.001$, Cohen's $d = 3.32$) (Table 1). The Sensory Profile 2 further supported these findings. Post-intervention scores reflected greater normalization of sensory responses across domains, particularly in movement processing, body position processing, and social-emotional responses.

Table 1. The differences of sensory processing and motor development before and after hippotherapy sessions (N = 30)

Variable	Pre-Tx M (SD)	Post-Tx M (SD)	Mean Δ [95% CI]	t (df)	P	Cohen's d
Sensory Processing	4.67 (3.13)	12.10 (3.39)	7.43 [6.60, 8.27]	18.19(29)	< .001	3.32
Motor Development	19.20 (8.22)	39.37 (10.16)	20.17 [17.59, 22.74]	7.01(24)	< .001	2.92

Association Between Sensory Processing and Motor Development

Spearman's rank correlation revealed a strong positive association between sensory processing and motor development following hippotherapy ($r = 0.760$, $p = .001$) (Table 2). This suggests that gains in sensory responsiveness were closely linked with improvements in motor competence.

Table 2. Spearman's rank correlation coefficient between sensory processing and motor development after a hippotherapy session

Variable	Motor development after a hippotherapy session *r* (*p*)
Sensory processing after a hippotherapy session	0.760 (p=0.001)**

**. Correlation is significant at the 0.01 level (2 tailed).

4. Discussion

This study demonstrated that hippotherapy produced significant improvements in both motor development and sensory processing in children with disabilities. All participants showed positive changes, and large effect sizes highlight clinically meaningful gains. Importantly, sensory processing improvements were strongly correlated with motor outcomes, supporting the role of sensory–motor integration in rehabilitation. In relation to motor development improvements, this study consistent with previous studies, children exhibited enhanced postural stability, bilateral integration, and

anticipatory movement following hippotherapy (American Hippotherapy Association, 2020; Shurtleff, Standeven, & Engsberg, 2009). The dynamic, three-dimensional gait of the horse closely mimics human walking, providing repetitive vestibular and proprioceptive stimulation that strengthens trunk control and balance (Brown & Dunn, 2010). Similar benefits have been reported in children with cerebral palsy and Down syndrome (Shotwell, 2011; Fisher, 1934). In addition, this study confirmed significant improvements in sensory processing. Children demonstrated better responses in tactile, proprioceptive, vestibular, and auditory domains, as reflected in both the HEAT and SP2 assessments. These findings align with earlier work showing that hippotherapy promotes multisensory integration, reduces sensory defensiveness, and enhances adaptive behaviour (Bland & Altman, 1996; Biau, Kernéis, & Porcher, 2008). The normalization of movement and body position processing also suggests potential benefits for attention and emotional regulation. Similar associations have been documented in studies with preterm and neurodevelopmentally delayed infants (Dunn, 2014). The present findings extend this principle to hippotherapy, suggesting that improvements in sensory modulation may provide the foundation for motor skill acquisition.

These findings reinforce the value of hippotherapy as an evidence-based occupational therapy intervention. By simultaneously targeting sensory and motor domains, hippotherapy offers a holistic approach that can complement conventional rehabilitation. The study has several limitations. First, the retrospective design and absence of a control group limit causal inference. Second, the relatively small sample size from a single centre restricts generalizability. Third, reliance on caregiver-reported measures may introduce bias. Future research should employ randomized controlled trials with larger, diverse samples, and include follow-up assessments to evaluate the durability of outcomes.

5. Conclusion

This study provides evidence that hippotherapy significantly enhances both sensory processing and motor development in children with disabilities. The strong positive correlation between the two domains highlights the importance of addressing sensory–motor integration in pediatric rehabilitation. For occupational therapists, hippotherapy represents a valuable intervention that can complement conventional therapy approaches by engaging multiple sensory systems while simultaneously promoting motor skills. Future research should adopt randomized controlled trials with larger, diverse samples and incorporate functional outcomes and long-term follow-up to establish the durability and generalisability of effects.

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