

Why Children With Special Needs Feel Better with Hippotherapy Sessions: A Conceptual Review

Anabel Corral Granados, MA, and Inmaculada Fernández Agís, PhD

Abstract

Background: Hippotherapy literally means “therapy with the help of a horse” and is derived from the Greek word *hippos*, meaning “horse.” Hippocrates was the first to describe the benefits of hippotherapy for rehabilitation purposes. Although this therapy has many years of history, few scholars have defined the theoretical bases of hippotherapy and less about how psychologic, physical, social, and educational benefits can be achieved through hippotherapy in children with special needs.

Objective: This article is designed from a chronological perspective to provide mental health professionals, educators, and others with current information on how horses can be used as a main tool in an effective and holistic therapy for children with special needs. This is supported by current literature review through a conceptual framework of hippotherapy explained by dynamic system theory along with the theory of neuronal group selection and sensory integration theory.

Conclusions: Hippotherapy, by affecting multiple systems such as the sensory, muscular, skeletal, limbic, vestibular, and ocular systems simultaneously, leads to psychologic, social, and educational benefits that will be evidenced in behavioral patterns used in other environments.

Introduction

THE THERAPEUTIC VALUE of riding horses has been known since the days of ancient Greece. Hippocrates was the first to describe the therapeutic benefits of horseback riding, calling it a universal exercise with a “healing rhythm”.^{1–3} The value of horseback riding for the rehabilitation of persons with physical disabilities has been recognized since 1875 when Chassaignac, a physiotherapist, noted that as a result of the riding experience, the rider’s balance was improved, muscles were strengthened, joints became more supple, and there was a marked improvement in the rider’s morale.⁴ More recently, in the 1960s, therapeutic riding centers emerged throughout Europe, Canada, and the United States. Since then, horses have been a part of physical therapy and are gradually playing a role in the field of mental health, especially as a part of early-intervention therapies.

Hippotherapy

How a child with disabilities can benefit from riding depends first on the individual needs of the child prior to the intervention, and second on the particular riding therapy

offered. The use of horses within a therapeutic setting can be described under four broad categories: valuing, hippotherapy, riding therapy, and riding for rehabilitation.⁵ Biery⁵ evaluated the effectiveness of these four therapies and gave hippotherapy the distinction of being a primary early-intervention therapy for children with disabilities. Furthermore, according to Reichert,⁶ modern hippotherapy may represent an alternative to traditional therapies using only oral communication. The use of animals in therapy creates a situation where the need for language decreases. For instance, the therapist may have to depend more on the child’s physical communication (i.e., posture and facial expressions), which assists in getting to know the child better as well as in helping the therapist to interpret what the child is trying to communicate.

Heine⁷ theorized that there are two types of hippotherapy, classic and modern, which are described next.

Classic hippotherapy

This therapy reflects the German model that has been practiced throughout Europe since the 1960s. Classic hippotherapy is performed with 1 rider (the patient) and at least

1 therapist (a physical therapist, occupational therapist, or a speech-language pathologist) and a horse or a donkey. The therapist uses the three-dimensional movement of the horse's back as an apparatus to manipulate the passive body of the patient.* The treatment consists entirely of the horse's movement and the patient's response to this movement. The patient may be positioned astride the horse in different positions such as facing forward or backward, or lying prone or supine.² This therapy, based on the positive effect of the horse's movement on the person, is beneficial for the rehabilitation of neuromuscular, musculoskeletal, and cardiopulmonary dysfunctions.⁸

Modern hippotherapy

Present-day hippotherapy is a treatment approach that uses the movement of the horse as in classic hippotherapy, but with the added component of psychological intervention.⁹ Modern hippotherapy is used to achieve physical, psychological, cognitive, social, behavioral, and educational goals. It represents a multidisciplinary form of treatment that can be applied by a physical therapist, occupational therapist, psychologist, or psychotherapist. This treatment approach uses activities with a horse, donkey, pony, or llama to address the specific needs of a patient.*

