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The Efficacy of Hippotherapy for Physical Rehabilitation: A Systematic Review

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The Efficacy of Hippotherapy for Physical Rehabilitation: A Systematic Review

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Approval Page

This Scholarly Project Paper, submitted by Megan Hilgers & Haley Nielsen in partial fulfillment of the requirement for the Degree of Master's of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

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PERMISSION

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Signature Megan L Hilgers

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Abstract

Purpose: The purpose of this scholarly project is to examine existing literature pertaining to hippotherapy and conditions impacting physical health through completion of a systematic review. According to the American Hippotherapy Association (AHA, 2017), hippotherapy is defined as "how occupational therapy, physical therapy, and speech-language pathology professionals use evidence-based practice and clinical reasoning in the purposeful manipulation of equine movement to engage sensory, neuromotor, and cognitive systems to achieve functional outcomes" (What is Hippotherapy, para. 1). Hippotherapy was initially cited in occupational therapy practice in the 1980's, but minimal attention and research have been applied to the topic as time has progressed (Govender, Barlow, & Ballim, 2016). Further review of existing evidence has the potential to increase its acceptance by healthcare practitioners and therapists (Rigby & Grandjean, 2016).

Methodology: The literature search was conducted across six databases- PubMed, CINAHL, PsychInfo, SPORTDiscus, SCOPUS, and Cochrane. Articles included in the systematic review must have been quantitative research published in a peer-reviewed journal in the past 15 years. Additionally, articles must have been published in English, refer to a condition impacting one's physical health, have intervention conducted by an occupational, physical, or speech-language therapy practitioner and be relevant to intervention with a horse.

Results/Conclusions: In total, 1955 articles were reviewed from the six databases, and 17 were determined to meet inclusion criteria. Themes identified were client factors, performance skills, and occupational therapy based outcomes. Specific client factors identified in the literature benefitting from hippotherapy included neuromusculoskeletal and movement-related functions and sensory functions such as pain. Some improvements noted in the area of client factors included muscle symmetry, muscle stability, muscle control, muscle tone functions, muscle strength, control of voluntary movement, postural alignment, gait pattern functions, and sensorimotor experiences. Performance skills evident in the literature were identified motor skills, specifically reaching and functional mobility. Although no occupational therapy-specific outcome measures were documented in the literature, outcomes connecting the literature and the Occupational Therapy Practice Framework (OTPF) were identified by the student researchers and included occupational performance, prevention, role competence, and quality of life. Evidence does exist pertaining to the efficacy of hippotherapy related to conditions impacting physical health, but there is a lack of evidence in the fields of occupational therapy, physical therapy, and speech-language therapy. There is a need for conduction of studies with high-level evidence in this area to promote usage of hippotherapy with conditions affecting physical health in the occupational therapy profession. With improvements in client factors and performance skills, occupation-based outcomes are hopeful. Thus, it is recommended future studies explicitly measure occupation-based outcomes related to hippotherapy intervention and physical health conditions.

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Chapter I: Introduction

The term hippotherapy refers to "how occupational therapy, physical therapy, and speech-language pathology professionals use evidence-based practice and clinical reasoning in the purposeful manipulation of equine movement to engage sensory, neuromotor, and cognitive systems to achieve functional outcomes" (American Hippotherapy Association (AHA), 2017. What is Hippotherapy, para. 1). As hippotherapy practice has continued to grow since the 1980s, a lack of attention and research in this area is present (Govender, Barlow, & Ballim, 2016). Additionally, there is limited literature specifically connecting terminology from the Occupational Therapy Practice Framework (OTPF), an occupational-therapy specific guide for treatment, to hippotherapy intervention and practice. Further justifying the need for this scholarly project, there is a shortage of high level evidence regarding the benefits of hippotherapy. It is necessary to further research in this area to increase acceptance of hippotherapy practice among healthcare professionals (Rigby & Grandjean, 2016).

The purpose of this scholarly project is to explore existing research on hippotherapy and occupational therapy's role in utilizing hippotherapy with individuals who have a condition impacting their physical health. As mentioned prior, hippotherapy is intended to be conducted by an occupational therapy, physical therapy, or speech language therapy practitioner. There is currently a substantial amount of evidence pertaining to utilization of hippotherapy for treatment of mental health conditions, hence the reasoning behind the students choosing to focus on the plethora of physical benefits

hippotherapy can provide through completion of a systematic review. However, in both physical and mental health, there is a lack of literature conducted on interventions completed by an occupational therapy, physical therapy, or speech-language therapy practitioner, indicating a shortage of evidence of true hippotherapy used in professional practice. This systematic review has potential to produce significant results due to the gap of credible information pertaining to the correlation between hippotherapy and physical health conditions. Instead of utilizing a specific theory, the OTPF has been used to guide the development of search terms as well as terminology connecting hippotherapy to occupational therapy interventions addressing physical health.

The research question is as follows: Is there evidence supporting the efficacy of hippotherapy for physical rehabilitation relevant to occupational therapy? The existing literature has assisted the student researchers in completing a systematic review examining the efficacy of hippotherapy for those diagnosed with a condition impacting physical health. The literature search has been conducted across six databases- PubMed, CINAHL, PsychINFO, SPORTDiscus, SCOPUS, and Cochrane.

The student researchers have anticipated the results of this systematic review will support usage of hippotherapy with individuals diagnosed with conditions impacting physical health. It has been predicted there will be a lack of research on hippotherapy specific to the field of occupational therapy, especially in relation to conditions impacting physical health. The systematic review will provide healthcare professionals with an increased understanding of the efficacy of hippotherapy and its applicability to the domain of occupational therapy. The student researchers have predicted the results will assist in identifying how occupational therapy is best suited to apply evidence-based

practice in hippotherapy and determine the need for future research. This research project has potential significance to provide the field of occupational therapy with increased knowledge of hippotherapy interventions related to conditions impacting physical health through identifying the amount and quality of current data supporting the use of hippotherapy in physical rehabilitation.

There are a few limitations which have affected this systematic review as a whole. One of the main limitations is the time constraints faced when completing the systematic review. The student researchers only had access to certain databases, which placed a restriction on the amount of articles that were able to be included in the systematic review. This is the first systematic review the student researchers have completed, therefore they lacked experience with the systematic review process and interpretation of high level evidence.

The remainder of this scholarly project will contain a review of literature in which current supporting hippotherapy evidence has been analyzed and compared to the occupational therapy profession, which can be found in Chapter II. In Chapter III of this scholarly project, research methodology has been outlined, describing the guidelines followed and steps of the systematic review process completed by the student researchers. Chapter IV contains the presentation, analysis and interpretation of data collected throughout the process of completing the systematic review. Lastly, Chapter V consists of an overall summary, conclusions, and recommendations for future research identified by the student researchers.

Terminology

American Hippotherapy Association (AHA): Non-profit organization in which provides certification pertaining to hippotherapy, committed to providing education in the realm of equine-assisted therapy, providing research, and providing evidence of the effectiveness of hippotherapy

American Hippotherapy Certification Board (AHCB): The American Hippotherapy Association regulatory body, responsible for administration of certification examinations as well as maintaining records of examinations (AHA, 2017)

American Hippotherapy Certification Board (AHCB) Certified: "A licensed therapist (occupational therapist, occupational therapy assistant, physical therapist, physical therapy assistant, speech-language therapist, or speech-language therapy assistant) who has attended both the American Hippotherapy Association, Inc. Level I and II courses (or an equivalent) and successfully completed a national board written exam showing a baseline level of competency in using hippotherapy in treatment" (AHA, Inc. Terminology Paper, 2017, p. 1)

Client Factors: Components of the person regarding specific abilities, characteristics or beliefs such as values, spirituality and body functions or structures that influence overall occupational performance (AOTA, 2014)

Equine-Assisted Activities (EAA): Activities occurring within an equine environment with the overarching goal of skill attainment, education, leisure, or recreation including but not limited to adaptive riding, competition, equine-facilitated learning, horsemanship, and stable management, yet without a therapeutic component (AHA, 2017)

Equine-Assisted Therapy (EAT): Therapy or treatment utilizing equine activities or using the environment with client-centered goals related to rehabilitation or habilitation within a medical professional's standards of practice (AHA, 2017)

Hippotherapy: Refers to "how occupational therapy, physical therapy, and speech-language pathology professionals use evidence-based practice and clinical reasoning in the purposeful manipulation of equine movement to engage sensory, neuromotor, and cognitive systems to achieve functional outcomes" (AHA, 2017, What is Hippotherapy, para. 1)

Hippotherapy Clinical Specialist (HPCS): "Licensed physical therapist, occupational therapist, or speech-language pathologist who has demonstrated an advanced level of knowledge in hippotherapy by successfully completing a written national board examination" (AHA, Inc. Terminology Paper, 2017, p. 1)

Horse Handler: Individual who prepares the horse for a hippotherapy session and is responsible for facilitating movement of the horse by following direction given by the occupational, physical, or speech-language therapy practitioner (AHA, 2017)

Occupational Therapy: "The therapeutic use of everyday life activities with individuals or groups for the purpose of enhancing or enabling participation in roles, habits and routines in home, school, workplace, community, and other settings" (American Occupational Therapy Association (AOTA), 2014, p. S1)

Occupational Therapy Practice Framework (OTPF): Profession-specific document outlining the central components of occupational therapy practice; functions to create a common understanding of the profession and its language

Occupational Therapy Practitioner: Certified occupational therapist or occupational therapy assistant

Outcomes: Identify the end-stages of intervention, represents desires results, commonly involves increases in health functioning (AOTA, 2014)

Performance Skills: Demands of an activity, skills required to complete an activity, observable components of an action that have clear functional purposes (AOTA, 2014)

Physical Condition: Includes physical diagnoses, symptoms impacting physical health and outcomes related to physical symptomatology

Side Walker: An individual who assists the therapist in maintaining patient safety during a hippotherapy session by walking next to the horse (AHA, 2017)

Therapeutic Riding: Form of riding, adaptive riding or riding lessons for individuals with special needs/disabilities focused on non-rehabilitative goals (AHA, 2017)

Chapter II: Literature Review

Introduction

The use of horses in rehabilitation settings is relatively new in a historical sense, however, the domestication of the horse, which is commonly thought to be the starting point of the human-horse relationship, can be traced to approximately 4000 BCE (Outram et al., 2009). According to the American Hippotherapy Association (AHA), the earliest known literature regarding hippotherapy can be linked to the lifetime of Hippocrates, 460-377 BCE, when he wrote a chapter surrounding the topic of natural exercise and mentioned horse riding (AHA, 2016). The positive effects of horseback riding on human health have been noted in medical literature starting from the second century CE, while animals contributing to the well-being of people can be dated to the 1600s (Fry, 2013). At the conclusion of the nineteenth century, numerous documents were published in which riding was examined as a possible form of medical treatment (Fry, 2013). In 1992, the AHA was founded and continues to promote excellence through education in equine-assisted therapy to this day (AHA, 2016).

As a result of this extended history, horses have become a vital component of a treatment team (Fry, 2013) such that equine-assisted therapy (EAT) has become a broad term used within therapies such as physical therapy, occupational therapy, speech-language therapy and psychotherapy. The American Hippotherapy Association (AHA) has published a terminology glossary to describe common terms in the realm of equine-assisted therapy in order to facilitate increased understanding of the field while

simultaneously clarifying the meanings of various terms across professions. Hippotherapy is defined as "how occupational therapy, physical therapy, and speech-language pathology professionals use evidence-based practice and clinical reasoning in the purposeful manipulation of equine movement to engage sensory, neuromotor, and cognitive systems to achieve functional outcomes" (AHA, 2017, What is Hippotherapy, para. 1). The AHA (2017) defines EAT as therapy or treatment utilizing equine activities or using the environment with client-centered goals related to rehabilitation or habilitation within a medical professional's standards of practice. Additionally, the AHA (2017) describes equine-assisted activity (EAA) as activities occurring within an equine environment with the overarching goal of skill attainment, education, leisure, or recreation including but not limited to adaptive riding, competition, equine-facilitated learning, horsemanship, and stable management, yet without a therapeutic component. Similarly, Rigby and Grandjean (2016) define equine-assisted activities and therapies (EAAT) as a broad topic in which EAA and EAT are combined, while the AHA considers these to be to separate entities.

