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Prevention of Falls in Adults Older than 60 Years through Therapeutic Riding: A Critically Appraised Topic

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Focus Question

Does therapeutic riding (either traditional or simulated) increase balance and postural control for adults older than 60 years old to prevent falls in desired occupations such as activities of daily living (ADLs), instrumental activities of daily living (IADLs) and health management?

Introduction

This critically appraised topic paper will address the focus question relating to the intervention of therapeutic riding. A critically appraised topic (CAT) is an overview of scientific literature about an intervention or practical issue and how it relates to practice (Barends et al., 2017). The use of the Ecological Human Performance (EHP) model is to guide this CAT research with a theoretical basis. EHP was chosen for its emphasis on the person, environment, and tasks. The person is described in EHP as including their experiences, sensorimotor, cognition, and psychosocial abilities (Dunn et al., 1994). The use of EHP provides a holistic and comprehensive approach to understand the context and person relating the intervention of therapeutic riding.

Clinical Scenario

According to the Center for Disease Control and Prevention, more than one out of four older people fall each year (2017). Over 800,000 patients are hospitalized per year because of falls, with insurance companies such as medicare and medicaid shouldering 75% (of $50 billion) of the costs (Center for Disease Control and Prevention, 2017). The focus population for this CAT is older adults aged 60 years and older including adults with health conditions and healthy adults. The increase of adults older than the age of 65 is rapidly growing with 49 million (15%) of the U.S. population in 2016 and a suspected increase to 71million (21.7%) by 2030 (Centers For Disease Control and Prevention, 2020). Due to this rapid increase in the 65+ population, fall prevention will become more precedent. Furthermore, adult conditions were included to see the benefits of riding therapy for implications to the general older adult population.

Hippotherapy is an intervention strategy that utilizes many disciplines such as physical, occupational, and speech therapy and uses the gait and movement of a horse to provide motor and sensory input to improve patient physical conditions (Koca & Ataseven, 2016; Uchiyama et al., 2011). In contrast, therapeutic riding is beneficial for the purpose of contributing positively to the cognitive, physical, emotional, and social wellbeing of individuals (Smith, n.d.). In the past, hippotherapy has been utilized solely because of its emphasis with physical improvements, however, therapeutic riding's utilization of cognitive, emotional, and social well-being (as well as physical) allows for a more overarching approach when working with clients. Although there is little research with adults older than 60 years old, individuals with developmental delays and mental health needs have shown improvement physically, mentally, and emotionally from therapeutic riding therapy (Hawkins et al., 2014; Champagne & Dugas, 2010; Johnson et al., 2018). Although there are discrepancies in construct definitions, within this CAT, therapeutic riding and equine-assisted therapy are synonymous.

The culture of most older adults is to remain independent in their own home. Therapeutic riding is an intervention that needs more research for the value of promoting independence as well as strengthening balance and postural control with older adults in completing occupations like ADLs, IADLs, and health management. EHP framework looks at a

person in their context and what tasks are available to them (Dunn et al., 1994). EHP can offer insight on how therapeutic riding therapy may increase a participants' performance range and tasks available to them which can result in increased independence.

Purpose Statement

The purpose of this critically appraised topic is to understand if therapeutic riding will increase the performance range in occupations like ADLs, IADLs, and health management in adults older than 60 years old due to increase in performance skills (balance and posture control) (Dunn et al., 1994). This idea would allow adults over the age of 60 years to live in their home longer and engage in meaningful occupations, with satisfaction of their performance and of their choosing. Analysis to understand if therapeutic riding produces a reduction of falls would prove if there is improvement in strength, balance and postural control.

