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**Viability of Equine Assisted Activities and Therapies for Individuals with Developmental
Disorders: A Systematic Review**

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The University of Tennessee at Chattanooga
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Viability of Equine Assisted Activities and Therapies for Individuals with Developmental Disorders: A Systematic Review

Faith Pinson

Abstract

The objective of this review is to determine whether Equine-Assisted Activities and Therapies (EAAT) are a viable form of therapy for people with various developmental disorders. A viable form of therapy is one that is more beneficial than traditional forms of therapy that already exist, as traditional therapies may be generally less expensive and have plentiful research to support their use). In order to be beneficial, EAAT would need to yield improved results when either compared side by side with traditional therapy or used as a complementary therapy with traditional therapy. In this systematic review, the included studies examined the effect of an EAAT intervention for individuals with a developmental disorder such as autism spectrum disorder (ASD) or Downs Syndrome (DS). Studies that focused on participants with cerebral palsy were excluded as well as studies that were not written in English. Results were compared between studies, with a focus on social outcomes in four categories: communication, social motivation, socialization, and social functioning. There were 18 studies included in the final research. It was found that EAAT is generally beneficial for people with developmental disorders. A limiting factor of this review was the inconsistent methodology between studies. This included the sample sizes, outcomes measured, and the methods of measurement. More research needs to be completed regarding the long-term effects of EAAT; however, even as an on-going treatment, EAAT may be viable.

Introduction

Developmental disorders are described as a group of conditions characterized by atypical maturation and significant impairment of cognitive functions which are associated with limitations in learning, adaptive behavior, and skills (Karmiloff-Smith, 1998; Salvador-Carulla et al., 2011). Therapy is one of the most effective treatments for people with this type of disorder (Peters et al., 2020). This therapy comes in many different forms: cognitive behavioral therapy, applied behavior analysis therapy, physical therapy, speech therapy, and occupational therapy. Still, there are subsets within those various forms of therapy. Equine-Assisted Activities and Therapies (EAAT) are methods of treatment involving horse-back riding that may combine occupational therapy, physical therapy, and speech therapy. It is often used for individuals with developmental disabilities (Lanning et al., 2014).

Occupational therapy is meant to help patients accomplish their everyday occupations, such as activities of daily living (ADLs). For adults, this often means work-related activities or chores around the home, but children's occupations look different. Pediatric occupational therapy may focus on a child's ability to play or complete activities at school (Peters et al., 2020). Pediatric physical therapy is similar, but it focuses on children's gross motor skills whereas occupational therapy focuses on their occupations, which may include fine motor skills such as handwriting and teeth brushing. The goal of both therapies is to help patients get back to their desired activities; the focus is truly whatever activities and life skills are important to the clients. The therapist meets patients where they are, so they may start at a level in which sitting exercises are necessary, progressing to standing exercises if possible, or they may be working on active exercises (Kalmbach et al., 2020, American Physical Therapy Association).

While EAAT is a form of treatment involving horses that has been used since the 1960s, it originated much earlier. The basic idea behind EAAT dates back to early European history

where horseback riding was used to treat physical and psychological ailments. The same group who researched the early history of EAAT concluded that current research points to the possibility that EAAT could be beneficial for individuals with developmental disorders such as autism spectrum disorder (ASD) (Lanning et al., 2014). When EAAT is introduced, the patient is able to move and exercise in an entirely new way; the rhythmic movement of the horse improves the rider's balance, muscle symmetry, coordination, and posture (Borgi et al., 2016). The movement and gait of the horse is meant to improve motor coordination as well as core strength. Some studies have also seen improvements in neurological, sensory, and social changes which can improve many of the symptoms of ASD and other developmental disorders (Peters et al., 2020).