Further specifying this wide-ranged topic, the Horses and Humans Research Foundation (HHRF) describes therapeutic riding as mounted activities including traditional riding and adaptive riding under the instruction of a trained practitioner. While the AHA does not have a standard definition of therapeutic riding, the association recommends therapeutic be used as a stand-alone term and adaptive riding be used to refer to riding lessons for individuals with special needs with non-rehabilitative goals (AHA, 2017).

Health Professionals Conducting Hippotherapy

Another standard in hippotherapy is described by the HHRF (2011); that is, a trained professional in the United States is a licensed therapist or therapy assistant who is registered with the AHA following completion of specified coursework and meeting required hours of practice in a hippotherapy setting. In addition, AHA (2017) describes a hippotherapy clinical specialist (HPCS) in the United States as a "licensed physical therapist, occupational therapist, or speech-language pathologist who has demonstrated an advanced level of knowledge in hippotherapy by successfully completing a written national board examination" (AHA, Inc. Terminology Paper, p.1, para. 5). The AHA's regulatory body, known as the American Hippotherapy Certification Board (AHCB), is responsible for administration of certification examinations as well as maintaining records of examinations.

In the United States, physical, occupational, and speech-language therapy practitioners with additional training in hippotherapy typically conduct hippotherapy sessions with the utilization of equine movement as a central component of therapy (Fry, 2013). Practitioners with backgrounds in rehabilitation are in a highly qualified position to consult within their specified areas of expertise to create environments in which encourage engagement related to horses (Naumann & Penning, 2014). Hippotherapy is to be used in conjunction with other treatment strategies in a client's plan of care, in order to engage sensory, neuromotor, and cognitive systems to achieve outcomes (AHA, 2017). The horse's movement promotes active responses in the service recipient, which are intended to affect an individual's overall function (AHA, 2016). Variations in a horse's movement are directed by a qualified practitioner in order to promote desirable responses

within a client, which may include but are not limited to, outcomes such as improvements in balance, strength, gait, mobility, sensory processing, emotional regulation, coordination, speech, language, communication, vocal intensity, and participation in daily activities (AHA, 2016).

Throughout the remainder of this literature review, hippotherapy referring to occupational therapy, physical therapy, and speech-language therapy practitioners employing evidence-based practice and clinical reasoning in the purposeful manipulation of equine movement, will be further explored, specifically related to treatment of individuals with conditions affecting their physical health (AHA, 2017).

Relevance to Occupational Therapy

Occupational therapy is defined in the Occupational Therapy Practice Framework (OTPF) as "the therapeutic use of everyday life activities with individuals or groups for the purpose of enhancing or enabling participation in roles, habits and routines in home, school, workplace, community, and other settings" (AOTA, 2014, p. S1). According to the American Occupational Therapy Association (AOTA), the use of the movement of a horse (hippotherapy) is one of many interventions that may be used by occupational therapy practitioners. The use of hippotherapy must be dependent on one's medical diagnoses, is based on an appropriate occupational therapy evaluation, and integrated into a broader occupational therapy program and client-centered plan of care with the overall goal of supporting engagement in daily activities and occupational performance (AOTA, 2011).

Occupational therapy practitioners can act as key facilitators to develop functional rehabilitative programs supporting populations who are motivated by the idea of forming

relationships with horses, making occupational therapists well-qualified to practice in this area (Naumann & Penning, 2014). Despite this, according to Naumann and Penning (2014), occupational therapy practitioners have not been extensively involved in providing equine-assisted therapy and with increasing public interest in animal-assisted therapy, it is vital occupational therapists become more involved in its functional applications. To do so, it is pivotal for occupational therapy practitioners to understand the difference between hippotherapy and therapeutic riding prior to intervention planning. Therapeutic horseback riding has a main goal of riding a horse, and is not considered occupational therapy while the goal of hippotherapy is to support engagement in daily activities and improve occupational performance (AOTA, 2011).

The main concept behind hippotherapy intervention, according to Rigby and Grandjean (2016), "relies on the fact that a horse's smooth and rhythmic gait elicits motor responses in the rider that are essential for movement patterns of a human pelvis while walking" (p. 10). Riding a horse while positioned either backward or forward on the horse's back in a consistent and repetitive rhythmical movement can be utilized as a treatment tool to develop strength and balance and to normalize muscle tone. For example, an individual with hypertonic muscles may experience muscle relaxation as a result a horse's fluidity in movement, and hypotonic muscles may be strengthened during faster, more rapid, movement of the horse (Granados & Agis, 2011). One example of an occupational therapy goal utilizing a horse would be working to improve dynamic balance, a skill used in many everyday activities (AOTA, 2011).

According to the OTPF, participation in activities and occupations that are meaningful to the client involve emotional, psychosocial, cognitive and physical aspects

of performance. Participation in meaningful activities and occupations enhance health, well-being and life satisfaction (AOTA, 2014). In paraphrasing Chandler (2005), Cole and Howard (2013) state, "the novelty of the horse can incite interest and involvement for many clients who may otherwise lack motivation to participate in therapy" (p.237). Thus, the incorporation of hippotherapy into select rehabilitation treatment plans would provide added meaning and motivation for their participation in therapy sessions. In addition, the environment and context in which hippotherapy occurs, offers an opportunity for exposure to a variety of sensory opportunities, which may also help to further deepen the rehabilitation process and simultaneously enhance motivation.

In the profession of occupational therapy, the OTPF provides a guide for treatment. There are various occupational performance components from the framework that relate to hippotherapy practice. There are eight areas of occupation in the OTPF, and hippotherapy indirectly influences each area, but can directly affect the occupations of activities of daily living (ADLs) and instrumental activities of daily (IADLs). Through skilled hippotherapy intervention, clients are able to make improvements in their physical health and overall function, which influences life roles and participation in ADLs and IADLs, amongst other areas of occupation.

Client factors are components in the OTPF which resonate inside a client and ultimately influence an individual's performance in occupations. Specifically, body functions which may be impacted by hippotherapy treatment include mental functions, sensory functions and neuromusculoskeletal and movement-related functions, referred to as movement functions throughout the remainder of this review. Movement functions such as muscle, tone, power, endurance, joint stability, control of movement, and reflexes

are components of occupational therapy practice that may be facilitated in the hippotherapy treatment process. Although there is research supporting use of hippotherapy for mental functions, such as improving attention, perception, energy, drive, temperament and experience of self, the focus of the remainder of this review will be on movement and sensory functions.

One of the most beneficial, yet unique, aspects of hippotherapy is the integration of the numerous senses at any given time. The unique experience of riding a horse and being in a different environment addresses the sensory functions of proprioception, vestibular, touch, vision and hearing. For example, a horse produces and provides extra body warmth that can promote improvements in a rider's musculature by increasing plasticity, reducing spasticity, and providing stretch to muscles (Granados & Agis, 2011). Additionally, the olfactory system responds to the wide variety of smells integrated throughout the process of a hippotherapy session (Granados & Agis, 2011). The sensory and motor capacities that hippotherapy intervention influence may include auditory processing, proprioception, coordination between sides of the body, fine motor control, motor planning, ocular control, perception of movement, touch perception, and visual–spatial perception (Granados & Agis, 2011). During hippotherapy, the movement of the horse elicits the tactile sense, which is derived from touch and factors in the environment (Granados & Agis, 2011). In addition, according to Granados and Agis (2011), "the vestibular system is stimulated by the horse's change of direction and speed" (p.193).

Similarly to client factors, the OTPF identifies performance skills that may also be addressed through the use of hippotherapy. "Performance skills are observable elements of action that have an implicit functional purpose" (AOTA, 2014, p. S25). The

specific performance skills that have an implicit functional purpose and outcomes in the hippotherapy process include motor skills such as, coordinate, grip, manipulate, position, stabilize, calibrate, endure, pace, reach, and walk. For example, during a hippotherapy session, a client may improve functional reach through holding the horse's rein, pulling oneself onto the horse, or brushing the horse. While there is limited occupational therapy literature connecting the OTPF client factors and performance skills to intervention strategies utilizing hippotherapy, we hypothesize that literature is present from various disciplines supporting the use of hippotherapy for individuals with conditions impacting their physical health.

While literature does suggest hippotherapy is a useful tool for intervening with individuals having physical impairments, barriers such as obtaining live horses, lack of funds, unpredictability in weather, liability purposes, and inability to provide an adequate facility, have resulted in growing popularity of hippotherapy using a simulated horse. Robotic, mechanical, and simulated hippotherapy have recently been integrated into conventional neurorehabilitation as an alternative choice for hippotherapy in a clinical environment or in centers where real horses are not readily accessible or affordable.

Some additional inquisition has been pursued in the similarities between hippotherapy on a real horse and therapy on a robotic horse, also known as a hippotherapy simulator or mechanical horse. Lee, Kim, and Na (2014) studied the differences in therapeutic outcomes between these two intervention types with children with cerebral palsy (CP) using a randomized control trial with 13 children in each group. Primary outcomes were the Pediatric Balance Scale (PBS) to determine dynamic balance, and static balance was measured using the Balance Performance Test (BPM, SMS

Healthcare Inc., UK). Lee, Kim and Na (2014) found statistical significant improvements on both outcome metrics for both groups, with no significant difference between the two groups. Thus, the authors found hippotherapy simulators and hippotherapy to provide similar benefits to clients, without the cost or space demands of a real horse. In another study measuring whether a hippotherapy simulator has influence on symmetric body weight bearing during gait in patients who have had a stroke, the authors concluded the hippotherapy simulator can improve asymmetric weight bearing in patients by influencing trunk muscles (Sung, Kim, Yu, & Kim, 2013). While the potential value in robotic hippotherapy is recognized, there is a specific uniqueness in the role of live animals, specifically horses, in the healing process. As a result, the focus of this literature review is based upon studies involving a live a horse and relevance to physical rehabilitation.

Relevant Research Support

There are many populations which can benefit from the outcomes listed above, including older adults, individuals experiencing balance deficits, individuals diagnosed with cerebral palsy (CP) or multiple-sclerosis (MS), and individuals who have sustained a stroke or other neurological condition. For example, Araújo et al. (2012) studied a population of elderly volunteers in a randomized control trial and employed the Berg Balance Scale (BBS) to measure balance, the Time Up and Go (TUG) test to quantify functional mobility, and a 30 second Chair Stand Test (30CST) to measure muscle strength in the lower limbs. Araújo et al. (2012) concluded that hippotherapy provides significant improvements in balance and lower limb muscle strength ($p = 0.003$ and 0.032, respectively), but not in functional mobility ($p = 0.063$). Further insights can be

gained by examining the results of the randomized control trial performed by Kim and Lee (2014), who also investigated the effects of hippotherapy on balance. Kim and Lee (2014) utilized a program named Biorescue (RM INGENIERIE, France) to measure limits of stability, or the ability of a volunteer to displace his/her center of gravity without falling and found a significant ($p < 0.05$) increase in the hippotherapy group in comparison to the control group after the intervention.

Another population which can readily benefit from hippotherapy are those who have experienced stroke or traumatic brain injury. Han et al. (2012) found in a non-randomized pre-/post-test study with a control group of 37 people who experienced strokes, which balance parameters significantly improved by the end of intervention. The authors employed the BBS and found a significant difference between groups ($p = 0.001$).

In a case study by Galeote, Bastien, Viruega, and Gaviria (2014), the authors qualitatively followed the progress of a volunteer undergoing hippotherapy, after the individual had sustained a traumatic brain injury (TBI). The authors noted the deficits in the volunteer's ability to perform activities of daily living (ADLs) and multiple challenges related to posture and gait, including loss of balance. Through observations only, the authors reported improvements in coordination, balance control, fine motor control, attention, working memory, and postural control.