The American Hippotherapy Association,¹⁰ the largest hippotherapy association in the world, defines hippotherapy as a physical, occupational, and speech therapy treatment strategy that utilizes equine movement. It is referred to as a "passive" type of riding, in which the horse moves the rider. The gait of a horse has been shown to closely resemble that of human walking, so by sitting on the walking horse, riders can go through the physical motions of walking without placing any weight on their legs.¹¹ Modern hippotherapy is not only used for physical rehabilitation, however. As we will see in the next section, it can be useful for developing attention, communication, learning, and social skills in children with neurologic disorders. Therefore, modern hippotherapy is not centered only on teaching clients to ride a horse; rather, its exercises have far-reaching effects on patients and benefit them in a holistic manner. According to Bukovek,[†] hippotherapy has been used to treat children who have a wide range of disabilities, including autism, cerebral palsy, communication disorders, cerebrovascular accident stroke, developmental delay, Down syndrome, language disabilities, multiple sclerosis, muscular dystrophy, spinal cord injuries, traumatic brain injuries, and hearing impairment. However, it is also important to note that hippotherapy is not appropriate for all children. For instance, it is not recommended for children with conditions such as fragile bones, hemophilia, hemorrhoids, a history of aggression toward animals, or uncontrolled epilepsy.⁷

*Grobler R. The Influence of Therapeutic Horse Riding on Neuropsychological Outcomes in Children with Tourette Syndrome. Dissertation in the partial fulfillment of the requirements for the degree master psychology, Faculty of Humanities of South Africa, Pretoria, 2004.

†Bukovek T. Hippotherapy. Student research projects for the Masters of Physical Therapy Program at Cleveland State University. Online document at: <http://health.csuohio.edu/mptprojects/altmedpdf/bukovechippotherapy.pdf> Accessed August 23, 2009.

Considering the complexities of the procedures used in hippotherapy, and their potential benefits, it is worthwhile to examine various theories that may account for the benefits of hippotherapy.

Current Theoretical Framework

This article asserts that the therapeutic value of hippotherapy has a theoretical footing in recent theories of childhood cognitive development and control, as well as in neurophysiologic theory. In contrast with other therapies, hippotherapy does not have a unique model to explain its effects. Consequently, the conceptual framework of hippotherapy presented here incorporates three theories: dynamic systems theory, neuronal group selection theory, and sensory integration theory.

Dynamic systems theory

Dynamic systems theory assumes that the complex human system continuously interacts, adapts, and changes in response to the dynamic, interrelated, and shifting constraints that occur in three domains: within a person, within the task performed by the person, and in the environment.¹² The theory regards development as an organized process occurring in stages. Stage transitions begin when there is instability in the aforementioned factors, and end when stability is achieved. It is assumed that the child's activity and exploration, coupled with the relationship of these to the environment, dictate what behaviors will emerge.¹³ Dynamic systems theory claims that all developmental outcomes can be explained as the spontaneous emergence of coherent, higher-order forms resulting from recursive interactions among simpler components. How may this theory explain the therapeutic value of hippotherapy? According to McGibbon and Haehl (Table 1),¹⁴ movement patterns in the patient emerge during hippotherapy as a result of the self-organizing process involving the interaction of multiple constraints.

According to the most recent literature review, the main constraints that may act as control parameters during hippotherapy are postural control, arousal, motivation, temperature, and rhythm.

Postural control is a prerequisite to performing daily activities such as walking and reaching,¹⁵ and may be trained through hippotherapy. The link between reaching and postural control has a firm neurophysiologic basis, and is mediated primarily by medially descending brain signals. The strong relationship between reaching and postural control is

TABLE 1. ADAPTED VERSION OF CONSTRAINTS INVOLVED IN HIPPO THERAPY SESSIONS

<i>Individual</i>	<i>Environmental</i>	<i>Task</i>
Strength & postural control	Terrain	Patient position
Stiffness	Therapist cues	Size of horse
Mass	Temperature	Horse movement & rhythm
Arousal	Noise	Equipment
Motivation	Gravity	Horse speed and direction

Table adapted from McGibbon and Haehl, 2002.¹⁴

reflected in the presence of postural adjustments accompanying reaching movements.