Search Strategy Methodology

The initial literature search was completed March 1st, 2021- March 8th, 2021. The databases that were used for the article search were CINAHL and PubMed. CINAHL and PubMed are databases that have studies that are related to healthcare, biomedics, and health sciences. These databases were chosen because of the wide range of multidisciplinary studies that are pertaining to therapeutic riding. These databases are not occupational therapy specific, however therapeutic riding is multidisciplinary so understanding other disciplines with therapeutic riding can enhance its applicability to occupational therapy. Studies were searched using various combinations of the following key terms: *therapeutic riding, equine therapy, hippotherapy, equine-assisted, riding therapy, occupational therapy, balance, gait, core strength, posture,* and *adults.*

Inclusion criteria for studies in this CAT were research studies with participants who were aged 60 years old and older. Originally, studies were only included if the older adults did not have pre-existing health conditions. However, after further analysis, the criteria were widened to include adults with motor difficulties because of the rationale that older adults with motor diagnoses benefit from therapeutic riding, so would healthy community-dwelling older adults. Studies were included if they analyzed both the physical and mental aspects of the riding intervention. In addition, studies were included if the terms therapeutic riding therapy, hippotherapy, equine-assisted therapy, riding therapy, and simulated riding therapy were used.

The exclusionary criteria include individuals who are younger than 60 years old as our population of interest was adults who are older than 65 years old. Studies were also excluded if the therapeutic riding programs were administered solely for the purpose for mental or emotional health reasons. Studies were excluded from the study if they were older than 20 years to maintain clinical relevance.

Study Designs and Studies Retrieved

Ten studies were analyzed for synthesis. The studies included an emphasis on older adults and the intervention of riding therapy to benefit balance and postural control. Two studies used systematic review design that is a level I research design (Hilliere et al., 2018; Stergiou et al., 2017). Four studies involved a control trial, some were level I randomized control trials, others not randomized at a level II research study (Arujo et al., 2011; Beinotti et al., 2013; Homnick et al., 2015; Kim & Lee, 2015). Wehofer et al. (2013) was a case study, Dopking

(2003) involved a single subject design, Homnick et al. (2013) is a pretest-posttest single group trial, and Borges de Araujo et al. (2019) was quasi experimental design at a level III design.

Synthesized Summary of Key Findings

Conditions of populations

In the studies synthesized, the desired population analyzed were adults who are older than 60 years old. Studies found looked at the benefits of therapeutic riding for adults over 60 years old with no chronic health conditions or no severe sensory limitations (Ajaujo et al., 2011; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Wehofer et al., 2013). The remaining studies retrieved included adults older than 60 with diagnoses of Alzheimer Disease, Stroke, or Parkinson's (Beinotti et al., 2013; Borges de Araujo et al., 2019; Dopking, 2003). These populations were included to gain a more holistic view of the older adult population. Eighty-five percent of adults over the age of 65 years old have at least one chronic condition, and 60% of adults older than 65 years old have two chronic conditions (Center for Disease Control of Prevention, 2017).

Intervention

Interventions ranged from exercises and type of horse or simulation horse used, to amount of sessions a week. Most studies had a brief outline of exercises performed such as using horse gait speeds and riding a horse on different surfaces (Ajaujo et al., 2011; Borges de Araujo et al., 2019; Hilliere et al., 2018; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Stergiou et al., 2017; Wehofer et al., 2013). Only two studies included horse simulation as the intervention type of riding therapy (Hilliere et al., 2018; Kim & Lee, 2015). Some studies used mounting the horse as part of the intervention exercise (Dopking, 2003; Homnick et al., 2013; Homnick et al., 2015). Most studies ranged in amount of minutes per session, however the length of the study sessions consistently ranged from 8 weeks to 12 weeks long (Ajaujo et al., 2011; Borges de Araujo et al., 2019; Hilliere et al., 2018; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Stergiou et al., 2017; Wehofer et al., 2013). Beinotti et al. (2013) and Dopking (2003) included sessions that varied due to the study design and/or participants capabilities. Implication for future interventions, the average time appears to be 30-minute sessions, for once or twice a week for about eight weeks (Ajaujo et al., 2011; Borges de Araujo et al., 2019; Hilliere et al., 2018).

Study results

The synthesis done in retrieved studies was primarily on the improvement of standardized balance scores and/or the improvements made in Quality of Life (QoL) indicators (Ajaujo et al., 2011; Beinotti et al., 2013; Borges de Araujo et al., 2019; Dopking, 2003; Hilliere et al., 2018; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Stergiou et al., 2017; Wehofer et al., 2013). Some studies indicated that the intervention of therapeutic riding is a safe and effective form of exercise for older adults (Dopking, 2003; Homnick, 2015). The type of intervention may be a safety concern for populations with severe conditions, however some studies did a screening as part of the inclusion/exclusion criteria for their participants (Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Wehofer et al., 2013).