Silkwood-Sherer and Warmbier (2007) performed a pre-/post-test control trial to determine the efficacy of hippotherapy on balance in individuals with MS using the BBS and the Tinetti Performance Oriented Mobility Assessment (POMA). The authors found a statistically significant improvement (9.15 points, $p = 0.012$) in the experimental group

on the BBS, as well as on the POMA, with a mean increase of 5.12 points and $p = 0.006$. The control group did not see significant increases, with a mean increase of 0.73 points and 0.13 points on the BBS and the POMA, respectively. Interestingly, the most dramatic increase in score occurred during the first seven weeks, as evidenced by the scores at the midterm evaluation, with little improvement occurring during the remaining seven weeks of the study, which was 14 weeks in total. Thus, hippotherapy appears to have a lasting impact on postural stability as evidenced by the research performed by these authors.

A more rigorous study was performed by Vermöhlen et al. (2017) in a randomized control trial on the effects of hippotherapy on individuals with MS. Vermöhlen et al. (2017) utilized the same primary and secondary outcome metrics (BBS and Multiple Sclerosis Quality of Life assessment) as Silkwood-Sherer and Warmbier (2007), with 70 participants as opposed to the 15 used by Silkwood-Sherer and Warmbier (2007). A more modest increase in the experimental group of Vermöhlen et al. (2017) was observed when compared to the results of Silkwood-Sherer and Warmbier (2007), with a mean increase of 6.00 points while the control group saw an increase of 2.9. On the BBS, a score from 0-20 indicates a high risk of falling, 21 - 40 indicates a medium risk, while 41 - 60 indicates a low risk of falling. Hence, the increases observed on the BBS translate into a lower risk of falling in those who have completed hippotherapy as opposed to traditional therapy. Additionally, both Silkwood-Sherer and Warmbier (2007) and Vermöhlen et al. (2017) observed a net decrease in fatigue and spasticity, as observed with the Fatigue Severity Scale (FSS) and Numeric Rating Scale (NRS), respectively. In both these secondary outcomes, a statistically significant relative improvement of the

experimental group over the control group was noted. Finally, both groups of authors also observed a net increase in both physical and mental health in comparison to baseline, as well as a larger increase than the control group experienced.

A well-documented population which benefits from hippotherapy are children with cerebral palsy (CP). Benda, McGibbon and Grant (2003) performed a randomized control trial to determine the benefits in children 4-12 years of age. The experimental group in this study received eight minutes of hippotherapy per session, while the control group sat upon a stationary barrel for eight minutes. Additionally, the stationary barrel was made to simulate the size and feel of a stationary horse. Electromyography (EMG) was used to measure muscle activity in the trunk and upper legs of the participants before and after the intervention, but not during. The outcome metric was a custom asymmetry score determined by the difference in EMG signal from the left and right side of the participants' bodies. These scores were measured in percentages, such that a 100% improvement meant the participant's asymmetry was completely resolved; raw changes in asymmetry were not analyzed, only percent changes. Thus, the average percentage improvement in the experimental group was 64.6%, while in the control group, the average change was -12.8%, which indicates a decrease in symmetry as compared to before therapy.

Another study of children with CP was performed by Shurtleff, Standeven and Engsberg (2009) in which the experimental group received 45 minute sessions on a horse, one time per week for 12 weeks. An upper-extremity functional reach test was performed and data collected by means of video capture and reference markers to accurately determine distances in the frames of the video. Since data was collected by

video, additional metrics could also be tracked, such as dynamic stability, which is the ability to maintain the position of head and trunk while the pelvis was in motion. This was quantified using head angle and anterior posterior translation of the spine and head as variables. Effect size were calculated using Cohen's d, which is a pooled standard deviation to compare results between testing times such that the progress of participants could be tracked in time. Smaller values of d (near zero) correspond to small changes in a variable, larger values (near 1) correspond to larger, more observable changes. Shurtleff et al. (2009) found a significant positive change in head stability post-intervention and post-washout period; the washout period was a two-week period after the final intervention in which participants received no therapy to determine the lasting effects of the therapy. Anterior-posterior translation also significantly improved, but the results of the functional reach test were far more intriguing. Immediately following the intervention, both the elapsed time to reach and the reach distance significantly improved, but following the washout period, only the elapsed time variable maintained its level of improvement. The most noteworthy drawback of this latter study is the small sample size; 11 participants in total, with one dropout.

Summary

Hippotherapy was initially cited in occupational therapy practice in the 1980s, but since then, minimal attention and research have been applied to the topic as time has progressed (Govender, Barlow, & Ballim, 2016). Further review of existing evidence related to hippotherapy has the potential to increase its acceptance by healthcare practitioners (Rigby & Grandjean, 2016). Specifically, there are currently no official *systematic* reviews that have been completed relevant to rehabilitation professionals such

as occupational therapy, physical therapy and speech language pathology practitioners focused on treating individuals who have conditions impacting their physical health utilizing hippotherapy. At this point in time, there is minimal existence of high-level, high-quality evidence regarding the benefits of hippotherapy as a therapeutic modality (Naumann & Penning, 2014). Considering the current lack of evidence, it would be beneficial for the growth of not only hippotherapy, but also occupational therapy as a profession to develop a more advanced consensus of how the two work coherently. As mentioned by Fry (2013), "In order for equine-assisted therapy to be established as a valid form of treatment and accepted as different from recreational activities involving horses, more research and information is needed" (p. 280). According to Selby (2009), "Despite the fact there has been exponential growth of the equine-assisted therapy field, in the past decade, the quality of research is considered moderate at best" (as cited in Fry, 2013, p. 264).

In summary, there is literature supporting the effectiveness of hippotherapy and it is recognized by the AOTA as a valid form of occupational therapy. The horse works as a unique modality and intervention tool proven to help clients with many different physical conditions make improvements in body function and everyday life occupations. The purpose of this scholarly project is to develop a thorough evidence-based systematic review that outlines the efficacy of hippotherapy specifically related to physical conditions. The systematic review will explore existing research on hippotherapy and occupational therapy's role in utilizing hippotherapy in physical rehabilitation. In addition, the outcomes of this project will contribute to defining and differentiating the unique roles medical professionals, including occupational therapy, physical therapy, and

speech-language pathology practitioners play during the hippotherapy process. The systematic review will provide healthcare professionals with an increased understanding of the efficacy of hippotherapy and its applicability to the domain of occupational therapy. The product will help determine how occupational therapy is best suited to apply evidence-based practice in hippotherapy to provide effective care.

Chapter III: Methods

The following systematic review has been completed using guidelines set by the American Occupational Therapy Association (AOTA) and following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. No funding was provided for this review. No Institutional Review Board (IRB) approval was required since there were no live study subjects involved in the systematic review process. No review protocol was utilized, but the student researchers obtained guidance from a librarian with the University of North Dakota School of Medicine and Health Sciences (UND SMHS) and their academic advisor from the University of North Dakota Occupational Therapy Department.

Six databases were selected with the assistance of Devon Olson, UND SMHS librarian. The six databases selected include: PubMed, CINAHL, PsychINFO, SPORTDiscus, Cochrane, and Scopus. The PubMed database was chosen to be included because it is the main source of evidence-based information for biomedical research and journals. CINAHL was determined to be useful for this systematic review because it focuses on nursing and allied health literature, so it was likely occupational therapy-specific literature pertaining to hippotherapy could be found through searching this database. PsychINFO was chosen to be included in the systematic review because this particular database has an emphasis on interdisciplinary healthcare treatment, which aligns well with hippotherapy and is common in treatments utilizing hippotherapy. Although the majority of the articles on SPORTDiscus were written by

physical therapy practitioners and athletic trainers, it was pivotal this database was utilized in this systematic review because hippotherapy is performed by professions other than occupational therapy, including physical therapy and speech language therapy. Cochrane was utilized in this systematic review because this particular database has a collection of health care-related systematic reviews pertaining to a variety of topics and provides evidence-based resources. The Scopus database was chosen to be included because it is one of the largest databases with peer-reviewed literature and allowed the student researchers to search specific author names to ensure anything related or relevant was not missed in the searching process.

Theory

Due to the complexity of conducting a systematic review, a specific theoretical basis was not applied; rather the Occupational Therapy Practice Framework (OTPF) was utilized to guide search terms for the systematic review. In addition, the OTPF serves as a document in which hippotherapy can be compared to occupational therapy specific terminology related to physical conditions. Prior to searching databases, a brief review of literature was conducted individually by each student researcher. Common terms gathered from the literature review included equine-assisted therapy, animal-assisted therapy, hippotherapy, riding therapy, horseback riding, equestrian therapy, and horse riding. The student researchers compiled a list of key search terms, including both occupational therapy-specific and interdisciplinary terms, and used this to guide further meetings with the librarian in which search strings were collaboratively developed. Search terms were agreed upon through brainstorming and collaborating with

the librarian in order to make the key search words database-friendly to ensure optimal results in the data gathering phase of the systematic review.

As previously mentioned, six databases were examined; no contact occurred with any authors to identify additional studies outside of the six databases. All databases were last searched on May 5, 2017 with the guidance of the medical school librarian. The search strings for the databases are displayed in the subsequent tables, with all search strings and the corresponding number of results reported.

Table 1: PubMed Search Characteristics (from May 5, 2017)

Search String	Number of Results
(("Equine-Assisted Therapy"[Mesh] OR "Animal Assisted Therapy"[Mesh] OR "riding therapy" OR "equestrian therapy" OR "equine-assisted" OR "hippotherapy") AND (("Treatment Outcome"[Mesh] OR outcome OR efficacy) OR ("Rehabilitation"[Mesh] OR rehab) OR "Occupational Therapy"[Mesh] OR "Physical Therapy Modalities"[Mesh] OR "Physical Therapy Specialty"[Mesh] OR "Motor Skills"[Mesh] OR method OR neuro)	454
("Therapeutics"[Mesh]) AND Horses"[Mesh]	9
("Therapeutics"[Mesh]) AND ("Equine-Assisted Therapy"[Mesh] OR "hippotherapy" or "equestrian therapy")	167
(("Equine-Assisted Therapy"[Mesh] OR "hippotherapy" or "equestrian therapy")) AND "Treatment Outcome"[Mesh]	57

Table 2: CINAHL Search Characteristics (from May 5, 2017)

Search String	Number of Results
((MH "Equine-Assisted Therapy" OR MM "Horses" OR MM "Horseback Riding" OR "hippotherapy" or "equestrian therapy" OR "equine assisted") AND ((MH "Therapeutics+" OR outcome OR efficacy OR MM "treatment outcomes") OR (MH "Rehabilitation+" OR rehab) OR MH "occupational therapy+" OR MH "physical therapy+" OR MH "motor skills" OR method OR neuro)	304

Table 3: PsychINFO Search Characteristics (from May 5, 2017)

Search String	Number of Results
DE "Rehabilitation" AND (DE "Horses" OR "equine-assisted therapy" OR "equestrian therapy" OR "hippotherapy" OR "horse rid*")	11
"equine-assisted therapy" OR "equestrian therapy" OR "hippotherapy" OR "horse rid*"	158
DE "Motor Processes" AND (DE "Horses" OR "equine-assisted therapy" OR "equestrian therapy" OR "hippotherapy" OR "horse rid*")	0

Table 4: SPORTDiscus Search Characteristics (from May 5, 2017)

Search String	Number of Results
(DE "RIDING therapy" OR "riding therapy" OR "equestrian therapy" OR "equine assisted" OR "hippotherapy") AND ((DE "TREATMENT" OR outcome OR efficacy) OR (DE "MEDICAL rehabilitation" OR rehab) OR DE "OCCUPATIONAL therapy" OR DE "PHYSICAL therapy" OR DE "MOTOR ability" OR method OR neuro)	67

Table 5: Cochrane Search Characteristics (from May 5, 2017)

Search String	Filter	Number of Results
"horse therapy" OR "hippotherapy" OR "equestrian therapy" OR "equine-assisted"	Reviews	6
"horse therapy" OR "hippotherapy" OR "equestrian therapy" OR "equine-assisted"	Trials	60

Table 6: SCOPUS Search Characteristics (from May 5, 2017)

Search String	Number of Results
Hippotherapy	355

Equine-assisted therapy	199
Riding Therapy	59
Equestrian Therapy	38
Horse Therapy	11

In order for an article to be included in the systematic review, it must have been published within the past 15 years in order to exclude outdated research. Additionally, articles must have been published in a peer-reviewed journal to establish credibility with respect to their individual methods. Unpublished and non-peer reviewed results were not considered since they have not undergone peer-review to establish the robustness of their research methods. Only articles published in English were considered to prevent any errors in translation from contaminating the results of the review. The purpose of this systematic review is to examine quantitative research regarding hippotherapy, and as such, only quantitative research articles which are relevant or specific to interventions with a horse are included. Finally, only studies whose service recipients have a condition impacting physical health are included, as another purpose of this study was to examine the effects of hippotherapy on physical rehabilitation. To ensure interventions are conducted by qualified experts, only studies where intervention was provided by an occupational therapy, physical therapy, or speech-language pathology practitioner were utilized.