EAAT can be split into two groups: Equine Assisted Activities (EAA) and Equine Assisted Therapies (EAT). EAA includes Therapeutic Riding (TR) and Equine-Assisted Learning (EAL) while EAT includes Equine-Facilitated Psychotherapy (EFPT) and Hippotherapy (HT) (Anderson & Meints, 2016). Praying Hands Ranch, an EAAT organization, includes a page with EAAT definitions on its website. They define EAT as services provided by a licensed health professional that incorporate horses into the therapy process. EAA are defined by the same organization as services provided by a non-licensed professional (i.e., a PATH certified instructor) that utilize the inherent therapeutic benefits of being around horses to enhance non-clinical activities. EAA Facilitators are not regulated by a state board and are not required to have a degree in their field. Finally, hippotherapy is a more specific term falling under the category of EAT that is defined by the use of horseback riding/equine movement in physical, occupational, or speech therapy. It is provided by a licensed physical, occupational, or speech therapist. (Administrator, 2023).

EAAT works by giving the participant activities (both on and off the horse) that are aimed at improving self-efficacy, social skills, balance, and other skills. Due to the unique type of social interaction that animals offer, it has been proposed that EAAT affects social skills in participants because relationships with animals can dampen the effects of social isolation (Borgi et al., 2016). This could point towards one reason for the improvements in social skills for kids with ASD who participate in EAAT. The activities involved in EAAT fall into two main categories: groundwork and riding skills. Groundwork activities include caring for the horse, picking its hooves, brushing it, petting it, mounting the horse, and communicating/conversing with the instructor. Riding skills include balancing in the saddle, sitting up straight, steering the horse, and completing horse-based exercises chosen by the therapist. These exercises may be balance-focused or strength-focused. All exercises work on intellectual and social skills because the participants must process what their instructor says and complete the action. They also must communicate with their instructor while on the horse so that they know what to do at every moment. Since many participants might not be familiar with horses, they are working as a team with their instructor to obtain or improve a skill and to ride a horse. EAAT is often a tool used alongside traditional therapies such as occupational or physical therapy. Both traditional therapy and EAAT may be implemented at one clinic or EAAT may be completed at a different location given the resources required for horse therapy: horses, a barn to board them, and an arena to work on riding skills (Peters et al., 2020; Trzmiel et al., 2019).

Previous systematic reviews have been written on this topic (McDaniel Peters & Wood, 2017; Potvin-Bélanger et al., 2022; Srinivasan et al., 2018; Trzmiel et al., 2019). Some of these reviews focused on people with ASD while others looked at all developmental disorders. Three of the reviews focused on treating individuals with ASD (McDaniel Peters & Wood, 2017;

Srinivasan et al., 2018; Trzmiel et al., 2019). Two reviews included participants of a broad age range (McDaniel Peters & Wood, 2017; Srinivasan et al., 2018) while the other two focused on children and adolescents (Potvin-Bélanger et al., 2022; Trzmiel et al., 2019). One of these reviews focuses only on hippotherapy (Potvin-Bélanger et al., 2022) while the others reviewed various types of EAAT. The common limitations of these reviews included a small sample size and heterogeneous research methodology (McDaniel Peters & Wood, 2017; Potvin-Bélanger et al., 2022; Srinivasan et al., 2018; Trzmiel et al., 2019).

EAAT has also become an established form of treatment for posture, balance, and coordination for those with cerebral palsy (Borgi et al., 2016). There are a plethora of studies, meta-analyses, and systematic reviews focused on people with cerebral palsy, but this systematic review will exclude that population in order to focus on different populations that may benefit from a new form of therapy (Bass et al., 2009; Borgi et al., 2016; Jackson-Maldonado, 2021; Potvin-Bélanger et al., 2022; Trzmiel et al., 2019).

The current review will specifically focus on EAAT for people with ASD and other developmental disorders as compared to traditional therapy for this population. This review will focus on the social outcomes that occur in response to an EAAT program. This review is necessary because hippotherapy and other EAAT could potentially be a helpful tool for many people who otherwise would not get such a well-rounded treatment. It is also important to know if this therapy is not efficient so as to not waste time and resources for a program that is not especially beneficial.

