

A Systematic Review of the Efficacy of Animal-Assisted Interventions for Neurological Disorders in Adults



P-ISSN: 1680-9300
E-ISSN: 2790-2129
Vol. (26), No. (2)
pp. 99-112

¹ Abeer M. Alsheikly, ² Hadeel E. Hassan, ³ Shahad F. Abass, ⁴ Marwah A. Alfahad

^{1,2,3,4} College of Pharmacy, Mustansiriyah University, Baghdad, Iraq.

Abstract:

Animal-assisted therapy (AAT) has gained increasing attention due to its potential to enhance physical, psychological, and social well-being. In recent years, its application has expanded within clinical rehabilitation settings, including neurological care. This systematic review aims to critically evaluate the effectiveness of animal-assisted interventions in adults with neurological disorders. A comprehensive literature search was conducted across PubMed, Scielo, Embase, and PEDro databases to identify clinical studies examining the impact of AAT on neurological conditions. Studies were selected based on predefined inclusion and exclusion criteria focusing on adult populations, clinical trial designs, and clearly reported outcome measures. From the initially identified studies, seventeen clinical trials met the eligibility criteria and were included in the final analysis. Overall findings indicate that animal-assisted therapy contributes positively to multiple outcome domains, including motor performance, physical functioning, psychological health, and behavioral outcomes across various neurological disorders. The evidence synthesized in this review suggests that animal-assisted therapy represents a promising complementary approach in neurological rehabilitation. These findings provide occupational therapists and rehabilitation professionals with supportive evidence to integrate AAT alongside conventional therapeutic strategies to improve patient outcomes.

Keywords: Animal-Assisted Therapy, Hippotherapy, Equine-Assisted Therapy, Neurological Rehabilitation, Occupational Therapy.

1. Introduction

Human–animal relationships have existed for thousands of years and have played a fundamental role in shaping human society, health, and well-being. Archaeological and historical evidence suggests that early interactions between humans and animals, particularly dogs and horses, evolved from utilitarian

purposes such as hunting, protection, and transportation into complex social and emotional bonds (Dotti, 2005; Levine, 1999). Over time, these relationships extended beyond daily life activities and began to be explored within medical and therapeutic contexts (Dorothea and Maello 2003; Rollin 2006). The intentional use of animals in healthcare settings has been documented since the seventeenth century and has gradually developed into structured therapeutic practices (International Association of Human-Animal Interaction Organizations (IAHAIO, 2013; Filan and Llewellyn-Jones, 2006). Contemporary animal-assisted therapy (AAT) is founded on the premise that interactions with animals can positively influence physical, psychological, emotional, and social

functioning. Animals are believed to facilitate communication, motivation, and emotional engagement, particularly in individuals who demonstrate limited responsiveness to conventional therapeutic stimuli (Llewellyn-Jones, 2006; Marks and McVilly, 2020).

While animal-assisted interventions (AAIs) aim to improve quality of life through entertainment, recreation, and motivation, animal-assisted therapy (AAT) is a targeted intervention where a healthcare professional works with animals to develop and improve participants' social, physical, emotional, and cognitive aspects (Berry et al., 2012; Marcus et al 2012). The use of animals in the diagnosis, treatment, or prevention of human disease is known as animal-assisted therapy (AAT). Another way to look at it is as a goal-oriented intervention, which is used when a therapy procedure relies heavily on an animal that meets specific criteria (Vallejo ,2016).

Multisensory stimulation, physical touch, play, developing affection, reinforcing desired behaviors, and stress reduction are some of the ways AAT works (Gutiérrez et al., 2007; Fine, 2019). While fish, cats, dogs, and horses are the most common animals used in Animal-Assisted Therapy (AAT), any appropriately trained animal, regardless of size, can be helpful depending on the patient. Other acceptable options include birds, rabbits, dolphins, pigs, chickens, and pigs. To help individuals achieve complete well-being, this therapy is mainly designed to be done either individually or in groups (Pereira et al., 2007).

The use of horses and dogs as therapeutic animals is the focus of this comprehensive review. As a kind of therapeutic support, dogs are invaluable in the medical field. In addition, horses play an integral role in equine therapy in three different ways: passive hippotherapy, in which the patient does nothing while the therapist guides rehabilitation exercises; active hippotherapy, which uses neuromuscular exercises to improve balance, postural control, muscle tone, and coordination; and therapeutic riding, a sport-based approach to equine therapy that gives the patient more agency over the horse and encourages them to participate actively in exercises like galloping, jogging, and stepping that are adapted to their

growing abilities.

Anxieties and loneliness are reduced in mental health through animal-assisted therapy (AAT) with dogs, and cardiovascular health is improved through a drop in blood pressure, which means fewer medications are needed in physical health (UCLA Health ,2020). New research shows that having a pet can improve your health in many ways. It lowers your risk of cardiovascular disease, like coronary heart disease, increases your chances of surviving a myocardial infarction, and makes you less reliant on medical services when you're going through tough times.