The assessment of bias was done at the study level by analyzing possible sources of bias, such as sampling biases resulting from small sample sizes which do not appropriately reflect the general population, or even the population the study is intended to generalize to. Studies which, by choice or design, could not use single- or double-

blinding were subjected to additional scrutiny to determine if blinding could have been used, and if so, why it was not. Additionally, the authors of this review sought to identify what effect, if any, this had on the results. Another possible source of bias is in the method of participant solicitation, as a response bias could occur if participants from a particular demographic are more likely to participate than others, which is another source of a non-representative sample which does not accurately reflect the characteristics of the population the study is intended to be researching.

Prior to searching for articles in the mentioned qualified databases, the student researchers met with their academic advisor in order to determine what would be used for inclusion and exclusion criteria throughout the entirety of the systematic review process. The first step of data collection began when the student researchers made master lists of all the articles found on the initial database search on May 5th, 2017. Due to the chosen databases adding new articles frequently, a master list was required to ensure the student researchers would not review an article from a database that was not there during the initial search, as new articles are frequently added to databases. Another essential function of the master list was to provide a consistent document in which all articles were assigned a number to assist the student researchers in keeping track of articles and ensuring they were reviewed in the same order. The student researchers collaborated on creating a strategic system to track articles using an online tracking system to ensure consistency between them. The system employed was chosen because it had the ability to be shared with others if desired and it saved automatically on a consistent basis, reducing the likelihood of losing data. The online tracking system had a designated portion for each search string from every database. Each online data spreadsheet was

organized into three sections including a column for the article title, a yes/no column to identify if the article was included or excluded, and a column to provide an explanation of why the article is being excluded or questions the student researcher desired to address with the other student researcher.

Prior to beginning the first individual review of each article, the student researchers collaborated on the specifics of what was intended by each inclusion/exclusion criteria. Specifically, the criteria 'service recipient has a physical health condition' was determined to include both physical diagnoses, symptoms impacting physical health, as well as outcomes that are related to physical symptoms. Individually, each student researcher reviewed 1,955 articles from the six databases through abstract and title review. Upon scrutinizing each article, the student researchers were required to ensure it had not been reviewed in a previous database, in which case it would have been included or excluded already, as that would lead to counting a single article more than once. If the article had been reviewed previously in a different search string or database, the student researcher would write 'duplicate' in the explanation column of the online search tracking system to avoid the article being counted more than one time. After the student researchers had reviewed all 1,955 article abstracts and titles individually, the second phase of reviewing began.

In this second phase of the systematic review, student researchers compared articles together that were either previously excluded or included. During each step in which the student researchers were together reviewing their individual tracking sheets to make final decisions, the first student researcher had the responsibility of tracking the excluded articles and the reasons for exclusion, while the other student researcher was

responsible for keeping an ongoing list of the articles being kept for further full-article review. A consensus was made determining if each article should be included or excluded and the reason for exclusion in the case of discarding articles. If there was disagreement in whether an article should be included or excluded, the student researchers reviewed the article abstract and title again to determine a final agreement. The student researchers prioritized the exclusion criteria in order to ensure the most prominent reason for exclusion was consistent across all databases and search strings. The student researchers made an additional online tracking spreadsheet for each database that specified the articles that were to be included and the number of articles excluded from each database. The articles that were excluded were identified by a number in the spreadsheet, indicating the specific exclusion criteria applied. At the conclusion of each database, the student researchers totaled the number of excluded articles with the number of articles that were included to ensure there were no mistakes and the total number of articles reviewed, matched that of the total number reflected in the initial search.

The third phase of reviewing occurred individually in which each student researcher did a full-text review of the articles that were included from each database. Similarly to the last two phases, each student researcher made another online tracking spreadsheet organized into three sections including a column for the article title, a yes/no column to identify if the article was included or excluded, and a column to provide an explanation of why the article is being excluded. It was pivotal at this point in the review process to ensure each article met all of the inclusion criteria and it was excluded if any inclusion criteria were not completely met. The fourth and final phase of

reviewing occurred collaboratively as the student researchers compared the articles that were individually included and excluded during phase three, the full article review. The student researchers organized a final online tracking spreadsheet that included only the articles that met all of the inclusion criteria and a final exclusion sheet that identified reasons for exclusion. After both student researchers came to a final consensus, the articles that were included after this fourth and final phase of reviewing, reflect the articles in which all inclusion criteria was clearly met and were included in the final outcome from the systematic review process. Upon further discussion with the student researchers' academic advisor and the medical school librarian, it was determined at this point that systematic reviews, meta-analyses, case series, case reports and literature reviews would be excluded due to intervention not being conducted by an occupational, physical, or speech language practitioner. Each article that was chosen to be included in the final review was reviewed fully by the student researchers and the information from each article was organized into a chart format. Each chart contained the following sections: article title, author, year of publication, level of evidence, type of study design, participant data, hippotherapy intervention, outcome measures used, and study results. The OTPF was used to make final conclusions and identify occupation-focused themes from individualized article charts in order to connect the results to the occupational therapy profession.

Chapter IV: Results

PsychINFO

In the PsychINFO database, 169 articles were the product of the initial search. Results from round one, which consisted of an abstract and title review, are displayed below in Table 7.

Table 7: PsychINFO Exclusions Round One

Intervention not completed by OT, PT, or SLP	3
Not quantitative research	27
Not published in English	9
Not published in the past 15 years	9
Not published in a peer-reviewed journal	7
Irrelevant or not specific to interventions with a horse	48
Service recipient does not have a condition impacting physical health	44
Article not from CINAHL, PubMed, PsychInfo, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	7
Simulators	7

Based on Table 7 above from the first round, 154 articles were eliminated for meeting various exclusion criteria, and 17 articles were kept for full article review. Data from round two, which consisted of full article reviews, is displayed in Table 8 below.

Table 8: PsychINFO Exclusions Round Two

Intervention not completed by OT, PT, or SLP	8
Not quantitative research	1
Not published in English	0
Not published in the past 15 years	0
Not published in a peer-reviewed journal	0
Irrelevant or not specific to interventions with a horse	2

Service recipient does not have a condition impacting physical health	1
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	0
Simulator	1

After completing round two, which consisted of full article reviews of 15 articles, 12 articles were excluded for meeting various exclusion criteria, and three articles were kept for inclusion in the systematic review.

Through all phases of searching PsychINFO, there were 11 articles eliminated from the systematic review because the intervention was not completed by an occupational therapy, physical therapy, or speech language therapy practitioner. Next, there were 28 articles in total eliminated from this database because they did not include quantitative data. There were nine articles in total that were eliminated due to being published in a language other than English. There were nine articles that were not included because they were not published within the last 15 years. Seven articles in which were not published in a peer-reviewed journal were eliminated during the process of analyzing articles in this database. There were 50 articles in this database determined to be irrelevant to intervention with a horse, leading to exclusion. In total, there were 45 articles in the PsychINFO database determined to not contain a condition impacting physical health. Seven duplicates were identified throughout the search of this database. Additionally, there were eight articles pertaining to horse simulators, which was kept track of simply due to student researcher interest. In total, three articles were kept permanently and determined to meet all inclusion criteria for this systematic review.

Cochrane

In the Cochrane database, 66 articles were the product of our initial search. Results from round one, which consisted of an abstract and title review, are displayed below in Table 9.

Table 9: Cochrane Exclusions Round One

Intervention not completed by OT, PT, or SLP	0
Not quantitative research	1
Not published in English	0
Not published in the past 15 years	1
Not published in a peer-reviewed journal	0
Irrelevant or not specific to interventions with a horse	7
Service recipient does not have a condition impacting physical health	14
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	22
Simulators	4

Based on Table 9 above from the first round, 45 articles were eliminated for meeting various exclusion criteria, and 21 articles were kept for full article review. Data from round two, which consisted of full article reviews, is displayed in Table 10.

Table 10: Cochrane Exclusions Round Two

Intervention not completed by OT, PT, or SLP	8
Not quantitative research	0
Not published in English	2
Not published in the past 15 years	0
Not published in a peer-reviewed journal	2
Irrelevant or not specific to interventions with a horse	2
Service recipient does not have a condition impacting physical health	0
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	0

Simulator	1

After completing round two, which consisted of full article reviews of 21 articles, 14 articles were excluded for meeting various exclusion criteria, and seven articles were kept for inclusion in the systematic review.

Through all phases of searching Cochrane, there were eight articles eliminated from the systematic review because the intervention was not completed by an occupational therapy, physical therapy, or speech language therapy practitioner. Next, there was one article in total eliminated from this database because they did not include quantitative data. There were two articles that were not included because they were not published in English. One article was not included because it was not published in the last 15 years. Two articles that were not published in a peer-reviewed journal were eliminated during the process of analyzing articles in this database. There were nine articles in this database determined to be irrelevant to intervention with a horse, leading to exclusion. In total, there were 14 articles in the Cochrane database determined to not contain a condition impacting physical health. There were 22 duplicates identified throughout the search of this database. Additionally, there was one article pertaining to horse simulators, which was kept track of simply due to student researcher interest. In total, seven articles were kept permanently and determined to meet all inclusion criteria for this systematic review.

SPORTDiscus

In the SPORTDiscus database, 67 articles were the product of our initial search. Results from round one, which consisted of an abstract and title review, are displayed below in Table 11.

Table 11: SPORTDiscus Exclusions Round One

Intervention not completed by OT, PT, or SLP	2
Not quantitative research	15
Not published in English	1
Not published in the past 15 years	3
Not published in a peer-reviewed journal	1
Irrelevant or not specific to interventions with a horse	7
Service recipient does not have a condition impacting physical health	6
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	12
Simulators	0

Based on Table 11 above from the first round, 47 articles were eliminated for meeting various exclusion criteria, and 20 articles were kept for full article review. Data from round two, which consisted of full article reviews, is displayed in Table 12.

Table 12: SPORTDiscus Exclusions Round Two

Intervention not completed by OT, PT, or SLP	9
Not quantitative research	0
Not published in English	1
Not published in the past 15 years	0
Not published in a peer-reviewed journal	2
Irrelevant or not specific to interventions with a horse	0
Service recipient does not have a condition impacting physical health	1
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	1
Simulators	0

After completing round two, which consisted of full article reviews of 20 articles, 14 articles were excluded for meeting various exclusion criteria, and six articles were kept for inclusion in the systematic review.

Through all phases of searching SPORTDiscus, there were 11 articles eliminated from the systematic review due to intervention being completed by an individual not associated with practitioners from the field of occupational therapy, physical therapy, or speech language therapy. In total, 15 articles were determined by the student researchers to not be quantitative in nature and were eliminated for this reason. There were two articles that were not published in English, leading to exclusion. Three articles were excluded from this systematic review due to not being published in the past 15 years. Three articles in which were not published in a peer-reviewed journal were eliminated during the process of analyzing articles in this database. There were seven articles in this database determined to be irrelevant to intervention with a horse, leading to exclusion. In total, there were seven articles in the SPORTDiscus database determined to not contain a condition impacting physical health. Thirteen duplicates were identified throughout the search of this database. Additionally, there were no articles pertaining to horse simulators, which was kept track of simply due to student researcher interest. In total, six articles from SPORTDiscus were determined to meet all inclusion criteria.

CINAHL

In the CINAHL database, 304 articles were the product of our initial search. Results from round one, which consisted of an abstract and title review, are displayed below in Table 13.