Methods

Eligibility Criteria

This study is a systematic review on the current research within the field of EAAT, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Page et al., 2021). In order to be included in the review, each study had to a) have a subject population which included people with developmental disorders such as ASD, Downs syndrome, or intellectual disabilities, b) have a form of EAAT as its intervention and focus, and c) have a focus on social and communication outcomes. Ideally, each study would include a comparison group of individuals in traditional therapy or individuals who were not in therapy. While a control group would strengthen the interpretation/design, it was not required. Each study needed to be published in a peer-reviewed journal. The first step of data collection consisted of searching four reputable databases (PubMed, Cinahl, WebofScience, and OTDBase). The search terms for this review were as follows: “Hippotherapy OR horse therapy OR equine therapy OR equine assisted therapy OR riding therapy AND developmental disorders OR autism OR ASD OR intellectual disability OR down syndrome NOT cerebral palsy.”

Exclusion Criteria

After recording the initial search results, this review implemented a three-step exclusion process. First, certain studies were excluded after reading through the titles and determining that they were not relevant (i.e., did not meet the criteria). The second set of elimination occurred after reading the abstract of each article. The third step included reading the full article and determining if each study fit the eligibility criteria.

This review excluded any studies on EAAT for people with cerebral palsy. Studies were excluded if they were written before 2005. Only reports in English were included. Twenty-three

studies were excluded due to the type of outcomes they focused on. In five of these studies, the outcome was not clarified.

Outcomes

After starting the research process, social skills outcomes were a common theme that arose in many of the studies. This aspect of EAAT became the primary outcome focus, since the review is gathering information on people with ASD and other types of developmental disorders, who may not have severe physical deficits. The outcomes within the broad category of social skills include communication, social motivation, socialization, and social functioning. For each article, these factors were also recorded: Author, Date Published, Database, Study Design, Comparison/Control Group, Subject Population, Outcomes Measured, and Conclusion. This information was recorded for each study in order to compare the articles and consolidate the information in order to form one conclusion. One reviewer assessed the information in these studies with two readers checking the outcomes to minimize risk of bias. Databases were used to find relevant studies, but no other automation tools were used.

Outcomes Measured

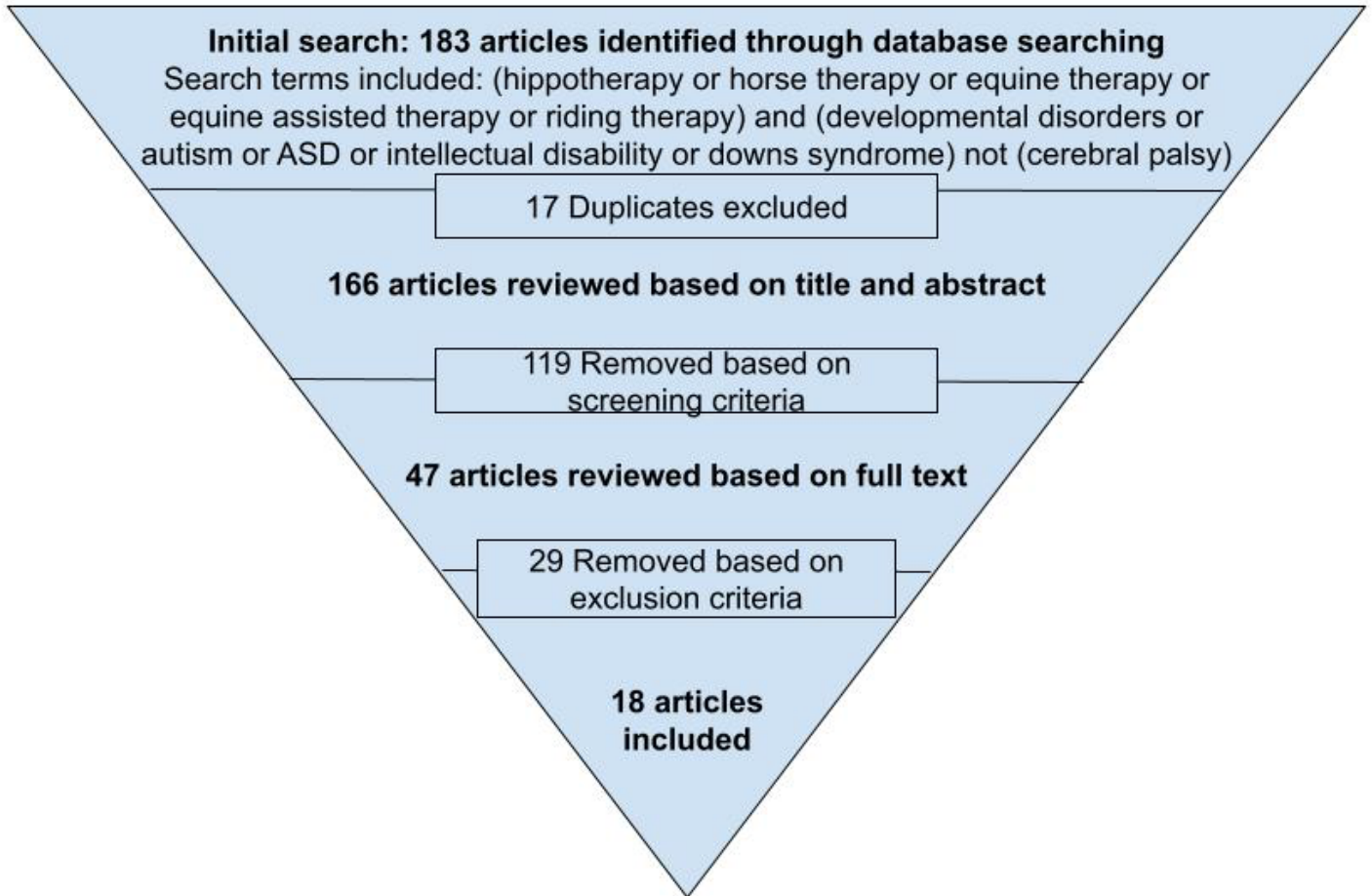
Various outcomes measured within the articles were considered in this review. Each outcome fell under the broad category of social skills; however, many subcategories were derived from the included studies. These subcategories included: communication, social motivation, socialization, and social functioning.