On the flip side, horses have a number of medicinal uses. The main goal is to improve balance and alignment reactions in order to increase postural control. This is especially important for people who have impaired muscle patterns or delayed antagonist muscle responses, like those with multiple sclerosis or cerebrovascular illnesses. The second goal is to improve human gait, which can be automated until it becomes a natural rhythm because riding a horse mimics human walking (Hansen et al., 2022). Thirdly, we want to make sure that improving muscle tone synchronization when riding. hippotherapy can help with this by stimulating the agonist and antagonist muscles simultaneously, which improves the flow of information between them (Slim et al., 2007). In the end, hippotherapy covers a range of feelings, relationships, and thought processes, and it also has societal advantages (Gomez ,2006).

There are a variety of markers that can be used to evaluate the physiological impacts of human-animal interactions. As an example, research has shown that engaging in pleasant interactions with dogs can reduce stress levels, leading to lower cortisol levels and a much higher increase of oxytocin. Oxytocin is involved in many species' bonding processes, social affiliations, and trust (Nagasawa, 2009). Based on the available evidence, this systematic review aims to investigate the potential benefits of animal-assisted therapy in the field of neurology. Specifically, it will focus on the following diseases: dementia, stroke, spinal cord injury, Parkinson, epilepsy, amyotrophic lateral sclerosis, multiple sclerosis, and others. The clinical manifestations of these disorders, such as impaired

strength, spasticity, selective motor control and balance, and loss of muscle tone, are examined to determine whether the proposed therapy can alleviate these issues.

2. Methods

2.1 Study Design and PRISMA Compliance

This systematic review was conducted in strict accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A complete PRISMA checklist has been provided as supplementary material to ensure transparency and reproducibility. A complete PRISMA checklist has been provided as supplementary material.

2.2 Search Strategy and Timeline

To identify relevant studies, a systematic search was conducted across four major electronic databases: PubMed, Scielo, Embase, and PEDro. The literature search was conducted between January 2010 and June 2021. The search strategy employed a combination of Medical Subject Headings (MeSH) terms and free-text keywords related to animal-assisted interventions and neurological disorders.

The following Boolean search string was used: (('Animal-Assisted Therapy' OR 'AAT' OR 'Animal-Assisted Activities' OR 'AAA' OR 'Hippotherapy' OR 'Equine-Assisted Therapy' OR 'Dog-Assisted Therapy') AND ('Neurological Disorders' OR 'Stroke' OR 'Multiple Sclerosis' OR 'Parkinson's Disease' OR 'Adults')). No initial language restrictions were applied to ensure a comprehensive scope, although the final selection was narrowed down to peer-reviewed clinical trials published in English and Spanish. Additionally, the reference lists of the included studies and previous systematic reviews were manually screened to identify any missed relevant literature.

2.3 Inclusion and Exclusion Criteria

To maintain consistency, the following inclusion criteria were applied:

- 1) Participants: Adults (18+ years) diagnosed with neurological disorders.
- 2) Intervention: Structured Animal-Assisted Therapy (AAT) or Animal-Assisted Activities (AAA).
- 3) Study Design: Clinical trials, including randomized controlled trials (RCTs) and quasi-experimental studies.
- 4) Language: English and Spanish.

2.4 Quality Assessment (Risk of Bias)

The methodological quality and risk of bias of the included studies were independently assessed using the PEDro scale. This scale evaluates 11 criteria, providing a total score out of 10 (the first item is not included in the total score). Studies were categorized based on their scores to ensure the reliability of the synthesized evidence.

2.5 Data Extraction Process

Data extraction was performed independently by two researchers to ensure reliability and minimize bias. A standardized data extraction form was developed and used to collect relevant information from the included studies, including: author and year of publication, study design, participant characteristics (sample size, age, and neurological condition), type of animal-assisted intervention (AAT or AAA), animal species involved, duration and frequency of sessions, and primary clinical outcomes. Any-discrepancies or disagreements between the two reviewers during the extraction process were resolved through discussion or by consulting a third senior reviewer until a consensus was reached.

Table 1 contains the study scores. Using the PEDro scale, which yields an average score of 7 out of 10, the clinical trials and pilot studies were reviewed.