Table 13: CINAHL Exclusions Round One

Intervention not completed by OT, PT, or SLP	2
Not quantitative research	95
Not published in English	4
Not published in the past 15 years	14
Not published in a peer-reviewed journal	0
Irrelevant or not specific to interventions with a horse	73
Service recipient does not have a condition impacting physical health	35
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	51
Simulators	4

Based on Table 13 above from the first round, 274 articles were eliminated for meeting various exclusion criteria, and 30 articles were kept for full article review. Data from round two, which consisted of full article reviews, is displayed in Table 14.

Table 14: CINAHL Exclusions Round Two

Intervention not completed by OT, PT, or SLP	15
Not quantitative research	4
Not published in English	0
Not published in the past 15 years	0
Not published in a peer-reviewed journal	3
Irrelevant or not specific to interventions with a horse	0
Service recipient does not have a condition impacting physical health	0
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	0
Simulator	0

After completing round two, which consisted of full article reviews of 30 articles, 22 articles were excluded for meeting various exclusion criteria, and eight articles were kept for inclusion in the systematic review.

Through all phases of searching CINAHL, there were 17 articles eliminated from the systematic review because the intervention was not completed by an occupational therapy, physical therapy, or speech language therapy practitioner. Next, there were 99 articles in total eliminated from this database because they did not include quantitative data. There were four articles that were not included because they were not published in English. Fourteen articles were not included because they were not published in the last 15 years. Three articles that were not published in a peer-reviewed journal were eliminated during the process of analyzing articles in this database. There were 73 articles in this database determined to be irrelevant to intervention with a horse, leading to exclusion. In total, there were 35 articles in the CINAHL database determined to not have a condition impacting physical health. There were 51 duplicates identified throughout the search of this database. Additionally, there were four articles pertaining to horse simulators, which were kept track of simply due to student researcher interest. In total, eight articles were kept permanently and determined to meet all inclusion criteria for this systematic review.

SCOPUS

In the SCOPUS database, 662 articles were the product of our initial search. Results from round one, which consisted of an abstract and title review, are displayed below in Table 15.

Table 15: SCOPUS Exclusions Round One

Intervention not completed by OT, PT, or SLP	2
Not quantitative research	32
Not published in English	0
Not published in the past 15 years	70
Not published in a peer-reviewed journal	12
Irrelevant or not specific to interventions with a horse	88
Service recipient does not have a condition impacting physical health	69
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	327
Simulators	10

Based on Table 15 above from the first round, 600 articles were eliminated for meeting various exclusion criteria, and 62 articles were kept for full article review. Data from round two, which consisted of full article reviews, is displayed in Table 16.

Table 16: SCOPUS Exclusions Round Two

Intervention not completed by OT, PT, or SLP	20
Not quantitative research	0
Not published in English	31
Not published in the past 15 years	0
Not published in a peer-reviewed journal	3
Irrelevant or not specific to interventions with a horse	2
Service recipient does not have a condition impacting physical health	0
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	1
Simulator	0

After completing round two, which consisted of full article reviews of 62 articles, 57 articles were excluded for meeting various exclusion criteria, and five articles were kept for inclusion in the systematic review.

Through all phases of searching SCOPUS, there were 22 articles eliminated from the total because the intervention was not completed by an occupational therapy, physical therapy, or speech language therapy practitioner. Next, there was 32 articles in total eliminated from this database because they did not include quantitative data. There were 31 articles that were not included because they were not published in English. Seventy articles were not included because they were not published in the last 15 years. In total, 15 articles that were not published in a peer-reviewed journal were eliminated during the process of analyzing articles found in this database. There were 90 articles from SCOPUS determined by the student researchers to be irrelevant to intervention with a horse, leading to exclusion. In total, there were 69 articles in the SCOPUS database determined to not have a condition impacting physical health. There were 328 duplicates identified throughout the search of this database, leading to exclusion since the duplicate articles had already been counted during the systematic review. There were 10 articles pertaining to horse simulators, which were kept track of simply due to student researcher interest. In total, five articles were kept permanently and determined to meet all inclusion criteria for this systematic review.

PubMed

From the PubMed database, 687 articles were the product of our initial search. Results from round one, which consisted of an abstract and title review, are displayed below in Table 17.

Table 17: PubMed Exclusions Round One

Intervention not completed by OT, PT, or SLP	7
Not quantitative research	17
Not published in English	2

Not published in the past 15 years	15
Not published in a peer-reviewed journal	2
Irrelevant or not specific to interventions with a horse	171
Service recipient does not have a condition impacting physical health	58
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	413
Simulators	0

Based on Table 17 above from the first round, 685 articles were eliminated for meeting various exclusion criteria, and two articles were kept for full article review. Data from round two, which consisted of full article reviews, is displayed in Table 18.

Table 18: PubMed Exclusions Round Two

Intervention not completed by OT, PT, or SLP	1
Not quantitative research	0
Not published in English	1
Not published in the past 15 years	0
Not published in a peer-reviewed journal	0
Irrelevant or not specific to interventions with a horse	0
Service recipient does not have a condition impacting physical health	0
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	0
Simulators	0

After completing round two, which consisted of full article reviews of two articles, two articles were excluded for meeting various exclusion criteria, and zero articles were kept for inclusion in the systematic review.

Through all phases of searching PubMed, there were eight articles eliminated from the systematic review due to intervention being completed by an individual not

associated with practitioners from the field of occupational therapy, physical therapy, or speech language therapy. In total, 17 articles were determined by the student researchers to not be quantitative in nature and were eliminated for this reason. There were three articles that were not published in English, leading to exclusion. Fifteen articles were excluded from this systematic review due to not being published in the past 15 years. Two articles in which were not published in a peer-reviewed journal were eliminated during the process of analyzing articles in this database. There were 171 articles in this database determined to be irrelevant to intervention with a horse, leading to exclusion from the systematic review. In total, there were 58 articles in the PubMed database determined to not contain a condition impacting physical health. There were 413 duplicates identified throughout the search of this database, leading to exclusion. Additionally, there were no articles pertaining to horse simulators, which was kept track of simply due to student researcher interest. In total, there were not any articles from PubMed in which were determined to meet all inclusion criteria that have not already been accounted for in the systematic review.

Final Round

Upon further discussion with the student researchers' academic advisor and the medical school librarian, the student researchers decided to eliminate systematic reviews, meta-analyses, case series, and case reports from the final inclusions due to lack of direct intervention being provided by an occupational, physical, or speech language practitioner. From 1955 articles reviewed, 150 were reviewed fully, and there were 17 articles included in the systematic review.

Table 19: Final Round Exclusions

Intervention not completed by OT, PT, or SLP	11
Not quantitative research	0
Not published in English	0
Not published in the past 15 years	0
Not published in a peer-reviewed journal	0
Irrelevant or not specific to interventions with a horse	1
Service recipient does not have a condition impacting physical health	0
Article not from CINAHL, PubMed, PsychINFO, SPORTDiscus, SCOPUS, or Cochrane	0
Duplicates	0
Simulators	1

After exclusions specified in Table 13, there were 17 articles determined to meet all inclusion criteria for the systematic review. A breakdown of the total articles and exclusions is displayed in Figure 1, and charts analyzing the 17 included articles can be viewed in Table 20.

Figure 1: Breakdown of Articles and Exclusions

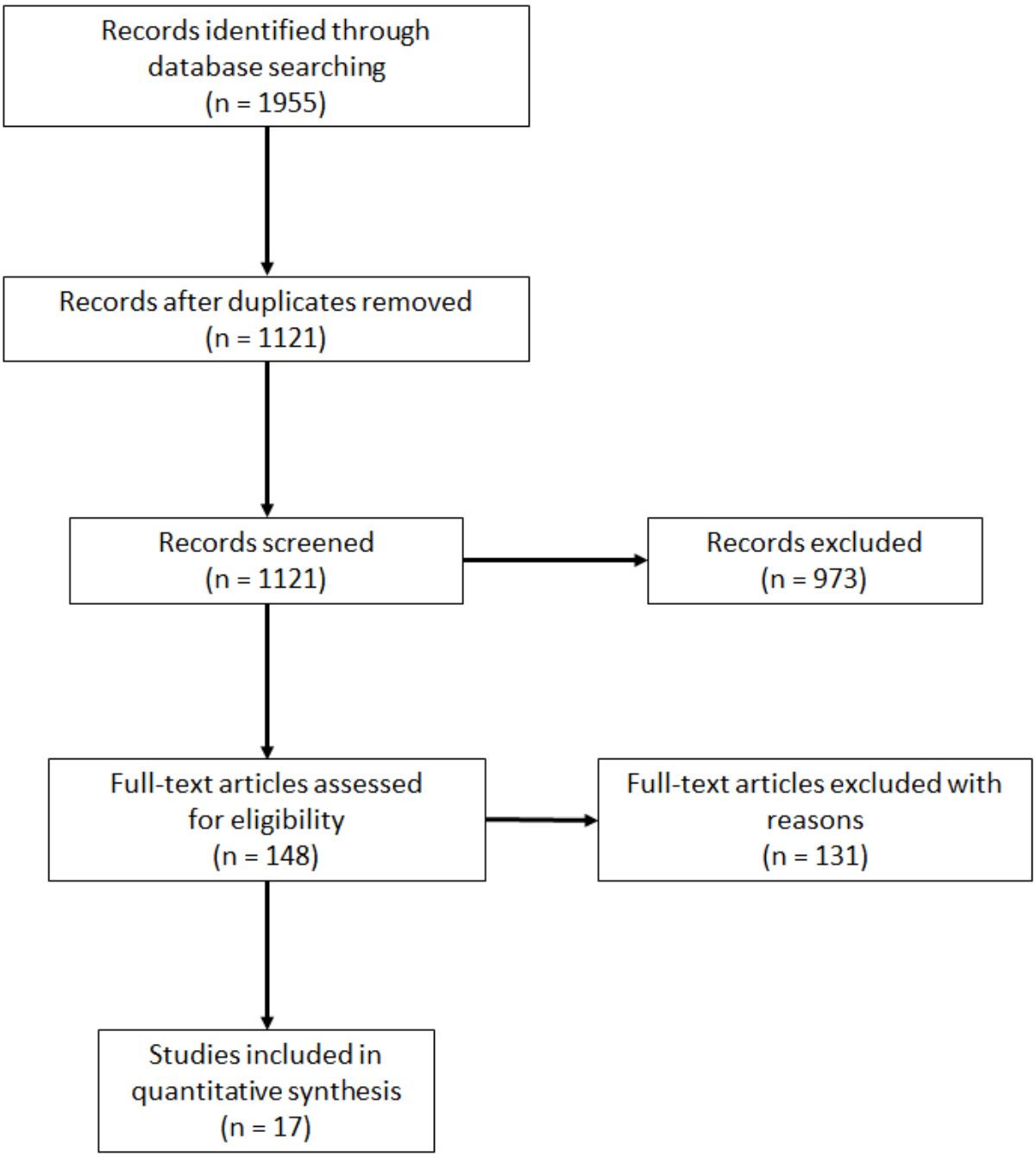

Table 20: Results of Systematic Review
Level I:

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Kwon et al. (2015) Effects of hippotherapy on the sitting balance of children with cerebral palsy: A randomized control trial.	Level of Evidence: I Study Design: Randomized control trial Participants: N = 92 children aged 4-10 years old with cerebral palsy	Hippotherapy sessions were conducted by a licensed physical therapist who was trained and certified by the American Hippotherapy Association (AHA). Children in the hippotherapy group had 2 sessions per week for 8 weeks and each session was 30 minutes. The children were matched to a horse depending on their size and functional status. Utilizing the McGibbon protocol, the sessions consisted of muscle relaxation, postural alignment, independent sitting, and active exercises such as stretching, dynamic balance and	Gross Motor Function Measure (GMFM)-88 Gross Motor Function Measure (GMFM)-66 Pediatric Balance Scale (PBS)	The study showed a significant improvement in PBS scores for the group of children receiving hippotherapy compared to the control group. Dimensions of GMFM-88 improved significantly after hippotherapy varied by GMFCS level: dimension E (jumping) in level I, dimensions D (standing) and E (jumping) in level II, dimensions C (crawling) and D (standing) in level III, and dimensions B (sitting) and (crawling) in level IV. Overall, this study showed hippotherapy positively affects gross motor function and balance in children with CP of

		postural control. The control group received 30 minutes of home-based aerobic exercise (walking or cycling) twice a week for 8 weeks with conventional physiotherapy.		various functional levels.