Arousal is a state of alertness and mental and physical activation. Thayer¹⁶ was one of the best-known researchers in self-reported arousal. The author maintained that strong instigation of a pleasure (as occurs during hippotherapy) arouses the child. Other variables that can affect one's level of arousal include time of day, and physical exercise. Performing hippotherapy and exercise simultaneously around midday may contribute greatly to arousal.¹⁷

Motivation is defined as a process in which internal and external factors direct and energize thoughts, feelings, and actions. It is described as a consequence of interpretations of personal factors (values and beliefs) and social factors. These factors include personal goals or incentives, expectations of personal efficacy, movement-related perceptual and affective experiences, and social and physical features of the environment. Lewthwaite¹⁸ suggested the importance of personal and social-environmental variables in one's motivation for physical activity, thus, understanding these variables may allow the therapist to heighten the client's motivation for exercise. McGibbon and Haehl¹⁴ suggested that hippotherapy motivates children to actively engage in the treatment because

1. The therapy demands and encourages participation.
2. The outdoor environment and exercise with the horse are pleasurable.
3. The presence of the child's family during the therapy is a major factor in motivating the child.¹¹

Temperature of the body of the equine is about 1°–5° higher than that of a human, principally in the neck, mane, and quarters, depending on the type of exercise the animal is performing. This extra warmth can help increase the rider's plasticity, reduce spasticity, and stretch the rider's muscles.⁹ Relaxation exercises performed on the back of a horse, allowing the rider to feel the warmth and the massaging motions of the horse, enhance the rider's overall sense of relaxation. Research suggests that certain exercises are not appropriate for every patient, but on the other hand, may be especially beneficial for certain disorders. For example, lying prone or supine on the back of the horse during therapy may be particularly effective for children diagnosed with spastic cerebral palsy or hyperactivity.

Rhythm is a fundamental element of hippotherapy. The horse's multidimensional swinging rhythm is transferred to the patient's pelvis in a manner that mirrors the normal human gait. Wolff described rhythm as a crucial aspect of movement, suggesting that a pattern of rhythmic exercise during hippotherapy will result in the appearance of spontaneous movement in the patient. Spontaneous movement in turn may contribute to a patient's cognitive and motor development, and the hippotherapy exercises may motivate patients to repeat these movements while off the horse (Wolff in Piek¹⁹). Riding a horse in a moderate walk in backward and forward positions should be a consistent and repetitive rhythmical movement experience for the child and can be a treatment tool to develop strength and balance and to normalize muscle tone.²⁰ Muscle tone may be stabilized in two ways. When the horse performs soft and smooth movements, hypertonic muscles in the rider will relax.

Conversely, when the horse moves rapidly, as during trotting, hypotonic muscles will be strengthened. These exercises, furthermore, activate movement signals in the brain and spinal cord that correspond to the motion of walking.⁹

Theory of sensory integration

According to Randall,^{21,22} learning and behavior depend on a series of sensory and motor capacities. These capacities include auditory processing, body awareness, coordination between sides of the body, fine motor control, motor planning, ocular control, perception of movement, touch perception, and visual-spatial perception. Developing the tactile sense, the vestibular sense, and the proprioceptive sense provide the foundation of a child's health. Randall²² explained several examples that we can adapt for use in hippotherapy. For instance, understanding auditory information requires the ability to differentiate sounds and plays an important role in the development of language. Performing exercises that promote body awareness allows proprioceptive information to be sent to the brain and on to muscles and joints, preventing inappropriate muscle resistance. The ability to coordinate the right and left sides of the body and to cross the midline of the body is an indication that both sides of the brain are working together and sharing information efficiently. This ability is observed when children transfer objects from one hand to the other, or when they jump and ride the horse. When this coordination develops, children can control objects of various sizes, weights, shapes, and textures and use fine motor control.