Table 1. The Results Stated in The Studies Used for The Meta-Analysis

Author and Year	Neurological Pathology	Study Design	Participants	Intervention	Outcome Measures	Key Findings	PEDro Score
Bunketorp-Käll et al. (2019)	Stroke	Randomized longitudinal	N=123	Rhythm/music therapy; hippotherapy control, 12 weeks, horses	10MWT;6MWT; M-MAS UAS	Functional performance improved; hippotherapy faster than control.	10-Aug
Menna et al. (2019)	Dementia (Alzheimer's disease)	Randomized longitudinal	N=22	AAT vs control, 3 months, dogs	MMSE; GDS	Reduced cortisol levels in intervention group.	10-Aug
Muñoz-Lasa et al. (2019)	Multiple sclerosis	Non-randomized longitudinal	N=10	Hippocampal intervention vs control, 6 months, horses	T25-FW; MAS; BDI; MSQOL-54	Improved fatigue, spasticity, health perception, QoL.	10-Jun
Bunketorp-Käll et al. (2018)	Stroke	Randomized longitudinal	N=106	Rhythm/music therapy; hippotherapy; control, 12 weeks, horses	LISS	Caregiver scores improved post-treatment and at 3 months.	10-Aug
Vermöhlen et al. (2018)	Multiple sclerosis	Randomized longitudinal	N=70	hippotherapy + standard treatment vs control, 12 weeks, horses	BBS; FSS; NRS; VAS; MSQOL-54; EDSS	Balance, fatigue, spasticity, and pain improved.	10-Sep
Bunketorp-Käll et al. (2017)	Stroke	Randomized longitudinal	N=123	Rhythm/music therapy; Hippotherapy; control, 12 weeks, horses	SIS; TUG; BBS	Positive outcomes maintained after 6 months.	10-Aug
Wollenweber et al. (2016)	Multiple sclerosis	Randomized longitudinal	N=70	Hippocampal manipulation + physiotherapy vs control, 12 weeks, horses	BBS; FSS; MSQoL-54	Clinical trial protocol.	10-May
Olsen et al. (2016)	Dementia	Randomized longitudinal	N=80	Animal-assisted activity vs control, 12 weeks, dogs	MMSE; BBS; QUALID	Balance improved; QoL unchanged.	10-Jul
Martin-Lemoyne et al. (2016)	Spinal cord injury	Quasi-experimental cross-sectional	N=10	Wheelchair ramp task with/without assistance dog	VAS; WUSPI; AIS	Less strain and faster ramp climbing with dog.	10-May
Friedmann et al. (2015)	Dementia (Alzheimer's disease)	Randomized longitudinal	N=40	Canine intervention vs control, 12 weeks, dogs	MMSE; AES; CSDD; CMAI	Significant physical, behavioral, emotional benefits.	10-Jul

Majic et al. (2013)	Dementia	Randomized longitudinal	N=65	Animal-assisted activity vs control, 10 weeks, dogs	MMSE; DSM-IV; CMAI	Control worsened depression/agitation; intervention stable.	10-Jul
Beinotti et al. (2013)	Stroke	Randomized longitudinal	N=24	Horse-riding treatment vs control, 16 weeks	SF-36; DSM-IV	Improved functional ability and mental health.	10-Aug
Bunketorp-Käll et al. (2012)	Stroke	Randomized longitudinal	N=120	Rhythm/music therapy; hippotherapy control, 12 weeks	ICF; SIS; ADL; ARAT etc.	Clinical trial protocol evaluating efficacy.	10-May
Mosello et al. (2011)	Dementia (Alzheimer's disease)	Non-randomized longitudinal	N=10	Stuffed dogs control then assisted animal activity	MMSE; SIB; ADL; CMAI	Improved enjoyment, activity, alertness.	10-May
Moretti et al. (2011)	Dementia	Non-randomized longitudinal	N=21	Animal treatment vs control, 6 weeks, dogs	MMSE; GDS	Cognitive enhancement in intervention group.	10-Jul
Lechner et al. (2007)	Spinal cord injury	Randomized crossover trial	N=12	hippotherapy vs Bobath roll vs stool	Ashworth Scale; AS	Reduced pain and improved mental health short-term.	10-Jul

Timed 25-foot walk (T25-FW), Mini-Mental State Examination (MMSE), and Geriatric Depression Scale (GDS) are acronyms. FIS, Multiple Sclerosis Quality of Life-54, Beck Depression Inventory, and MSQOL-54 The following acronyms stand for various measures: King's Health Questionnaire, CV20, LSS, EDSS, FSS, VAS, NRS, SIS, BDL-BS, and QUALID are all measures of quality of life in constipation, life situation among spouses, expanded disability status, fatigue severity, visual analog scales, stroke impact, and late-stage dementia. Those bars: The acronym that describes these assessments is A Brief Rating of Agitation; Apathy Evaluation Scale (AES), Cornell Scale for Depression in Dementia (CSDD), Cohen-Mansfield Agitation Inventory (CMAI), and Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).