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
McGibbon, Benda, Duncan, & Silkwood-Sherer (2009) Immediate and long-term effects of hippotherapy on symmetry of adductor muscle activity and functional ability in children with spastic cerebral palsy.	Level of Evidence: I Study Design: Pretest/post-test randomized controlled trial plus clinical follow-up Participants: *Phase 1:* N = 47 total completed all testing, N = 25 randomized to the horse group and N = 22 to the barrel group. *Phase 2:* N = 6 children with spastic CP	Intervention took place under the direction of a physical therapist (PT) certified as a Hippotherapy Clinical Specialist (HPCS) by the American Hippotherapy Certification Board. *Phase 1*: A horse handler led the horse on a designated circular track at a steady walk for 10 minutes, 5 minutes in each direction. The PT and side walker walked alongside the horse for security only and not postural support. A stationary barrel was created using a 55-gallon drum. The child sat astride the barrel with the identical assistants present and was encouraged to remain in a forward	*Phase 1*: Surface electromyography *Phase 2:* Adductor muscle activity using surface electromyography Gross Motor Function Measure-66	*Phase 1:* The results of this study show that there is significant improvement in adductor muscle asymmetry after hippotherapy intervention and the effects of barrel-sitting were not significant. *Phase 2:* The results indicate that after 12 weeks of weekly hippotherapy, 4 of 6 children showed improved adductor muscle symmetry during walking. Additionally, all children improved on the Gross Motor Function Measure-66 and maintained improved function over baseline 12 weeks post-treatment

		position on the barrel for ten minutes while a horse video played. *Phase 2:* Treatment followed a standard 30 minute hippotherapy protocol. This was a 36-week repeated-measures design divided into three 12-week segments. This consisted of a baseline (no hippotherapy) phase, a treatment phase (12 weeks) and a post-treatment (no hippotherapy) phase. Treatment phase consisted of a warm up that had the child adjust to the dynamic sitting and the rhythmic movement of the horse's back. Initially the horse was led in straight lines with only slight curves. Larger figures such as serpentines and figure eights were then introduced to challenge the child's lateral		

		weight shift and postural control. An additional challenge that was added included accelerating/ decelerating the horse's walk to promote anticipatory or feedback postural control. Walking on uneven ground was used to incorporate predictive visual environmental cues. Also, lengthening the horse's stride to transmit greater movement amplitude through the child's pelvis and trunk. As the child improved other exercises were added as needed and they include: backward sit, supine to sit, trunk rotation, side-sit and upper-extremity exercises of stretching, reaching, and crossing midline. Coordination was achieved as the therapist added stirrups		

		and facilitated use of the child's leg strength to stand in the stirrups. Depending on the gross motor function level the assistance level varied.		

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
El-Meniawy & Thabet (2012) Modulation of back geometry in children with spastic diplegic cerebral palsy via hippotherapy training.	Level of Evidence: I Study Design: Randomized control trial Participants: N=30 children with spastic diplegia, ages 6 - 8 years old. The gender distribution was not reported.	The control group received a designed exercise program for 1 hour, 3 times per week for 3 months. This exercise program included stretching exercises, strengthening exercises, postural facilitation, and gait training. The experimental group received both the exercise routine used by the control group and additional hippotherapy. Hippotherapy was conducted once weekly for 13 weeks. Hippotherapy was led by a physical therapist and was broken into two 15 minute sessions with a 10-minute break separating the horse-riding segments. The first 15-minute segment consisted of	Formetric instrument system - measured lateral deviation of the spine from midline, trunk imbalance, pelvic tilt, and surface rotation.	Pre-test results between the control and experimental groups indicated no significant differences, confirming the homogeneity of the sample. Significant reductions were found in both groups post-treatment, but a comparison between groups also found significantly better improvements in the experimental group over the control group. Note that less lateral deviation, trunk imbalance, pelvic tilt, and surface rotation are all considered beneficial, and both groups saw decreases in all these values.

		the child maintaining postural alignment while using grips on the saddle to maintain balance. The second 15 minute segment had the child not using the grips and performing upper limb exercises while riding.		

Level II:

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Shurtleff, Standeven, & Engsberg (2009) Changes in dynamic trunk/head stability and functional reach after hippotherapy.	Level of Evidence: II Study Design: Cohort Participants: N = 19, N = 11 children with spastic diplegia cerebral palsy, N = 8 children with no disability	The group of 8 children with no disability did not participate in intervention, but engaged in testing to provide normative data prior to the 11 children with CP participating in hippotherapy sessions. The hippotherapy interventions took place for 45 minutes each, once per week for 12 weeks. Licensed physical or occupational therapists conducted the hippotherapy sessions. During the session, the children engaged in maintaining numerous positions such as forward-facing riding, side-sitting riding, kneeling while riding, backward-facing riding, and	Video Motion Capture (VMC) system- This video motion capture software was utilized to generate an image in which was able to be rotated in all planes to observe movement from various viewpoints. Markers were placed in numerous areas to gather and transmit data from one another in order to provide images. To ensure consistent marker placement on the participants' trunks and upper extremities, markers were strategically placed on bony landmarks or placed proportionately between specific bony landmarks. The VMC system gathered data throughout the	The results indicated there were significant changes in head and trunk stability, reaching, and targeting after 12 weeks of hippotherapy intervention. There were no improvements in the group of children without a disability since they did not participate in intervention. Results indicated that children with CP experienced an increase in motor control of the trunk and head after hippotherapy sessions.

		quadruped- positioned riding. Other movements incorporated into the sessions included upper extremity activities such as ball throwing and reaching, and cognitive games or activities. During the sessions, the horses used were led by a horse leader with experience. Therapists and side walkers ensured safety throughout the duration of the sessions.	hippotherapy sessions.	

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Shurtleff & Engsberg (2010) Changes in trunk and head stability in children with cerebral palsy after hippotherapy: A pilot study.	Level of Evidence: II Study Design: Cohort Participants: N = 12, N = 6 children with spastic diplegia cerebral palsy (CP) and N = 6 with no disability, age = 5-17 years old (group with CP) and age = 7-56 years (group with no disability)	Hippotherapy treatment sessions were conducted by licensed occupational therapist, physical therapist, or occupational therapy assistant. Hippotherapy sessions lasted 45 minutes each on a weekly basis for 12 weeks. During the session, the children engaged in maintaining numerous positions such as forward-facing riding, side-sitting riding, kneeling while riding, backward-facing riding, and quadruped-positioned riding. Other movements incorporated into the sessions included upper extremity activities such as ball throwing and reaching, and cognitive games or activities. During the sessions, the horses	Video motion capture (VMC)- This video motion capture software was utilized to generate an image in which was able to be rotated in all planes to observe movement from various viewpoints. Markers were placed in numerous areas to gather and transmit data from one another in order to provide images. To ensure consistent marker placement on the participants' trunks and upper extremities, markers were strategically placed on bony landmarks or placed proportionately between specific bony landmarks. The VMC system gathered data throughout the hippotherapy sessions.	The results indicated angular excursion of the head was reduced in children with CP after hippotherapy sessions. Reductions in translation and rotation of the head occurred after hippotherapy sessions as well and signify improvement in control of trunk and head movement. There were no significant improvements in the group without hippotherapy intervention.

		used were led by a horse leader with experience. Therapists and side walkers ensured safety throughout the duration of the sessions. The 6 children without CP were used as a convenience sample and underwent testing to provide a normative baseline to determine if changes were occurring in a typical direction. This group did not receive any intervention.		

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Antunes et al. (2016) Different horse's paces during hippotherapy on spatio-temporal parameters of gait in children with bilateral spastic cerebral palsy: A feasibility study.	Level of Evidence: II Study Design: Feasibility of a crossover trial Participants: N = 10 children age 5-25 with BS-CP and an age-matched group N = 10 healthy children	Interventions focused on exploring effects of a hippotherapy protocol for children with bilateral spastic cerebral palsy (BS-CP). There were two hippotherapy protocols explored through analyzing walk-trot pace on spatio-temporal parameters and muscle tone in children with BS-CP. Protocol 1 involved the horse's pace being that of a walking pace; and Protocol 2 involved the horse's pace being a walk-trot pace. Before and after each hippotherapy session, gait evaluation and spasticity of the hip adductors were measured.	Modified Ashworth Scale (MAS) Gross Motor Function Classification System (GMFCS) Wireless inertial sensing device Free4Act system	The article concluded that a 30-minute walk-trot protocol directly affected hip adductor spasticity and the basic spatio-temporal gait parameters of children with BS-CP, all at a statistically significant level. The gait parameters considered were cadence, swing phase, rolling phase, and double support percentage of the gait cycle. The three-dimensional movements of a horseback riding simulate the human gait and provide sensorimotor experiences to children with BS-CP.

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Giagazoglou, Arabatzi, Dipla, Liga & Kellis (2012) Effect of a hippotherapy intervention program on static balance and strength in adolescents with intellectual disabilities.	Level of Evidence: II Study Design: Prospective cohort study Participants: N = 19 healthy adolescents with an intellectual disability (ID). Mean age was 15.3 years.	The experimental group followed a 30 minute hippotherapy protocol, two times a week for 10 weeks. The intervention was led by a physical therapist and included activities that gradually increased with difficulty. To begin, each child was positioned in dynamic centered sitting and the horse's walk was in straight lines with slight curves. The first week was focused on familiarization for the horse and rider. The next weeks the client was positioned facing forward, side-sitting, facing backward and also performed therapeutic activities on the moving horse. Other activities included catching, throwing, and placing	EPS pressure platform-Balance AMTI force platform-strength Double-Leg Stance (DLS)- Balance One-Leg Stance (OLS)-Balance	There was significant improvement in the client's ability to balance on one leg after the hippotherapy intervention. The results of this study provide strong evidence for improved lower limb strength in clients with ID resulting in observed balance and strength adaptations. Overall, the results of this study indicate that hippotherapy intervention is considered an effective intervention for increasing strength and balance for clients with an ID.

		balls, rings and toys while on the moving horse. Also stretching activities such as reaching forward up to the neck of the horse, stretching down to touch his/her feet or reaching back while on the moving horse took place. Sessions employing protocol 1 involving walking and halting sequences, while sessions utilizing protocol 2 consisted of a halt, walk, fast walk, trot sequence. The gait parameters considered were cadence, swing phase, rolling phase, and double support percentage of the gait cycle.		

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Kwon et al. (2011) Effects of hippotherapy on gait parameters in children with bilateral spastic cerebral palsy.	Level of Evidence: II Study Design: Nonrandomized prospective controlled trial. Participants: N = 32 children with bilateral spastic cerebral palsy and a gross motor function classification level of 1or 2.	Clients were placed in either the conventional-physiotherapy control group or the hippotherapy-plus-conventional-physiotherapy group. Hippotherapy sessions were led by an AHA trained and certified physical therapist. The children in the hippotherapy plus physiotherapy group received 30 minutes of hippotherapy twice a week for 8 weeks (16 sessions) in addition to conventional physiotherapy. The horses that were used were paired with a child based on size and functional status. A fleece pad was used. Side walkers walked alongside the horse and only helped as needed. The activities were chosen based on the	Vicon 612 Motion Analysis System using plug in gait marker system to analyze gait. *Primary*: Stride length, cadence, single limb support and walking speed. *Secondary*: Pelvic and hip kinematics GMFM-88 Modified Berg Balance Scale	The results of the hippotherapy group compared to the control group show improved pelvic anterior tilt after the hippotherapy intervention. There was a significant increase in scores for the GMFM-88 dimension E of walking, running and jumping for the hippotherapy group. In the hippotherapy group, stride length increased significantly, with no change in cadence. In contrast, in the control group, cadence increased. According to this study hippotherapy used in conjunction with conventional physical therapy can help improve gait and balance in children with bilateral spastic CP.

		client and included muscle relaxation, postural alignment, independent sitting and active exercises such as stretching, strengthening, dynamic balance and postural control. The control group received 30 minutes of neurodevelopmental therapy twice a week from licensed physical therapists.		