Ayres^{23,24} suggested that all our senses need to work together in harmony. In other words, our sense of touch, smell, taste, sight and sound, as well as physical movement and body awareness, must function together. Sensory integration during hippotherapy occurs when riding stimulates the tactile sense, both through touch and environmental stimulation. Also, the vestibular system is stimulated by the horse's change of direction and speed. This system is located in the inner ear and has three semicircular canals that are filled with endolymph or fluid. These canals are sensitive to movement. The movement that occurs when riding a horse strongly activates these canals, which relay certain sensory inputs to the rest of the brain. The olfactory system responds to many smells involved in a horse stable and ranch environment. Vision is used in controlling the horses. The many sounds of the ranch help to involve the auditory system. All of these senses work together and are integrated during the act of riding. In addition, proprioceptors (receptors that provide information from our muscles, tendons, ligaments, and joints) are activated, resulting in improved proprioception.²⁵ Delius²⁶ developed a 7-month hippotherapy program to stimulate sensory integration.

Theory of neuronal group selection

This theory is related to neurobiology and behavior research. It has three main assumptions:

1. The anatomy and structure of the brain evolved to allow for neuronal plasticity, and this plasticity plays an important role in how the brain is organized.
2. Experience is the main factor in the selection of certain fixed response patterns. The brain has neural diversity,

but its wiring is not genetically predetermined; rather it is a "rough palette" modified by experience (exploration). It depends on selection: strengthening of connections among groups of neurons with experience. All children's experiences create new brain connections.²⁴

3. Neuronal maps form and change through a person's interaction with the environment. Each person's unique life experience results in unique neural connections and behaviors across individuals. The re-entering neurons are groups of neurons located in different areas of the brain, and they activate reciprocal and recursive signals from many other groups (perceptions are linked to actions and in the same way they are linked to perceptions ...).¹⁵

Neuronal plasticity allows children undergoing hippotherapy to learn and develop new connections in the brain through the multisensorial stimulation that hippotherapy offers. In turn, these connections allow the learning of new skills for functioning in the world. However, it is important to be aware that these are theoretical or speculative benefits, as to date no empirical data on the subject have been published.²⁶

Effects of Therapy

Several types of therapy use horses as an educational, physical, social, and psychologic intervention tool. Next, a summary is presented of empirical research on the effects of these therapies.[‡]

Physical benefits

One of the physical benefits of hippotherapy is improved muscle symmetry. One study found improved muscle symmetry with only 8 minutes of therapeutic treatment in a full 12-week hippotherapy program.²⁷ Another study performed the same experiment but included an extra 2 minutes of therapy and a 12-month baseline after treatment. The study concluded that hippotherapy treatment is an effective method to improve abductor muscle symmetry during walking as well as for enhancing functional motor skills.²⁸ Other physical benefits include increased balance and muscle strength and increased range of motion, which may lead to improved coordination between the upper and lower trunk and between the lower trunk and the back of the horse,^{29,30} and trunk/head stability,³¹ found in a 12-week hippotherapy program.³² Similar results were found through 12-week hippotherapy sessions in a group of 6 children with cerebral palsy. Those children improved head and trunk stability.³³ Bertoti⁴ found statistically significant improvements in posture while he observed and evaluated children's self-confidence, muscle tone, weight bearing, and sitting balance after a 10-week program involving twice-a-week 60-minute sessions.³⁴ Other authors, such as McGibbon et al.,³⁵ evaluated the effects of an 8-week hippotherapy program (30-minute session twice a week) in children with spastic cerebral palsy and concluded that sessions of this length may improve the children's gross motor functions and energy expenditure

during walking. In 2004, a group of researchers in Ohio (USA) replicated this study with a 10-week intervention (45-minute sessions once a week) to determine whether hippotherapy had effects on the general functional development of younger children (averaging 4 years of age) with cerebral palsy.³⁶ Sterba³¹ had reviewed quantitative studies in which hippotherapy and horseback riding therapy were the main tools. The author concluded that they are individually beneficial and a recommended treatment for children with cerebral palsy and both are medically indicated with benefits on gross motor rehabilitation.³¹ Researchers found hippotherapy to have positive effects on functional motor performance, and to be a good early-intervention tool for young children. Scott⁹ found that the most prominent effects of hippotherapy included greater strength and agility, improved balance and posture, weight-bearing ability, and improved circulation, respiration, and metabolism. A bareback pad is often used during hippotherapy to allow riders to absorb more warmth and massaging motions from the horse than they would in a heavy leather saddle.