Following intervention, balance was reevaluated to document if there was improvement in the participants of the study. Several different assessments were utilized in the studies

retrieved including the Timed Up and Go Test (TUG), Berg Balance Scale (BBS), and Fullerton Advanced Balance Scale (FABS), Activities-Specific Balance Confidence Scale (ABC), and increased muscle activation (Hilliere et al., 2018; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Wehofer et al., 2013). Dopking (2003) did a single-subject design where 75% participants show improvement in balance. The participants showed an improvement in their functional capabilities regarding balance in the TUG test with a decrease in the performance time (Araujo et al. 2011; Borges de Araujo et al. 2019). Participants also showed improvement in their balance scores on the BBS scale (Homnick et al., 2013; Homnick et al., 2015; Wehofer et al., 2013), however, in studies where both the BBS and the FABS were administered, the FABS produced more significant results (Homnick et al., 2013; Homnick et al., 2015). The FABS is "a validated test of static and dynamic balance and is especially suited to higher functioning individuals with slightly more challenging tasks", meaning improvement on this balance test could translate to more independence in desired occupations (Homnick et al., 2013, p. 623). Wehofer et al. (2013) and Dopking (2003) also administered the ABC or unspecified confidence scale to have a greater understanding of balance confidence, which also showed improvement by greater than 10%. Finally, muscle activation and limits of stability significantly increased in participants that received horse riding therapy intervention compared to the group that did not receive horse riding services (Kim & Lee, 2015).

Therapeutic riding programs offer not only the physical benefits of improvement in coordination, muscle tone, and postural alignment, but also improvements in mental and emotional wellbeing (Stergiou et al., 2017). These benefits were evident in the findings of quality of life (QoL) indicators. Improvements in QoL translated to higher mental health status, confidence, and functional and physical abilities (Beniotti et al., 2011; Beniotti et al., 2013). After intervention, perception of health in participants showed improvement and overall safety awareness within participants was heightened (Homnick et al., 2011; Homnick et al., 2013). Although one study did show decline of self-efficacy and confidence, it was hypothesized to be due to progression of their conditions and not the effect of the intervention (Dopking, 2003).

Limitations

The most substantial limitation of the studies retrieved was small sample size (Araujo et al., 2011; Beniotti et al., 2013; Borges de Araujo et al., 2019; Dopking, 2003; Kim & Lee, 2015; Homnick et al., 2013; Homnick et al., 2015; Wehofer et al., 2013). Due to small sample size, even with notable improvement in balance scores or QoL indicators, statistical significance was difficult to reach (Araujo et al., 2011; Dopking, 2003; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Wehofer et al., 2013). Control groups were hard to maintain due to the ethics of withholding treatment, as participants receiving traditional (non-THR) intervention could still show improvement in desired outcomes (Homnick et al., 2013; Homnick et al., 2015). Intervention timelines were not consistent throughout studies, however most hypothesized that with longer intervention time and larger sample size would show more improvement in the constructs analyzed (Beniotti et al., 2013; Borges de Araujo et al., 2019; Homnick et al., 2013; Homnick et al., 2015). Finally, previous fall history, medical history, nutrition history, and medication history were not always obtained (Araujo et al., 2011; Borges de Araujo et al., 2019). Certain populations were stated to be "too healthy" and therefore that's why there was no statistical significance (Homnick et al., 2015).

The Need for More Research

The need for further research is evident when it comes to research on therapeutic riding for fall prevention in adults older than 60 years old. From the studies retrieved, statistical significance was difficult to achieve due to small sample sizes, which therefore affected effect size (Araujo et al., 2011; Dopking, 2003; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Wehofer et al., 2013). Therapeutic riding and hippotherapy as interventions has proven successful for people with neuromotor, developmental, physical, and mental disabilities, however, many of the success indications from those populations is unclear with the 60+ population for prevention (Homnick et al., 2013; Homnick et al., 2015; Stergiou et al., 2017). Further research with larger sample size and longer intervention is recommended for clearer understanding of therapeutic ridings benefits. There is a need for further research on healthy adult populations as well to have a diverse population for the prevention of falls. Finally, studies with a more rigorous design are needed. Only half of the studies were at level one for levels of evidence in research design (Beniotti et al., 2013; Kim & Lee, 2015; Hilliere et al., 2018; Homnick et al., 2015; Stergiou et al., 2017).