The Cohen-Mansfield Agitation Inventory, Fourth Edition; CMAI Health Outcomes Inventory (SF-36) Topic 36: ICF Bäckstrand, Dahlberg, and Liljenäs Balance Scale; ARAT, Action Reach Arm Test; BBS, Bergs Balance Test; BBL BS,

International Classification of Functioning, Disability, and Health; BBT, Bergs Balance Test the Barrow Neurological Institute Screen for Higher Cerebral Functions (BNIS), the Box and Blocks Test, the EuroQol, the Falls-Efficacy Scale (EQ-5D), and so on. Measure of Adverse Reactions Scale-S (MADR-S): Near Montgomery-Åsberg (Self-Rating Depression Scale), the Modified Motor Assessment Scale (MAS) as developed by the Uppsala University Hospital, the Non-Verbal Learning Test (NVLTL), and the Ruff 2 and 7 SAT. S.A.I.S., Sense of Coherence, Test of Attentional Performance, Timed Up and Go, Wechsler Adult Intelligence Scale, and 6-minute walking test Ten-Meter Walk Time (6-Minute).

The following tests are employed: the Walk Test, the Neuropsychiatric Inventory, the Cohen-Mansfield Agitation Inventory (CMAI), and the Open Evaluation and Rating Scale (OERS). Wheelchair User's Shoulder Pain Index, Agitated Behavior Mapping Instrument, International Classification of Diseases, tenth Revision, Observed Emotion Rating Scale, and C-Score SIB stands for "severe impairment batter," and CDR, DMAS, MoBOF, and Dementia Mood Assessment Scale are

acronyms. Terms such as "Timed Up and Go" (TUG) and "American Spinal Cord Injury Association Impairment Scale" (AIS) are used. Letter-number sequencing test (LNS) and Befindlichkeits-Skala (Bf-S) are terms for the same thing.

3. Results

A total of 1,743 records were identified through database searching across PubMed, Scielo, Embase, and PEDro. After removal of duplicate records, titles and abstracts were screened for relevance. Full-text articles were subsequently assessed for

eligibility based on the predefined inclusion and exclusion criteria. Seventeen clinical trials fulfilled all criteria and were included in the final qualitative synthesis (Figure 1).

Table 1 summarizes the characteristics of the included studies, including author and year of publication, neurological condition, study design, sample size, intervention characteristics, outcome measures, and methodological quality. The included studies demonstrated substantial heterogeneity in terms of intervention duration, frequency, type of animal used, and assessment tools.