Psychologic benefits

Scott⁹ related hippotherapy to the release of endorphins that produce feelings of emotional well-being. Other benefits include the empowerment one feels by regaining a sense of control over one's own body. McConnell³⁷ agrees that hippotherapy offers patients psychologic benefits. For example, it can help patients improve their range of motion and strength (by brushing or petting animals), reduce stress, and reduce the need for pain-relief medication.

Macauley and Gutierrez³⁸ examined the effectiveness of hippotherapy versus traditional therapy in 3 boys ages 9, 10, and 12 years with language learning disabilities, after 6 weeks of hour-long hippotherapy sessions twice a week. They reported positive effects of hippotherapy on speech and language abilities and also improved motivation and attention. During the informal interaction with the horse, a child performs various exploratory behaviors (i.e., fine discrimination, visual examination, etc.) to examine the horse's responses and behavior as a social being. The child's emotional responses, such as self-efficacy and self-esteem,³⁹ will also be elicited by an equine-facilitated psychotherapy.¹ According to Barker,⁴⁰ the child-horse bond can promote the following qualities: mutual trust, respect, empathy, unconditional acceptance, sense of constancy, security, reliability, love and affection, sense of autonomy and initiative, and self-control. Barker drew these conclusions from an experiment that analyzed the effect of hippotherapy on grieving children. This study concluded that a 6-week hippotherapy program impacted positively on the confidence, trust, and communication of 5 children between the ages of 4 and 14.⁴¹ Rufus[§] also found enhancement in self-concept. Graham⁴² cited the positive effects of stroking horses in a recent Japanese study with three groups of children, one of which was made up of individuals who had negative attitudes toward animals. Participants experienced a decrease in tension after stroking

[‡]Taylor MS. Equine facilitated psychotherapy: An emerging field. A major paper submitted to the faculty of the program in clinical psychology of Saint Michael's College in partial fulfillment of the requirements for the degree of Master of Arts 2001.

[§]Rufus SD. The effect of horse riding therapy on the self-concept of learning disabled children. Dissertation in the partial fulfillment of the requirements for the degree master of science in clinical psychology, Medical University of South Africa, Pretoria, 1997.

the horses. Taylor et al.⁴³ have confirmed in a single-case design study that hippotherapy may be beneficial for the volition of children with autism disorder.

Social benefits

Beck and Meyers⁴⁴ argued that animals are an important instrument for developing social skills in children. Through their interactions with animals, children can obtain knowledge of values and attitudes from the animals. The authors provided evidence that the mere presence of animals positively alters children's attitudes about themselves and increases their ability to relate to others. Moreover, they suggested that animals are catalysts for social and verbal interaction in children. In the opinion of Taylor,⁴⁵ another author who worked as a therapist for children with special needs, children diagnosed with disorders can think about their own behavior and needs, which normally are not easily understood, through the animal. Because they view an animal as a social being, the projection of feelings regarding peer interaction is readily available. Often children with special needs have difficulties in forming close friendships, but in equestrian settings the horse becomes the focus of attention. The child develops a friendship with the horse, often sharing their innermost feelings and thoughts with the horse.⁴⁵ An important factor is that the horses are nonverbal. This gives the rider the freedom to express himself or herself fully without fear of objection or criticism. Many children, particularly those with special needs, spend hours a day isolated from the real world. In riding, as a social activity, there are normal social interactions occurring at different levels. On one level, the authors describe that, especially with peers who come to the group or other sessions, the child has the opportunity to share experiences and stories. On another level, because a number of helpers are needed in the therapy sessions, the child must develop relationships with them in order to communicate more successfully with the horse. On a third level, when the child leaves the therapeutic setting, the child returns to the world eager to report to those around him or her about their riding experiences. During hippotherapy sessions, children acquire socially acceptable ways to express feelings, such as when they observe and interact with the animal and discuss how the animal expresses its feelings and what behavior the child finds acceptable (e.g., prancing, nuzzling) or unacceptable (e.g., face-licking, neighing). It is important to discuss self-control in the therapeutic setting and how to regulate behavior in human relationships and experiences. The motivation and ability to understand how others feel (empathy) can be molded through hippotherapy. For example, when the child observes and interacts with the animal, the therapist may ask the child what the animal may be feeling and then the child becomes capable of transferring this behavior to situations involving people.⁴⁶ Bass et al.⁴⁷ concluded that horseback riding has been an important social motivator for children with autism spectrum. After 12-week sessions, children exhibited greater sensory seeking, sensory sensitivity, social motivation and less inattention, distractibility, and sedentary behaviors.