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Park,Wook Rha, Shin, Kim, & Jung (2013) Effects of hippotherapy on gross motor function and functional performance of children with cerebral palsy.	Level of Evidence: II Study Design: Cohort Participants: N = 34 children age 3–12 years who have spastic CP. 21 additional children with CP were recruited as a control group.	Hippotherapy sessions were led by an AHA certified occupational therapist. The sessions occurred for 45-minutes, two times per week for 8 weeks. The activities were aimed at developing the child's sensorimotor and perceptual-motor skills while seated on the horse. A side walker walked next to the horse to assist the child as needed. The child was encouraged to move in a forward and upward reaching direction to encourage active postural control, trunk strength, balance and trunk/pelvic dissociation.	GMFM- Measures capacity for gross motor function. The Pediatric Evaluation of Disability Inventory-Functional Skills Scale (PEDI-FSS)	Compared to the control group there was significant improvement in gross motor skills after hippotherapy intervention protocol for children with spastic CP. The results of this study indicate that greater improvements in PEDI scores observed suggest that hippotherapy helps children to engage more meaningfully in the functional activities of daily life.

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Benda, McGibbon, & Grant (2003) Improvements in muscle symmetry in children with cerebral palsy after equine-assisted therapy (hippotherapy).	Level of Evidence: II Study Design: Nonrandomized Pre-/post-test with control group Participants: N = 15 children ranging from 4 to 12 years of age diagnosed with spastic cerebral palsy.	A trained therapy horse was chosen according to stride length. The child was mounted on the horse sitting forward to begin. A horse handler led the client around a track at a steady speed and pace. The client was led clockwise for 4 minutes and then counter clockwise for another 4 minutes. A physical therapist and a side walker walked alongside the horse for security but not to stabilize the client. A stationary barrel was made from a 55-gallon drum approximating the girth of a horse and was covered with a fleece pad. The clients who were randomly assigned to the "barrel group" sat astride the barrel, as they would	Remote surface electromyography (EMG)- Electrodes used on left and right side muscle groups	The results of this study indicate that eight minutes of hippotherapy resulted in improved symmetry in muscle activity in children with spastic cerebral palsy. The mean change in asymmetry scores was 55.5 for the children in the hippotherapy protocol, and 11.9 for the children in the barrel protocol *Perfect symmetry=100

		have on a real horse, with the identical team of three assistants in place. The client watched a hippotherapy video while sitting astride the barrel for 8 minutes.		

Level III:

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Champagne, Corriveau, & Dugas (2016) Effect of hippotherapy on motor proficiency and function in children with cerebral palsy who walk.	Level of Evidence: III Study Design: Prospective quasi-experimental ABA design study Participants: N = 13 children age 4-12 years old with cerebral palsy classified level 1 or 2 by the gross motor function classification system.	The sessions were conducted by an occupational therapist with 10 years hippotherapy experience. The children received 30 minute hippotherapy session once a week for 10 weeks. Each child also spent 30 minutes each session preparing the horse and mounting/dismounting the horse. There was a horse handler and two side walkers present for each session. Each child rode the same horse for 10 weeks. The treatment sessions were designed to limit stopping. There were 8 different graded positions that varied in difficulty level and included: forward sitting, backward	Bruininks–Oseretsky Test of Motor Proficiency – Short Form (BOT2-SF) Gross Motor Function Measure (GMFM-88)	The results of this study provide significant evidence that supports the benefits of hippotherapy on gross motor function and suggests that hippotherapy can impact fine motor function for children at GMFCS levels I and II. The results of the BOT2-SF demonstrated increased abdominal and proximal arm strength. Three subtests of the BOT2-SF (fine motor precision, balance, and strength) as well as dimensions D (standing) and E (walking, running & jumping) of the GMFM-88 improved significantly after the intervention phase.

		sitting, side sitting, prone over the barrel of the horse, prone on forearms, quadruped facing backward kneeling facing forward and standing in the stirrups. To increase the challenge activities such as multidirectional reaching, catching and throwing were also included.		

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Sunwoo, Chang, Kwon, Kim, & Kim (2012) Hippotherapy in adult patients with chronic brain disorders: A pilot study.	Level of Evidence: III Study Design: Pre/posttest Participants: N = 8 males with chronic brain disorder, mean age of 42.4 +/- 16.6 years old 5 participants were diagnosed with a stroke, 2 had been diagnosed traumatic brain disorder, and 1 had a diagnosis of cerebral palsy.	Intervention was performed twice per week for 8 weeks in an indoor arena, for a total of 16 sessions. Each session was 30 minutes. During each session, one horse leader held the reins and led the horse in front, while two side walkers held each leg of the participant sitting on the saddle. The participant was held by the leg from both sides in attempt to prevent a fall from the horse, and the side walkers also assisted in facilitating the movements performed on the horse as directed by a physical therapist. Outcomes were evaluated both immediately after therapy and at 8 weeks after hippotherapy	Berg Balance Scale (BBS) Tinetti Performance-Oriented Mobility Assessment 10 Meter Walking Test Functional Ambulatory Category Korean Beck Depression Inventory Hamilton Depression Rating Scale	No significant difference was observed during two baseline assessments conducted before commencement of therapy, reaffirming that no improvements were occurring in the absence of therapy. At the conclusion of therapy, a statistically significant improvement was observed in balance and gait speed, which were sustained for two months after the conclusion of hippotherapy. No difference in emotion was observed in conjunction with the hippotherapy sessions.

		concluded. An additional follow-up set of measurements were taken 2 months after hippotherapy concluded.		

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Casady & Nichols-Larsen (2004) The effect of hippotherapy on ten children with cerebral palsy.	Level of Evidence: III Study Design: Pre/post-test Participants: N = 10 children with cerebral palsy, ages 2.3-6.8 years old	Hippotherapy once weekly for 10 consecutive weeks for 45 minutes each session. The hippotherapy sessions were conducted by a physical therapist. The subjects were each positioned according to their individualized postural ability. The positions utilized included forward facing, rear facing, side facing, modified side sitting, prone, or quadruped. Study subjects were encouraged to maintain postural alignment with symmetry of head, trunk, and lower extremities.	Pediatric Evaluation of Disability Inventory (PEDI) Gross Motor Function Measure (GMFM)	The findings of this study demonstrate a statistically significant treatment effect after the hippotherapy sessions have occurred. The results indicated statistically significant changes were found in the mean of the PEDI total score, GMFM total score, PEDI social score, and GMFM crawling/kneeling scores.

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Moraes, Copetti, Angelo, Chiavoloni, & David (2016) The effects of hippotherapy on postural balance and functional ability in children with cerebral palsy.	Level of Evidence: III Study Design: Pre/post-test Participants: N = 15 children with CP, from 5 - 10 years of age	Sessions were led by a physical therapist, and each session began with 5 minutes of stretching. After this, with the child seated on the horse, the horse zig-zagged across the arena while varying the tightness of each turn. During this process, the child performed upper limb abduction for 4 minutes. The position of the child upon the horse was also varied, while another activity involved blindfolding the child for various horse trajectories. Another activity involved varying the speed and amplitude of the horse's gait for 5 minutes, while a final activity had the horse climbing and descending hills on both grass and asphalt for 6 minutes.	Berg Balance Scale (BBS) Pediatric Evaluation of Disability Inventory (PEDI)	Dynamic balance was assessed with the BBS, with significantly improved outcomes at the completion of 24 sessions. Additionally, the self-care and social function scores from the PEDI assessment indicated significant improvements in mobility scores associated with functional skills and caregiver assistance.

		Assessment was performed after 12 sessions and again after 24 sessions.		

Level IV: None included

Level V:

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Wehofer, Goodson, & Shurtleff (2013) Equine assisted activities and therapies: A case study of an older adult.	Level of Evidence: V Study Design: Case study Participants: N = 1 76-year-old woman	The hippotherapy protocol included 45-minute sessions, 10 times over the course of 6 weeks. All sessions were led by a Certified Occupational Therapy Assistant, trained to provide treatment through the AHA. Each session had the participant sitting forward upon the horse and the participant never independently controlled the horse. The horse was led in figure eights, straight lines, cone weaving	Berg Balance Scale (BBS) Activities-Specific Balance Confidence Scale (ABC) Activity Card Sort (ACS) Video Motion Capture (VMC) system	Prior to hippotherapy, the participant reported infrequent falls which did not result in injury (less than once per year), high blood pressure, high cholesterol, and supraventricular tachycardia. Additionally, the participant reported a fear-of-falling (FOF) which significantly impacted participation in daily activities. Improvements in balance on the BBS and ABC were observed, while the

		patterns, and on uneven, outdoor terrain. During these exercises, the participant engaged in exercises such as reaching in various directions without holding the horse for balance. Speed changes, abrupt starting and stopping, and variations in gait were also part of the hippotherapy routines.		participant also reported decreases in chronic back pain, from a self-reported 5/10 pain level to a 0-2/10 pain level. She also reported less fatigue and no longer needed to take breaks to recover from back pain during activities. Additionally, she reported greater ability to recover from a fall, as well as less FOF, which led to greater engagement in daily activities.

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Gilliland & Knight (2012) Friedreich's ataxia and gait changes through participation in therapeutic horseback riding.	Level of Evidence: V Study Design: Case study Participants: N = 1 39-year-old male with clinical diagnosis of Friedreich's Ataxia (FA)	Hippotherapy sessions were provided to an individual in 30 - 45 minute sessions for 6 weeks, after which there was an approximately 5-month cessation in therapy. After this, a subsequent 6-week course was completed. Specific details of individual sessions were not noted.	Multiple Sclerosis Functional Composite (MSFC) The MSFC is composed of 4 parts; the first is a 9-hole peg test, the second a timed 25-foot walk, while the third is a speech test and the fourth subtest is a vision test. Tueky's LSD-measured stride length Joint angles and stride length were determined from videos of the participant walking.	There was a statistically significant improvement in stride length. This case study found no significant differences in joint angles from any of the pre/post-tests.

Author/Year/Title	Level/Design/Participants	Intervention	Outcome Measures	Results
Erdman & Pierce (2016) Use of hippotherapy with a boy after traumatic brain injury: A case study	Level of Evidence: V Study Design: Case study Participants: N = 1 male 13 year old with traumatic brain injury	The subject participated in 12, 45 minute hippotherapy sessions with a physical therapist over a 13-week period. Each session consisted of a warm-up, which involved facing forward on a pad or in a saddle while the horse is walked forward. Acceleration and deceleration activities were completed as well as riding in circles of varying diameters and figure 8 patterns. The participant's position on the horse was altered often throughout the session. Active exercises such as unilateral upper extremity weight	Pediatric Balance Scale (PBS) Dynamic Gait Index (DGI) Gross Motor Function Measure (GMFM) Self-Selected Gait Speed	The authors noted the participant demonstrated improvements in his PBS and DGI scores, and his gait speed. Improvements were noted in balance, strength, gross motor skills, gait speed, functional mobility, and reported participation. In regards to the GMFM, the participant experienced improvements in jumping skills, which the authors attributed to improved core strength.

		bearing and repeated sit to stand were completed each session. The cool-down was composed of seated forward-facing riding of the horse.		