Clinical Applicability

Adults older than 60 years old have an increased risk of falls due to poor postural control and balance (Center of Disease Control and Prevention, 2020). Therapeutic riding has improved postural control, balance, emotional well-being, and quality of life for individuals with neuromotor, developmental, and mental disabilities; however, little research has been done on the benefits of therapeutic riding in adults older than 60 years old in the prevention of falls (Hawkins et al., 2014; Champagne & Dugas, 2010; Johnson et al., 2018). The population of older adults is growing and more likely to have chronic conditions (Center of Disease Control and Prevention, 2020; Ory, 2020). In addition, people are living longer into retirement and find meaning in volunteering and giving back to the community (Ory, 2020). The goal of occupational therapy is to find meaningful interventions that are client-centered and therapeutic riding could be that for this population (Ball et al., 2013).

The EHP model was utilized throughout this study to look at the environment and the tasks available to the person based on their skills and abilities (Dunn et al., 1994). This is found in the studies chosen for this synthesis to determine what the clients in the studies were capable of and if they qualified for therapeutic riding intervention. It was mentioned that studies used screenings as part of the criteria for their participants to engage in therapeutic riding (Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Wehofer et al., 2013). The participants involved in the studies included had a performance range that matched the tasks available to them.

Although there is a need for more research, the studies retrieved showed results indicating that therapeutic riding improves balance and postural control in most participants. Many of the studies retrieved concluded that therapeutic riding can be an intervention that addresses the need for improvements in balance and/or quality of life in older adults (Araujo et al., 2011; Beniotti et al., 2013; Borges de Araujo et al., 2019; Dopking, 2003; Hilliere et al., 2018; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Stergiou et al., 2017; Wehofer et al., 2013). The articles ranged from randomized control trials, nonrandomized level II studies, single study pretest posttest, quasi-experimental design, and a case study. Being first year occupational therapy students, the array of levels of evidence in the studies, and the wide

inclusionary criteria that was utilized, bias may be noted and may impact the implications for practice.

Implementation of therapeutic riding for the prevention of falls in adults older than 60 years old would require the expertise of other disciplines, especially physical therapy. Physical therapists are experts in movement and have the ability to improve quality of life through prescribed exercise, hands-on-care, and patient education (American Physical Therapy Association, n.d.). Furthermore, physical therapists address individuals with injury, disabilities, and other health conditions; however, they also work with individuals who want to become healthier and prevent other health implications or disability (American Physical Therapy Association, n.d.). Physical therapists could offer occupational therapists a unique perspective with adults 60 years and older on balance and postural control in relation to their movement before, during, and after therapeutic riding intervention. In contrast, occupational therapists could apply the expertise of movement from the physical therapists to functional occupations that are meaningful to the population. Therefore, the collaboration of occupational therapy and physical therapy with adults older than 60 years old in the prevention of falls through therapeutic riding is warranted.

Balance/postural control and quality of life have the ability to impact participation in the occupations of ADLs, IADLs, and health management. Increase in the quality of life impacts a person's physical and mental health perceptions which then correlates with their gained physical abilities and functional status (Center of Disease Control and Prevention, 2018).

There are currently many different approaches to fall prevention like education, nutrition management, and strength (American Occupational Therapy Association, 2017). Although there are many approaches to implementing fall prevention, the most successful initiatives are those that utilize multifaceted approaches (AOTA, 2017.). Therefore, the utilization of therapeutic riding in conjunction with other methods will make the outcome of decrease in falls more substantial. In turn, the benefits of therapeutic riding for adults older than 60 years may increase participation in ADLs, IADLs, and health management due to outcomes of the intervention. Even with chronic conditions, adults over the age of 60 years can still engage and see benefits in therapeutic riding for prevention.