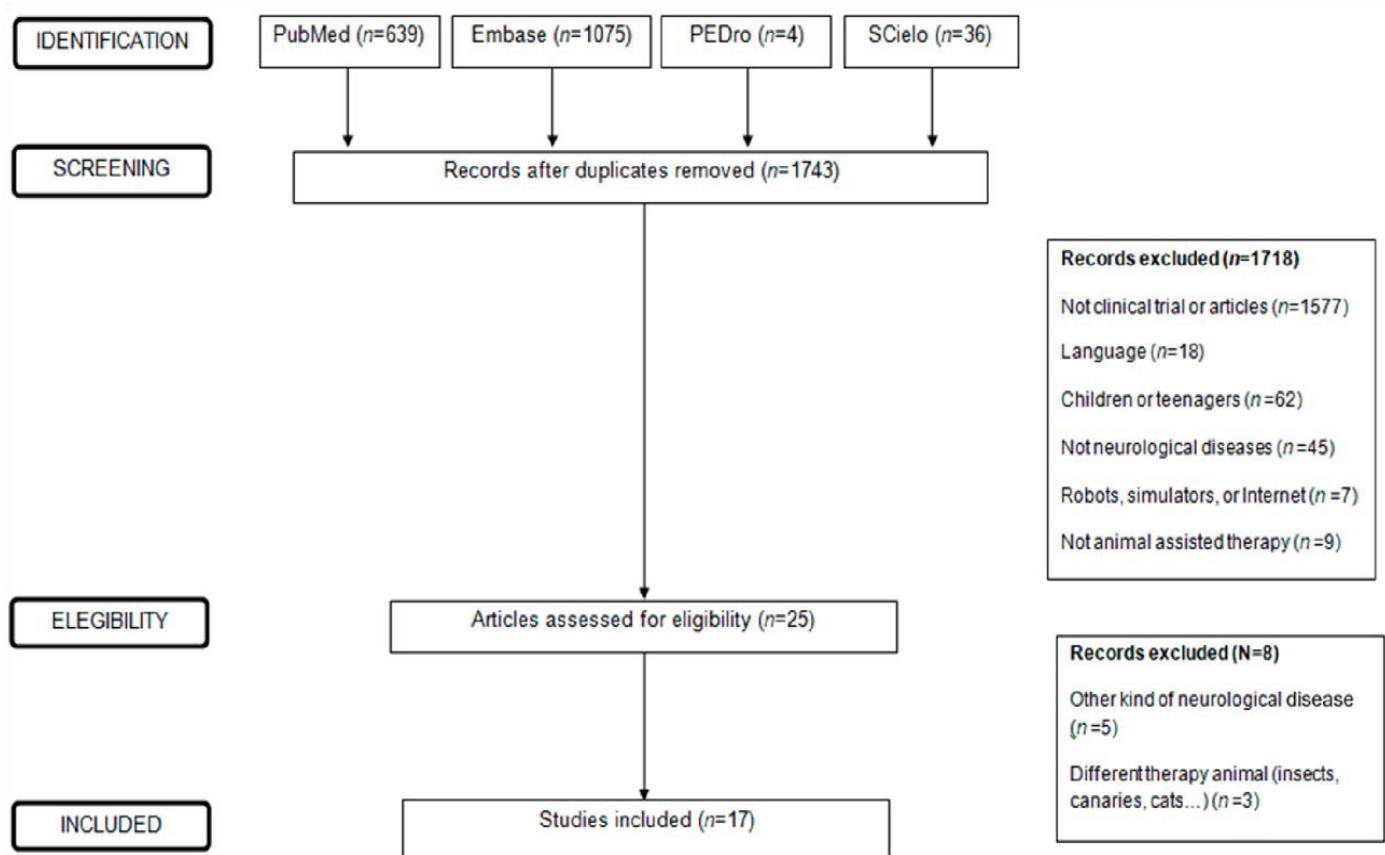


Figure 1. Articles' Progression Through the Systematic Review's Stages

For clarity, results were categorized according to the neurological condition investigated.

3.1 Consequences for Individuals with Dementia

Seven research (Menna et al., 2019) involved patients diagnosed with various forms of dementia. Of those, two were not chosen at random. Among the seven referenced articles,

three specifically enrolled Alzheimer's patients (Menna et al., 2019; Friedmann et al., 2015). In certain instances, the DSM-IV and ICD-10 were utilized for diagnostic purposes. All participants included canines as therapeutic aids. Particular assessments were employed to investigate several areas potentially affected by this neurological disorder. All studies, save one, utilized measures to assess symptoms of depression

(Olsen et al., 2016). All studies utilizing the MMSE to assess patients' cognitive status, with the exception of one (Menna et al., 2019), depended on this instrument.

Two of these studies (Menna et al., 2019, Olsen et al., 2016) examined the impact of dementia on quality of life in its advanced phases. Moreover, aspects like agitation, emotional elements, and equilibrium were evaluated (Friedmann et al., 2015, Moretti et al., 2011).

These trials employed a range of therapies, including AAT tailored to reality orientation therapy, caressing and greeting the dog, administering goodies and commands, grooming, clothing, adjusting collars, conversing with the dog, taking them on brief walks, among others.

The entire process was conducted to stimulate the physical, social, cognitive, and sensory systems. All publications examining the advantages of AAA yielded statistically significant outcomes, save for one (Majic et al., 2013), in which the intervention group's results remained unchanged from the study's inception. Significant outcomes in dementia patients undergoing therapy included reductions in cortisol levels indicative of stress (Menna et al., 2019); enhancements in balance (Olsen et al., 2016); decreases in depressive symptoms and improvements in quality of life (Menna et al., 2019); marked advancements in physical, behavioral, and emotional functioning (Friedmann et al., 2015); increases in pleasure, motor activity, and overall alertness; mitigation of sadness (Majic et al., 2013); and improvements in cognitive function (Moretti et al., 2011).

3.2 Results in Individuals with MS

Numerous studies with MS patients employed horses as therapeutic animals in every case (Muñoz-Lasa et al., 2019; Wollenweber et al., 2016). A randomized trial (Wollenweber et al., 2016), a previously documented methodology (Vermöhlen et al., 2018), and a non-randomized comparative open study (Muñoz-Lasa et al., 2019) were executed.

The Multiple Sclerosis Quality of Life Scale (MSQOL-54) was used to rate the quality of life in all of the publications. This scale was made for people with multiple sclerosis and for people who have constipation (CVE-20). To find out how tired people were, the FSS and FIS were used. The Ashworth scale

and the NRS were used to measure spasticity, and the EDSS scale was also used. We also looked at how people thought about their general health, how sad they were, how fast they walked (T25-FW), and how well they balanced (BBS).

The interventions were all about each operation. The equestrian team led the sessions throughout the study (Muñoz-Lasa et al., 2019). In addition to equestrian exercise, which includes sensory stimulation and a variety of movements, they also led workshops on other activities, such as grooming the horse, going on field trips, watching behavior, and studying how the horse interacts with its environment (Terapias ecuestres) (Fundación MHG, 2020).

Patient participants were informed by the German Therapeutic Riding Board (DKThR) (Hippotherapie, 2020) that took part in hippotherapy (Vermöhlen et al., 2018), which is when a hippotherapist guides a horse with long reins and does physiotherapy on the horse. Statistical analysis revealed substantial improvements in fatigue, spasticity, balance, and pain perception (Vermöhlen et al., 2018). There were also important effects for overall health perception and quality of life (Muñoz-Lasa et al., 2019). On the other hand, depression, constipation, and gait did not yield any statistically significant outcomes.