Communication: Communication is the ability to express one's needs and ideas. It is also the ability to engage in conversation with others. It includes expressive language (speaking) and receptive language (listening and understanding) (CafeMedia, 1998).

Social Motivation: Social Motivation is a person's internal desire and willingness to interact with those around them. When social motivation increases, a person begins to socialize without the need for outside incentive (Westminster public schools, 2008, p. 42).

Socialization: Socialization is defined as the acquisition of a complex set of skills required to interact effectively with others (Westminster public schools, 2008, p.42). This review will include social interaction, including interaction with peers, within the category of socialization (Westminster public schools, 2008, p. 42).

Social Functioning: Social functioning includes the ability to empathize as well as a lack of maladaptive or repetitive behaviors. This category represents internal and individual abilities that allow a person to relate to others "normally" (Administrator, 2023).



The diagram (1) above illustrates the screening process for the database searches.

Author	Date Published	Database	Study Design	Comparison Group Included?	Subject Population	Outcomes Measured	Communication	Social Motivation	Socialization	Social Functioning
Anderson, S. & Meints K.	2016	CINAHL	Single Case Experimental Design	No - Baseline measure of participants prior to intervention	5-16 year old individuals with ASD	Social functioning for ASD	↑(NS)	NM	=	↑
Bass M.M. et. al	2009	CINAHL	Randomized Control Trial	Yes - Children on waitlist	4-10 year old children with ASD	Sensory issues, social motivation, and distractibility for ASD	NM	↑	NM	NM
Borgi, M. et. al	2016	CINAHL	Randomized Control Trial	Yes - Children on waitlist	6-12 year old children with ASD	Social and executive functioning for ASD	=	NM	↑	NM
Dawson, S. et. al	2022	CINAHL	Single Case Experimental Design	No - Baseline measure of participants prior to intervention	12-32 year old individuals with ASD	Social functioning for ASD	NM	NM	NM	↑