Educational benefits

Building a good educational base for the child is certainly important, and hippotherapy may aid the student's ability to

learn.⁴⁸ Next, diverse activities ready to be used in hippotherapy for enhancing personal growth and development are described.

Reading is a basic skill that everyone needs in daily life, and the various games and activities in hippotherapy may improve people's capacity to learn, for instance, to recognize different shapes, sizes, and colors.

Improving math skills is also possible with hippotherapy. For example, the child can learn to count the horse's footsteps, the horse's body parts, and objects around the arena. Addition and subtraction can be taught through games involving throwing numbered foam dice and subtracting the numbers.⁴⁹ Rusty-Miller and Alston²⁸ have studied hippotherapy as an educational tool for children with disabilities. They used interviews with parents to relate the improvement in their children's life to hippotherapy. They found that parents indicated strong improvement in their children's social and academic development, particularly in terms of personal responsibility.

Conclusions

This article considered dynamic systems theory along with neuronal group selection and sensory integration theory as a theoretical basis for explaining how hippotherapy can be a successful intervention tool for children with special needs. Future intervention programs based in hippotherapy should consider the interactive nature of the organic subsystems of the individual and the environment, and how this interactive nature allows for the possibility of guiding the patient's development. Moreover, considering that neuronal plasticity is at its peak during the first few years of development, interventions should be implemented as early as possible. Casadi and Nichols-Larsen³⁶ provided a congruent summary of the three theories described in this article. The authors suggested that through the repetitive, rhythmical movement of the horse in hippotherapy, a child experiences and begins to anticipate movements with each step of the walking horse. Children learn to produce compensatory movements that reduce the displacements of their center of gravity and keep them on the moving horse. Practice and experience are believed to lead to the modification and reorganization of the central nervous system. By affecting multiple systems such as the sensory, muscular, skeletal, limbic, vestibular, and ocular systems simultaneously, hippotherapy leads to psychological, social, and educational benefits that will be evidenced in behavioral patterns used in other environments. The present review has highlighted the effectiveness of hippotherapy in several areas.^{5,7,8,14,15,20,25-50} The authors recommend future experimental studies examining the utility of hippotherapy as a holistic intervention in patients diagnosed with a broad number of pathologies, during a minimum of 12 weeks of continuous intervention and with a long-term follow-up. It would be helpful to classify hippotherapy studies by the age of the patients and the length of the intervention. Future research should explore different exercises for children with hypotonia and hypertonia, to develop exercises suited to their needs. In this regard, it is essential to design programs in a systematic manner to achieve tangible objectives, keeping individual capabilities in mind. In view of these recommendations, our research team is attempting to create

behavioral protocols of hippotherapy research based on experimental findings.

Disclosure Statement

No competing financial interests exist.