Themes

Client Factors

Client factors from the Occupational Therapy Practice Framework (OTPF) expressed in the literature analyzed can be attributed to the neuromusculoskeletal and movement-related functions category. One level I pre/posttest randomized control trial and one level II non-randomized pre/post-test concluded children with cerebral palsy demonstrated improved muscle symmetry after a sequence of standard hippotherapy sessions (McGibbon, Benda, Duncan, & Silkwood-Sherer, 2009; Benda, McGibbon, & Grant, 2003). Improved muscle symmetry is categorized within neuromusculoskeletal and movement-related functions; more specifically, it is broken down into the muscle tone component of muscle function (AOTA, 2014). An additional level I randomized control trial resulted in improved lateral deviation of the spine, trunk imbalance, pelvic tilt, and surface rotation after hippotherapy intervention for children with spastic cerebral palsy (El-Meniawy & Thabet, 2012). Improvements in lateral deviation of the spine, trunk imbalance, pelvic tilt, and surface rotation increase postural alignment, which falls within the OTPF's category of stability of joint functions related to neuromusculoskeletal and movement-related functions (AOTA, 2014). Similar to the findings from El-Meniawy and Thabet (2012), two level II cohort studies had results which provide evidence suggesting a significant improvement in head and trunk stability and control of movement after hippotherapy intervention in children with spastic cerebral palsy, in turn leading to enhancement in the stability of joint functions (Shurtleff, Standeven, & Engsberg, 2009; Shurtleff & Engsberg, 2010). Further evidence tying hippotherapy intervention to improvements in the stability of joint functions are found in a level II

cohort study which found significant reduction of excursion, translation, and rotation of the head in children with spastic cerebral palsy after hippotherapy intervention (Shurtleff & Engsberg, 2010). In a level II feasibility study of a crossover trial, Antunes et al. (2016) found a significant reduction in hip adductor spasticity after hippotherapy intervention, which is associated with degree of muscle tone. Although there were no specific outcome measures in this study related to sensorimotor client factors, another conclusion of Antunes et al. (2016) was hippotherapy intervention has the ability to provide sensorimotor experiences to children with bilateral spastic cerebral palsy.

According to the OTPF, improvements in strength are categorized with muscle power functions, which are a neuromusculoskeletal and movement-related function (AOTA, 2014). A level II prospective cohort study resulted in significant improvement of lower leg strength for adolescents with intellectual disabilities after hippotherapy intervention (Giagazoglou, Arabatzi, Dipla, Liga, & Kellis, 2012). Congruent with previous findings, Champagne, Corriveau, and Dugas (2016) conducted a level III prospective quasi-experimental ABA study focusing on children with cerebral palsy and noted an increased abdominal and proximal arm strength post-hippotherapy intervention. Moreover, one level V case study of an individual with a traumatic brain injury noted significant improvements in core strength following hippotherapy intervention (Erdman & Pierce, 2016). In a level I randomized control trial conducted by Kwon et al. (2015), hippotherapy sessions led to improvements in balance in children with various forms of cerebral palsy, and this same finding was noted in a level III prospective quasi-experimental ABA design study (Champagne, Corriveau, & Dugas, 2016).

Balance is determined to be a sensory function according to the OTPF, specified further to be a vestibular function, which is a client factor. Improvements in balance increase sensory function, enhancing overall occupational performance. Notwithstanding their findings relating strength gains to hippotherapy intervention, Giagazoglou, Arabatzi, Dipla, Liga, & Kellis (2012) also found significant improvement in balance after hippotherapy intervention for a client with an intellectual disability. Furthermore, a level III pre/posttest study found significant improvement in balance for adults with chronic brain disorders after hippotherapy intervention, which was sustained for 8 weeks after treatment ended (Sunwoo, Chang, Kwon, Kim, & Kim, 2012). Moraes, Copetti, Angelo, Chiavoloni, and David (2016) conducted a level III pre/post-test and indicated a significant improvement in dynamic balance in children with cerebral palsy. Overall improvements in balance were identified by Wehofer, Goodson, and Shurtleff (2013) in two level V case studies, one of which was specific to an older adult female, and one regarding an individual with traumatic brain injury conducted by Erdman and Pierce (2016). Related to balance are gait patterns, categorized in the OTPF as a movement function within the realm of neuromusculoskeletal and movement-related functions (AOTA, 2014). Improvements in gait patterns affect one's ability to engage in daily occupations. Sunwoo, Chang, Kwon, Kim, and Kim (2012) found increases in gait speed in participants with chronic brain disorders and emphasized maintained results for 8 weeks post-hippotherapy intervention. A level V case study showed statistically significant improvement in stride length, a component of gait patterns, for an adult with Friedreich's Ataxia after hippotherapy intervention (Gilliland & Knight, 2012). Erdman

and Pierce (2016) concluded improvements in gait speed after hippotherapy sessions as well.

Although not explicitly outlined in the OTPF, fine and gross motor skills undoubtedly affect occupational performance as a whole and are clearly highly applicable to the category of client factors. Fine and gross motor skills are categorized under control of voluntary movement, a client factor specific to movement function. Kwon et al. (2015) found significant improvements in gross motor functioning in the areas of jumping, standing, crawling and sitting in children with cerebral palsy after hippotherapy intervention. A subsequent level II cohort study indicated significant improvements in gross motor function in general after hippotherapy intervention in children with spastic cerebral palsy (Park, Wook Rha, Shin, Kim, & Jung, 2013). Complementary to the findings of Kwon et al. (2015) and Park, Wook Rha, Shin, Kim, and Jung (2013), McGibbon, Benda, Duncan and Silkwood-Sherer (2009) noted an ability of the study subjects to maintain improved gross motor function after 12 weeks post-hippotherapy treatment. Providing evidence of further benefit of hippotherapy on motor skills, Champagne, Corriveau, and Dugas (2016) found significant improvements in gross motor function, specifically pertaining to walking, running, jumping, and standing. Also finding generalized gross motor functioning improvements, Casady and Nichols-Larsen (2004) conducted a level III pre/post-test which specified additional improvements in crawling and kneeling were present after engagement in hippotherapy intervention while Erdman and Pierce (2016) noted increased jumping ability post-hippotherapy intervention. Further breaking down the category of motor skills, fine motor skills refer to precise movements of the body and are often attributed to the OTPF's term

manipulation, which falls under the motor skill of coordination. According to results found by Champagne, Corriveau, and Dugas (2016), hippotherapy intervention has the ability to improve fine motor function in children with cerebral palsy.

Performance Skills

Similarly to client factors, the OTPF identifies performance skills that may be addressed through the use of hippotherapy. "Performance skills are observable elements of action that have an implicit functional purpose" (AOTA, 2014, p. S25). Motor skills are defined in the OTPF as a specific performance skill related to moving while simultaneously interacting with a task, environment, and/or object (AOTA, 2014). Shurtleff, Standeven, and Engsberg (2009) found significant improvements after hippotherapy intervention in reaching and targeting. In relation to the OTPF motor skills, targeting while mounted on a moving object involves stabilization and alignment of an individual's body, indicating improvements in these areas increase overall motor function. Additionally benefiting overall motor function, reaching is defined as the motor skill of extending one's arm to effectively grasp an object (AOTA, 2014). Broadening the scope of motor skills addressed in hippotherapy literature, functional mobility is a motor skill relating to an individual moving his or her body in space in a purposeful manner (AOTA, 2014). According to Erdman and Pierce (2016) and Moraes, Copetti, Angelo, Chiavoloni, and David (2016), significant improvements in functional mobility were noted after hippotherapy intervention.

Outcomes

According to the OTPF, outcomes are defined as "the end result of the occupational therapy process; they describe what clients can achieve through

occupational therapy intervention" (AOTA, 2014, p. S34). Although no OT-specific outcomes were addressed in the literature, conclusions can be drawn on how these results could be achieved utilizing hippotherapy in OT intervention. Relevant outcomes discussed in the OTPF include occupational performance, prevention, participation, role competence and quality of life (AOTA, 2014).

Occupational performance is defined as an individual's ability to participate in daily areas of occupation (AOTA, 2014). Occupational performance is further divided into improvement and enhancement (AOTA, 2014). Improvement is the OTPF terminology used when a performance deficit is present but with decreased severity after intervention, while enhancement is used when a performance deficit is not present, yet performance increases (AOTA, 2014). Increases in client factors and performance skills resulting from intervention with a horse may lead to improvement or enhancement in overall occupational performance. There are various occupational performance components from the framework that relate to hippotherapy practice. There are eight areas of occupation in the OTPF, and hippotherapy indirectly influences each area, but can directly affect the occupations of activities of daily living (ADLs) and instrumental activities of daily (IADLs). Through skilled hippotherapy intervention, clients are able to make improvements in their physical health and overall function, which may influence life roles and participation in ADLs and IADLs, amongst other areas of occupation.

Prevention related to occupational therapy practice is focused on reducing risk factors and promoting healthy lifestyles (AOTA, 2014). Hippotherapy intervention has the opportunity to be utilized as a preventative measure for individuals that need to maintain their physical health for engagement in everyday occupation. The literature

supports the effectiveness of hippotherapy intervention for not only improving function, but also maintaining physical function over time (Chang, Kwon, Kim, & Kim, 2012; McGibbon, Benda, Duncan & Silkwood-Sherer, 2009). Maintaining physical function will prevent further impairment and reduce the incidence of unhealthy risk factors. Sustaining improvement of physical benefits over time may increase engagement in occupation and decrease hospital readmission rates, which decreases overall healthcare costs. For example, a child with cerebral palsy would benefit from regular hippotherapy sessions in order to maintain physical benefits such as strength, balance, muscle symmetry and decreased spasticity, which will prevent further worsening of physical impairment.

Role competence is defined in the OTPF as an individual's ability to effectively meet specific role demands relevant to the client (AOTA, 2014). Roles contribute to forming an individual's occupational identity and provide a sense of self-worth. Through hippotherapy intervention, one may experience an improved sense of self-worth as a result of the benefits experienced, hence increased participation in roles. For example, an adult mother who has sustained a stroke could experience increased muscle strength post-hippotherapy, enhancing her ability to effectively participate in her role as a mother. Role competence is a component of health functioning, which both contribute to overall quality of life (AOTA, 2014).

Quality of life is referred to as one's perceptions of his or her life satisfactions (AOTA, 2014). Various factors contribute to an individual's quality of life. First, self-concept consists of feelings about oneself, while health functioning refers to health status, self-care abilities, and role competence (AOTA, 2014). Literature qualitatively expressed

improvements in self-care ability, self-competence, and self-esteem post hippotherapy sessions, but no specific quantitative outcome measurements were evident. Hippotherapy intervention has the ability to improve an individual's perceptions of life satisfactions, leading to enhanced quality of life.

Chapter V: Summary

The purpose of this scholarly project was to explore existing research on hippotherapy and occupational therapy's role in utilizing hippotherapy in physical rehabilitation. There was a total of six databases searched throughout the systematic review process and they included: PubMed, CINAHL, PsychINFO, SPORTDiscus, Cochrane, and Scopus. Some key information found throughout the process includes themes identified through analyzing 17 articles, which were determined to fit all inclusion criteria and included in the systematic review. Themes identified were client factors, performance skills, and occupational therapy outcomes.

Limitations of this study include the researchers' lack of familiarity with the systematic review process, interpretation of high level evidence, time constraints, access to specific databases, and exclusion of the term physiotherapist. To address familiarly with the systematic review process and interpretation of high level evidence, more time would be beneficial to gain comfort with these processes, and involvement of a librarian is highly recommended to reduce this limitation in the future. We recommend more time be allowed for completion of systematic reviews or studies utilizing information found in this systematic review. Increases in access to databases would be useful in ensuring all relevant information has been obtained. We also recommend more research pertaining to the term physiotherapist and when it is acceptable to be used and when it is not appropriate due to variations in educational requirements across the globe. Overarching recommendations for future studies include conduction of more quantitative level I

research studies, an increase in studies conducted by OTs in which emphasize occupational performance and have occupation-based outcome measures, and studies pertaining to a wider variety of populations and conditions.

This scholarly project contributes to highlighting the need for further research in this area and serves to increase awareness of the lack of OT literature relating hippotherapy and physical rehabilitation. Through this study, we strived to increase acceptance of hippotherapy among healthcare professionals while outlining the existing literature which expressed increases in overall physical function after hippotherapy sessions. This systematic review has the potential to be utilized in creation of hippotherapy programs or further research regarding hippotherapy and occupational therapy.

In conclusion, there is a lack of OT-specific hippotherapy literature, but there is evidence to support the efficacy of utilizing hippotherapy in physical rehabilitation. There were significant physical health improvements found in the 17 articles included in the systematic review. There is opportunity for growth in the hippotherapy field, and the positive benefits have been documented to be applicable to numerous populations, although further research expanding these populations would be of significant value to healthcare professionals. Further scholarly potential of this project include possible publication, which would contribute to the expansion of OT's role in hippotherapy. This scholarly project provides documentation of foundational knowledge and OT involvement in hippotherapy.

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