4. Findings in Stroke Patients

Bunketorp-Käll et al. (2017, 2019) studied stroke patients. Every randomized study on animal-assisted therapy (AAT) included horses. employed the LISS questionnaire as delineated in a preceding study design (Bunketorp-Käll et al., 2012), to assess the influence of AAT on patient outcomes (Fundación MHG, 2020, Hippotherapie, 2020) and caregiver quality of life. Several tests were used to measure the individuals' cognitive abilities, such as the Grippit dynamometer for grip strength, the BNIS screen for overall cognitive performance, and the LNS test for working memory. The SF-36 survey, the SIS, and quality of life ratings were all utilized to find out what stroke did to people.

We also looked at things like motor skills, stress levels, confidence, how people thought about their physical health, depression, self-efficacy, psychomotor speed, non-verbal learning, independence and reliance, and quality of life. The

interventions included grooming and dressing the horse, doing equestrian activities that mimic human gait in three dimensions, practicing balance with hands on the head, doing diagonals or circles, rotating the torso with a stick, training the affected areas (like riding a bike, lying with arms around the horse, and grabbing the reins), cognitive exercises (like giving instructions or planning a route), strengthening exercises, relaxation techniques, body awareness, and deep, slow breathing, among others.

The trials showed that the SF-36 ratings for functional capacity, physical characteristics, and mental well-being all went up a lot and stayed that way for six months after the intervention (Bunketorp-Käll et al., 2017). A study showed that the quality of life of caregivers improved after horse-assisted treatment ended, and this improvement lasted for three months. However, it was not statistically significant at six months (Bunketorp-Käll et al., 2018).

Recent studies have confirmed that hippotherapy improves gait and functional mobility, although rhythm and music therapy did not exhibit comparable outcomes.

4.1 Outcomes for Individuals Suffering from Spinal Cord Injury

Two investigations captured our interest (Martin-Lemoyne et al., 2016; Lechner et al., 2007). One study examined a singular cohort of patients who experienced a spinal cord injury using a quasi-experimental design (Martin-Lemoyne et al., 2016). A third type of experiment used three groups and was a crossover design (Lechner et al., 2007). The initial study employed dogs as therapy subjects, while the subsequent study utilized horses.

The initial investigation employed both the VAS and the WUSPI. The first study attempted to assess perceived exertion in the upper limbs, while the second sought to identify wheelchair users reporting shoulder discomfort. Additionally, the severity of patients' sensory and motor functions was evaluated utilizing the AIS scale. The VAS scale was similarly employed in the second instance. The Bf-S and Ashworth scales were employed to assess mental health and spasticity, respectively.

The intervention in the quasi-experimental study involved training a dog to up a ramp. The canines had a five-month

training regimen prior to this, and the users also participated in training sessions. The use of an assistance dog to facilitate ramp ascent led to notable enhancements, including diminished strain on the upper limbs (namely the anterior deltoid, biceps, and pectoralis major muscles) and accelerated development (Martin-Lemoyne et al., 2016).

Twelve patients with spinal cord injuries were randomly allocated to one of three therapy groups in the crossover study. Patients received a four-week interval between the treatments of each group. hippotherapy (HTK therapy, when the patient is passively influenced by the horse's movements) was one of the interventions. In another instance, patients were positioned on a Bobath roll during therapy.

In one scenario, participants were seated on a stool while an electric motor operated a rocking chair. Subjects undergoing hippocampus modification exhibited short-term, clinically validated enhancements in spasticity. No statistically significant difference was observed between baseline and follow-up scores on the VAS for self-reported spasticity during the rocking chair intervention. The remaining two treatments demonstrated potential. Despite the lack of long-term improvement in the aforementioned parameters, the horse therapy intervention helped enhance mental health (Lechner et al., 2007).

5. Discussion

This thorough study focuses on animal therapy research concerning many neurological disorders, such as multiple sclerosis, spinal cord injury, stroke, and dementia, particularly including dogs and equines. In trials of animal therapy for dementia and spinal cord injuries, dogs were predominantly favored, with the exception of one study featuring a horse; conversely, horses were the preferred option for trials concerning multiple sclerosis and stroke. Therefore, it is essential to choose an animal that is appropriate for the user's condition or symptoms, as interacting with a certain animal can provide various benefits to users. It is crucial to highlight that the species in question have undergone distinct co-evolutions, resulting in varying therapeutic capabilities among the relevant animals. Consequently, it is essential to consider the elements influencing interspecific interactions, the attachment types of both animals and their owners, and the

relational reciprocity among the animals, patients, and team members collectively (Santaniello et al., 2021).