Occupational therapy utilizes the therapeutic use of occupations to establish/restore, alter, adapt, create, and prevent ailments that interfere with clients' everyday lives (Dunn et al., 1994). Therapeutic riding is an occupation-based activity that can be utilized to incorporate the movement of the horse's gait with clients to improve physical abilities like posture, core strength, and balance in older adults to prevent falls (Uichyama et al., 2011). While only a few studies indicated statistical significance related to balance, therapeutic riding has physical benefits for adults older than 60 in balance, QoL indicators, and/or emotional well-being (Araujo et al., 2011; Beniotti et al., 2013; Borges de Araujo et al., 2019; Dopking, 2003; Hilliere et al., 2018; Homnick et al., 2013; Homnick et al., 2015; Kim & Lee, 2015; Stergiou et al., 2017; Wehofer et al., 2013).This indicates that although there are benefits to therapeutic riding, there needs to be further research to establish therapeutic riding as a preventative measure in occupational therapy for older adults to prevent fall.

References

American Physical Therapy Association. (n.d.). *Becoming a Physical Therapist.* Retrieved May 3, 2021, from https://www.apta.org/your-career/careers-in-physical-therapy/becoming-a-pt#:~:text=Physical%20therapists%20examine%20each%20person,profound%20effect%20on%20people%27s%20lives.

Araujo, T. B., Silva, N. A., Costa, J. N., Pereira, M. M., & Safons, M. P. (2011). Effect of equine-assisted therapy on the postural balance of the elderly. *Brazilian Journal of Physical Therapy*, *15*(5), 414-419. https://dx.doi.org/10.1590/S1413-35552011005000027

Ball, J. E., Ball, C. G., & Kirkpatrick, A. W. (2013). Equine-assisted therapy: Is it safe for our clients. *Occupational Therapy Now*, *15*(3), 9-11. https://www.caot.ca/document/4000/may_Otnow%20MAY%202013.pdf#page=9

Barends, E., Rousseau, D. M., & Briner, R. B. (2017). *CEBMa Guideline for Critically Appraised Topics in Management and Organizations.* Center for Evidence-Based Management. https://www.cebma.org/wp-content/uploads/CEBMa-CAT-Guidelines.pdf

Beinotti, F., Christofoletti, G., Correia, N., & Borges, G. (2013). Effects of horseback riding therapy on quality of life in patients post-stroke. *Topics in Stroke Rehabilitation*, *20*(3), 226- 232. https://doi.org/10.1310/tsr2003-226

Borges de Araujo, T., Martins, W. R., Freitas, M. P., Camargos, E., Mota, J., & Safons, M. P. (2019). An exploration of equine-assisted therapy to improve balance, functional capacity, and cognition in older adults with Alzheimer's disease. *Journal of Geriatric Physical Therapy*, *42*(3), E155- E160. https://doi.org/10.1519/jpt.0000000000000 167

Centers for Disease Control and Prevention. (2020). *Promoting health for older adults.* https://www.cdc.gov/chronicdisease/resources/publications/factsheets/promoting-health-for-older-adults.htm

Champagne, D., & Dugas, C. (2010). Improving gross motor function and postural control with hippotherapy in children with Down syndrome: Case reports. *Physiotherapy Theory & Practice, 26*(8), 564-571. https://doi-org.ezproxylr.med.und.edu/10.3109/09593981003623659

Dopking, E. E. (2003). *Therapeutic Horseback Riding: Novel Interventions in the Treatment of Older Adults with Mild to Moderate Mobility Disability.* University of South Florida.

Dunn, W., Brown, C., & McGuigan, A. (1994). The ecology of human performance: A framework for considering the effect of context. *American Journal of Occupational Therapy*, *48*(7), 595-607. https://doi.org/10.5014/ajot.48.7.595

Hawkins, B. L., Ryan, J. B., Cory, A. L., & Donaldson M. C. (2014). Effects of

Equine-Assisted Therapy on Gross Motor Skills of Two Children With Autism Spectrum Disorder. *Therapeutic Recreation Journal*, *48*(2), 135-149.