References

1. Mayberry RP. The mystique of the horse in strong medicine: Riding as a therapeutic recreation. *Rehabil Lit* 1978;39:192–196.
2. Riede D. The relationship between man and horse with reference to medicine throughout the ages. *People Animals Environ* 1987;5:26–28.
3. Fine A. *Handbook on Animal-Assisted Therapy. Theoretical Foundations and Guidelines for Practice*. San Diego, CA: Academic Press, 2000.
4. Bertoti DB. Effect of therapeutic horseback riding on posture in children with cerebral palsy. *Phys Ther* 1988;10:1505–1512.
5. Biery MJ. Riding and the handicapped. *Vet Clin North Am Small Anim Pract* 1985;15:345–354.
6. Reichert E. Individual counselling for sexually abused children: A role for animals and storytelling. *Child Adolesc Soc Work J* 1998;15:177–185.
7. Heine B. Introduction to Hippotherapy. Barbara PT. Reprinted from NARHA Strides magazine, April (Vol. 3, No. 2). Online document at: www.twinenterprises.com/cp/hippotherapy/articles/introduction.htm Accessed August 24, 2009.
8. Scott N. *Special Needs Special Horses: A Guide to the Benefits of Therapeutic riding*. Denton: University of North Texas Press, 2005.
9. All AC, Living GL, Crane LL. Animals, horseback riding, and implications for rehabilitation therapy. *J Rehabil* 1999; 65:49–57.
10. American Hippotherapy Association. What is hippotherapy? Online document at: www.americanhippotherapy-association.org/aha_hpot.htm Accessed August 24, 2009.
11. Engel BT. *Therapeutic Riding Programs Instruction on Rehabilitation: Handbook for Instructor and Therapist*. Durango, CO: Barbara Engel Therapy Services, 1992.
12. Lewis MD. The promise of dynamic systems approaches for an integrated account of human development. *Child Dev* 2000;71:36–43.
13. Hernández N. Malnutrition and motor development [in Spanish]. *Revista Gastrohnutp* 2003;5:65–71.
14. McGibbon V, Haehl N. Conceptual Framework for Hippotherapy: Is It Useful to Practice of Physical Therapy? Online document at: www.pediatricapta.org/pass/pubs/CSM%2002%20Haehl.ppt Accessed August 24, 2009.
15. Van Der Heide J, Fock JM, Otten B, et al. Kinematic characteristics of postural control during reaching in preterm children with cerebral palsy. *Pediatr Res* 2005;58:586–593.
16. Thayer RE. Toward a psychological theory of multidimensional activation (arousal). *Motiv Emot* 1978;2:1–34.
17. Eysenck MW. *Attention and Arousal: Cognition and Performance*. New York: Springer-Verlag, 1982.
18. Lewthwaite R. Motivational consideration in physical activity involvement. *J Phys Ther* 1990;70:808–819.
19. Piek JP. *Motor Control and Sensory Motor Integration: Issues and Directions*. Advances in Psychology. North Holland: Elsevier Science Publishers, 1995:111.
20. Narha. *Therapeutic Horseback Riding*. CP-Parent Resource Centre. Online document at: www.cparent.org/barn.htm Accessed August 24, 2009.
21. Randall M. Sensory Integration. Pre-conference Workshop. Special Needs, Learning Support Committee. Newsletter. The Hague, February 2006.
22. Randall M. Helping Children Learn Through Sensory Integration. Online document at: www.Maximumpotential.info Accessed August 24, 2009.
23. Ayres AJ. *Sensory Integration and Learning Disorders*. Los Angeles: Western Psychological Services, 1972.
24. Ayres AJ. *Sensory Integration and the Child*. Los Angeles: Western Psychological Services, 1979.
25. Rusty-Miller HJ, Alston AJ. Therapeutic riding: An educational tool for children with disabilities as viewed by parents. *J South Agricultural Education Res* 2004;54:113–123.
26. Delius F. Ability to Promote Sensory Integration Through Remedial Vaulting for Children with Sensory Perception Disorders. United Kingdom: Deutsche Kuratorium für Therapeutisches Reiten, 1998.
27. Benda W, McGibbon NH, Grant K, Davis M. Improvement in muscle symmetry in children with cerebral palsy after equine-assisted therapy (hippotherapy). *J Altern Complement Med* 2003;9:817–821.
28. McGibbon NH, Benda W, Duncan BR, et al. Immediate and long-term effects of hippotherapy on symmetry of adductor muscle activity and functional ability in children with spastic cerebral palsy. *Arch Phys Med Rehabil* 2009;90:966–974.
29. Biery MJ, Kauffman N. The effects of therapeutic horseback riding on balance. *Adapt Phys Activ Q* 1989;6:221–229.
30. Pesce TV. Hippotherapy: Horses Provide Sensory Stimulation to Enhance Human Muscle Stability. The Rutgers Essayist. An Online Science Writing Journal. Online document at: http://bizntech.rutgers.edu/essayist/summer_2002/media/pesce.pdf Accessed August 24, 2009.
31. Sterba JA. Does horseback riding therapy or therapist-directed hippotherapy rehabilitate children with cerebral palsy? *Dev Med Child Neurol* 2006;49:68–73.
32. Haehl V, Giuliani C, Lewis, C. Influence of hippotherapy on the kinematics and functional performance of two children with cerebral palsy. *Pediatr Phys Ther* 1999;11:89–101.
33. Shurtleff TL, Engsborg JR. Changes in trunk and head stability in children with cerebral palsy after hippotherapy: A pilot study. *Phys Occup Ther Pediatr* 2010;30:150–163.
34. MacKinnon JR, Noh S, Laliberte D, et al. Therapeutic horseback riding: A review of the literature. *Phys Occup Ther Pediatr* 1995;15:1–15.
35. McGibbon NH, Andrade CK, Widener G, et al. Effect of an equine-movement therapy program on gait, energy expenditure, and motor function in children with spastic cerebral palsy: A pilot study. *Dev Med Child Neurol* 1998;40:754–762.
36. Casadi RL, Nichols-Larsen DS. The effect of hippotherapy on ten children with cerebral palsy. *Pediatr Phys Ther* 2004; 16:165–172.
37. McConnell RN. Myths & facts... about animal-assisted therapy. *Nursing* 2002;32:76.
38. Macauley BL, Gutierrez KM. The effectiveness of hippotherapy for children with language-learning disabilities. *Commun Disord Q* 2004;25:205–217.
39. Beck AM, Katcher AH. *Between pets and people: The importance of animal companionship*. West Lafayette, IN: Purdue University Press, 1996.
40. Barker SB. Therapeutic aspects of the human-companion animal interaction. *Psychiatric Times* 1999;February, VXVI:2. Online document at: www.psychiatrictimes.com/p990243.html Accessed August 24, 2009.