Dementia patients engaged in canine therapy exhibited enhancements in behavior, overall alertness, and enjoyment, alongside reductions in stress, anxiety, and depressed symptoms. Given the facts reported, it is plausible to conclude that individuals with substantial impairments in memory and reasoning, together with those lacking social skills, may benefit from this treatment (Santaniello et al., 2021).

Nonetheless, a study indicated that patients with severe and very severe dementias who underwent a combination of conventional treatment and animal-assisted therapy (AAT) continued to have persistent and even exacerbated symptoms of despair, anger, and agitation over time (Majic et al., 2013). Animal treatment in advanced dementia may assist in symptom management rather than enhancement; in other words, animals can facilitate symptom activation and decelerate their progression.

Olsen et al., demonstrate that this improves the quality of life for those with severe dementia. This animal treatment enhances patients' physical function and motor activity, leading to an overall increase in quality of life (Friedmann et al., 2015). Enhancing balance will diminish the probability of falls, benefiting our patients' health (Olsen et al., 2016). No significant effects were noted for the alleviation of agitation. Patients undergoing MS treatments with horses as co-therapists report reduced fatigue and spasticity after six months of hippotherapy (Moretti et al., 2011). Conversely, an alternative trial revealed that patients exhibited improved balance and reduced fatigue following 12 weeks of treatment, which was furthermore paired with standard care (Vermöhlen et al., 2017) hippotherapy has the ability to mitigate motor deficits in MS patients due to the intricate emotions it elicits, while also positively influencing the therapeutic bond between patient and horse. In all four trials including stroke patients, horses were the most often utilized therapeutic animals.

Two of these studies (Bunketorp-Käll et al., 2018, Bunketorp-Käll et al., 2019) investigated the advantages of music and rhythm-based therapy alongside hippotherapy; their methodologies were previously documented (Bunketorp-Käll et al., 2012) .

One study (Bunketorp-Käll et al., 2017) indicated that both interventions enhanced patients' perceptions of their recovery from late-stage stroke, with these enhancements lasting for up to six months. hippotherapy enhanced patients' performance on assessments of gait and balance, rhythm and music therapy, grip strength, and stability.

This offers additional evidence that the two could collaborate effectively. Therefore, customizing the multimodal strategy to meet the distinct requirements of each patient should be given considerable consideration. The second study examined the perceptions of stroke caregivers about their own quality of life (Bunketorp-Käll et al., 2018). The lives of these unpaid caretakers seem to have improved therefore.

Enhanced outcomes for these folks are attainable if we mitigate their anxieties regarding the provision of sufficient care for their loved ones. The latest study revealed that equine aid enhanced functional task performance (Bunketorp-Käll et al., 2019).

Conversely, previous research by Beinotti et al. indicated that patients' quality of life and physical attributes, such as balance, were markedly enhanced with hippotherapy -integrated physiotherapy, attributable to the therapeutic properties of horses. Despite the numerous benefits, users also encountered the feelings elicited by the therapy, which facilitated the development of confidence and a sense of autonomy (Beinotti et al., 2013).

Finally, one article proposed the utilization of dogs to assist individuals with spinal cord injuries in ascending ramps. The outcome was reduced tension on the muscles of the upper limbs and diminished mechanical load (Martin-Lemoyne et al., 2012).

Although this assistance may prevent discomfort and shoulder ailments in patients, it can adversely impact dogs' health over time, resulting in conditions such as hip dysplasia. Consequently, this treatment may be more harmful to the animal if it is not adequately trained and exercised. Animals should not be permitted to perform all labor on our behalf unless humans are physically incapable of doing so. Conversely, another study revealed that among three interventions— hippotherapy included—horse-assisted therapy

enhanced spasticity and mental well-being more effectively than stretching and passive rhythmic mobilization therapies (Lechner et al., 2007).

The horse's equine gait and the therapeutic benefits of its natural warmth support the hypothesis that horses can assist those with spinal injuries in motor functions such as spasticity. hippotherapy promotes enhanced mental health, perhaps because many individuals perceive it as an innovative therapy that facilitates the experiencing of diverse positive feelings.

This study involved just 4 weeks of equine therapy due to the trial's design; hence, although short-term benefits were observed, further evidence is required to determine effective methods for promoting long-term outcomes with these animals. Longitudinal studies assessing the effectiveness of hippocampus preservation in spinal cord injury patients are therefore necessary.

When an animal's displays of love and affection are returned, all these benefits may materialize. According to Iannuzzi and Rowan, "We must adhere to the principle that animals should not be used as a means to an end" (Iannuzzi et al., 1991), which highlights the fact that weighing the risks to animals against their potential benefits for rehabilitation is neither apparent nor straightforward.