Hilliere, C., Collado-Mateo, D., Villafaina, S., Duque-Fonseca, P., & Parraça, J. (2018). Benefits of hippotherapy and horse riding simulation exercise on healthy older adults: A Systematic Review. *PM & R*, *10*(10), 1062–1072. https://doi.org/10.1016/j.pmrj.2018.03.019

Homnick, D. N., Henning, K. M., Swain, C. V., & Homnick, T. D. (2013). Effect of therapeutic horseback riding on balance in community dwelling older adults with balance deficits. *Journal of Alternative & Complementary Medicine*, *19*(7), 622-626. https://doi-org.ezproxylr.med.und.edu/10.1089/acm.2012.0642

Homnick, T. D., Henning, K. M., Swain, C. V., & Homnick, D. N. (2015). The Effect of therapeutic horseback riding on balance in community-dwelling older adults: A pilot study. *Journal of Applied Gerontology*, *34*(1), 118–126. https://doi.org/10.1177/0733464812467398

Johnson, R. A., Albright, D. L., Marzolf, J. R., Bibbo, J. L., Yaglom, H. D., Crowder, S. M., Carlisle, G. K., Willard, A., Russell, C. L., Grindler, K., Osterlind, S., Wassman, M., & Harms, N. (2018). Effects of therapeutic horseback riding on post-traumatic stress disorder in military veterans. *Military Medical Research*, *5*(1), 3. https://doi-org.ezproxylr.med.und.edu/10.1186/s40779-018-0149-6

Kim, S. G., & Lee, J. H. (2015). The effects of horse riding simulation exercise on muscle activation and limits of stability in the elderly. *Archives of gerontology and geriatrics*, *60*(1), 62-65. https://doi-org.ezproxylr.med.und.edu/10.1016/j.archger.2014.10.018

Koca, T., & Ataseven, H. (2016). What is hippotherapy? The indications and effectiveness of hippotherapy. *Northern clinics of Istanbul*, *2*(3), 247-252. https://doi.org/10.14744/nci.2016.71601

HRQOL Concepts | CDC. (2018). Center of disease control and prevention. https://www.cdc.gov/hrqol/concept.htm

Occupational Therapy's and Fall Prevention. (2017). Retrieved March 31, 2021, from https://www.aota.org/About-Occupational-Therapy/Professionals/PA/Facts/Fall-Prevention.aspx#:~:text=The%20most%20successful%20falls%20prevention,maximize%20independence%20for%20older%20adults.

Ory, M. G. (2020). How Will Society Change As The U.S. Population Ages? *Texas A & M University*. Retrieved May 3, 2021, from https://today.tamu.edu/2020/09/28/how-will-society-change-as-the-u-s-population-ages/

Prevent Falls and Fractures. (2015). Retrieved March 31, 2021, from https://www.nia.nih.gov/health/prevent-falls-and-fractures

Smith, C. (n.d.). Learn about therapeutic riding. Path International.

https://www.pathintl.org/resources-education/resources/eaat/198- learn-about-therapeutic-riding

The Surprising Benefits of Senior Horse Therapy. (2017). Retrieved March 31, 2021, from https://www.ngcare.com/archives/the-surprising-benefits-of-senior-horse-therapy/#:~:tex=The%20Surprising%20Benefits%20of%20Senior%20Horse%20Therapy&text=This%20kind%20of%20horse%20therapy,problems%2C%20and%20even%20brain%20injury.

Stergiou, A., Tzoufi, M., Ntzani, E., Varvarousis, D., Beris, A., & Ploumis, A. (2017). Therapeutic effects of horseback riding interventions: A systematic review and meta-analysis. *American Journal of Physical Medicine & Rehabilitation, 96*(10), 717–725. https://doi-org.ezproxylr.med.und.edu/10.1097/PHM.0000000000000726

Uchiyama, H., Ohtani, N., & Ohta, M. (2011). Three-dimensional analysis of horse and human gaits in therapeutic riding. *Applied Animal Behaviour Science, 135*(4), 271- 276. https://doi.org/10.1016/j.applanim.2011.10.0 24

Wehofer, L., Goodson, G., & Shurtleff, T. L. (2013). Equine assisted activities and therapies: A case study of an older adult. *Physical & Occupational Therapy in Geriatrics, 31*(1), 71-87. https://doi.org/10.3109/02703181.2013.766916