41. Glazer HR, Clark MD, Stein DS. The impact of hippotherapy on grieving children. *J Hosp Palliat Nurs* 2004;6:171–175.
42. Graham B. *Creature comfort: Animals that Heal*. Australia: Simon & Schuster. 1999.
43. Taylor RR, Kielhofner G, Smith C, et al. Volitional change in children with autism: A single-case design study of the impact of hippotherapy on motivation. *Occup Ther Ment Health* 2009;25:192–200.
44. Beck AM, Meyers NM. Health enhancement and companion animal ownership. *Annu Rev Public Health* 1996;17:247–257.
45. Rolandelli PS, Dunst CJ. Influences of hippotherapy on the motor and socio-emotional behavior of young children with disabilities. *Bridges* 2003;2:1–14.
46. Britton V. *Riding for the Disabled*. London: B.T. Batsford, 1991.
47. Bass MM, Duchowny CA, Llabre MM. The effect of therapeutic horseback riding on social functioning in children with autism. *J Autism Dev Disord* 2009;39:1261–1267.
48. Fischbach N. Strides. Therapeutic Riding Centers, Inc. Welcome to the World of Therapeutic Riding. Online document at: www.strides.org/educational.html Accessed August 24, 2009.
49. Vidrine M, Owen-Smith P, Faulkner P. Equine-facilitated group psychotherapy: Application for therapeutic vaulting. *Issues Ment Health Nurs* 2002;23:587–603.
50. Shurtleff TL, Standeven JW, Engsborg JR. Changes in dynamic trunk/head stability and functional reach after hippotherapy. *Arch Phys Med Rehabil* 2009;90:1185–1195.

Address correspondence to:
Anabel Corral Granados, MA
18 Philip Blairman House 3 Elder Street
E16DG Tower Hamlets
London E16 DG
United Kingdom

E-mail: anabel.granados@student.anglia.ac.uk