Canines did not exhibit any overt symptoms of stress during treatment, as measured by rectal temperature, blood pressure, systolic pressure, resting heart and respiratory rates, and serum and salivary cortisol levels before, during, and 24 hours after therapy (Yamamoto et al., 2012) while it is still important to give animals rest periods to ensure their well-being (Máximo et al., 2012) So, we need to think about the moral implications of AAT programs and provide the groundwork for an exploitative-free society where people have control over their own relationships (Máximo et al., 2012) .

Here are a few guidelines:

- From a physiological and psychological standpoint, animals must be shielded from harm, pain, and stress.
- It is essential to ensure that animals receive sufficient medical attention.
- Every animal needs a peaceful spot to relax and

unwind every once in a while.

- Users and animals should have interactions in a way that doesn't compromise the animal's capacity to heal.
- Session suspension would occur without delay in the event of an abusive or stressful setting.

It is crucial to establish guidelines where animal respect is paramount, as it is difficult to establish a positive relationship that benefits the patient if it stresses out the animal, preventing them from providing the beneficial therapy they could otherwise. Consequently, the patient would not experience any beneficial outcomes.

The urgency of taking precautions and keeping tabs on patients during treatment and rest periods was highlighted in a 2015 report by the Italian Ministry of Health. The report recommended clinical and behavioral visits to track patients' health. Keep track of any changes in your body, whether they be physical, physiological, or behavioral. Interrupting the intervention requires an instruction from the animal's veterinarian or coadjutor. Adequate living conditions must be provided for animals that are no longer involved in AAT due to age or health issues (Ministero della Salute, 2015).

The necessity of sanitary measures and zoo sanitation in preventing the development of zoonosis during IAA has been the subject of an increasing amount of research in recent years. Some recommendations for the safe management and supervision of animals in healthcare were put forward by Murthy et al. (Murthy et al., 2015).

The use of animals in healthcare must adhere to all applicable laws and regulations and take all necessary precautions to prevent the spread of infectious diseases (Murthy et al., 2015). It will take a concerted effort by public health workers, veterinarians, epidemiologists, and doctors to stop the spread of these diseases and make everyone and everything healthy again (Santaniello et al., 2020).

Limitations Various studies employ varying approaches, such as utilizing various types of animals, varying study lengths, and varying session numbers. The tiny samples and dearth of research highlight the need for longitudinal investigations. Neither the mental health components nor psychiatric disorders have been explored extensively since this might be

the subject of an independent investigation.

In conclusion, it is important to note that assisted treatment with dogs and horses is available as a therapeutic alternative in numerous different fields and conditions, in addition to its various impacts in adult neurology. For instance, adults on the autism spectrum who participated in canine-assisted therapy reported reduced stress and improved social communication (Wijker et al., 2019) ; burn center patients and staff experienced elevated moods and increased satisfaction with the program following interactions with dogs (Pruskowski et al., 2020) ; patients awaiting a heart transplant benefited from therapy as an adjunct to conventional medical treatment and reported an enhanced quality of hospital stay (Snipelisky et al., 2019) ; and inmates' correctional plans were strengthened by the cultivation of human-animal relationships in a mental institution, which fostered the emotional intelligence of the incarcerated individuals (Dell et al., 2019) .

We also found that horse therapy had a lot of favorable impacts, though. hippotherapy shows promise as a medical treatment for a variety of conditions, including: improving gross motor function in children with Down syndrome (Moriello et al., 2020) , improving attachment in adolescents with Internet gaming disorders (Kang et al., 2019) , alleviating pain, increasing range of motion, and improving quality of life for adults and older adults with arthritis (White-Lewis et al., 2019) , promoting a steady increase from moderate to vigorous physical activity and increased self-efficacy for physical activity, and offering a pleasant solution for childhood obesity (Schroeder et al., 2019).

These results, in conjunction with research related to neurological illnesses (as previously mentioned) and various other settings (such as prisons), offer more support for the notion that animal-assisted therapy (AAT) may yield beneficial outcomes for mental, social, and physical health. Further study with larger samples and extended durations is necessary to reinforce and substantiate the evidence pertaining to the advantageous benefits of AAT.

This will help minimize contradictions and make the therapy more useful for other neurological illnesses, including Parkinson's or ALS, where it hasn't been evaluated yet. The therapy may not work as well for some people as it does for

others. For example, some people are terrified of animals, which can make things worse. The animals' traits (appropriate training is important), and the person who is leading the treatment can also affect how well it works. For this therapy to be widely available as a treatment option, more medical professionals need to learn about it. Since pets give a constant connection security, it would be useful to do more research utilizing attachment measures to find out how pet ownership affects owners' life in general, possibly by shielding them from the bad effects of bad human social relationships (Beck and Madresh 2015).

We need to do research that take into account all the important factors if we want to make sure that both people and pets can benefit from animal-assisted therapy. This kind of evidence-based knowledge should help develop more specific rules for how people and other animals should interact (Hediger et al., 2019). Some studies (Solomon et al., 2019) show that dogs are less stressed when they work with a human referent.

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