Gabriels R.L. et. al	2015	PubMed	Randomized Control Trial	Yes - Children completed art activity	6-16 year old individuals with ASD	Social cognition, social motivation, and communication for ASD	↑	↑(NS)	NM	NM
Jackson-Maldonado, D. et al	2021	CINAHL	Randomized Control Trial	Yes - Traditional language therapy	4-7 year old children with Down Syndrome	Communicative abilities for DS	↑	NM	NM	NM
Kalmbach, D. et. al	2020	CINAHL	Qualitative Descriptive Study	None required - Any previous therapies	Parents of 7 children with ASD	Occupational and social performance for ASD	NM	NM	↑(NM)	NM
Lanning B.A. et. al	2014	PubMed	Randomized Control Trial	Yes - Educational and recreational activities	4-14 year old individuals with ASD	Physical, emotional, and social functioning for ASD	NM	NM	NM	↑
McKissock, H. et. al	2022	CINAHL	Scaffolded instruction design model	No control	15-32 year old individuals with ASD	Social skills for ASD	NM	NM	NM	↑(NM)
Peters, B. et. al	2022	CINAHL	Randomized Control Trial	Traditional therapy - Occupational therapy in a garden	6-13 year old children with ASD	Goal attainment and social motivation for ASD	↑(NS)	↑	NM	NM
Peters, B. et. al	2020	CINAHL	Single Case Experimental Design	No - Baseline measure of participants prior to intervention	6-18 year old individuals with confirmed ASD	Occupational and social performance for ASD	↑	↑	NM	↑(NS)

Tan V. & Simmonds J.	2018	CINAHL	Qualitative Descriptive Study	None required - Any previous therapies	2-18 year old individuals with ASD	Social and emotional benefits ASD	NM	↑(NM)	↑(NM)	NM
Ward, S. et. al	2013	CINAHL	Single Case Experimental Design	No - Baseline measure of participants prior to intervention	Children from Kindergarten to fifth grade with ASD	Social interaction and sensory processing for ASD	↑(NS)	NM	↑	NM
Zhao M. et. al	2021	PubMed	Randomized Control Trial	Yes - Routine ASD program	6-12 year old children with ASD	Social interaction and communication for ASD	↑	NM	↑	NM

Table (1): ↑ indicates improvement; ↑(NM) indicates improvement where the significance was not measured; ↑(NS) indicates non-significant improvement; NM indicates Not Measured; = indicates No Change or No Difference between groups

Results

Communication

A total of eight studies looked at the communication outcomes of EAAT. Of these studies, four saw significant improvements in communication levels for those who participated in EAAT intervention. One randomized control trial (RCT) showed variable effects when looking at expressive versus receptive language (Jackson-Maldonado, 2021). Significant improvements in language comprehension were found after both traditional therapy and EAT; however, greater improvements in comprehension were recorded after traditional therapy than after EAT. On the other hand, there were greater improvements in language production after hippotherapy as compared to traditional therapy on its own. One single case experimental design study showed significant improvements in social communication compared to pre-intervention levels (Peters et al., 2020). The median social communication score improved from 40.0 on the pretest (lower scores indicate better functioning) to 38.0 post-intervention. Two RCTs showed significant improvements in communication outcomes in children with ASD when compared with a control group (Gabriels et al., 2015; Zhao et al., 2021). Each of their results were measured after 10 or more weeks of an EAAT intervention.

Two single case experimental design studies (Anderson & Meints, 2016; Ward et al., 2013) and one RCT (Peters et al., 2022) showed no significant improvements on communication in participants after the intervention. Each of these studies showed improvements in communication, but they were not found to be significant. One RCT showed no time-dependent improvement in communication (Borgi et al., 2016).

Social Motivation

Five studies were found that examined the effects of EAAT on social motivation. (Bass M.M. et al., 2009; Jackson Maldonado D. et al., 2021; Peters B. et al, 2020; Peters B. et al., 2022; Tan & Simmonds, 2018). Three of these studies found significant improvements in social motivation after intervention; these included two RCTs (Bass et al., 2009; Peters et al., 2022), and a single case experimental design study (Peters et al., 2020). One qualitative study found improvement but did not test the significance (Tan & Simmonds, 2018) One single case experimental study saw positive effects but not significant improvement (Gabriels et al., 2015).

Tan and Simmonds (2018) examined parent's perspectives of interventions in an equine environment. One of the main outcomes is social benefits for the child, but also included are the child's improved self-concept and emotional wellbeing, child's improved self-regulatory ability, and unexpected outcomes. Within the category of social benefits, parents reported relationship forming skills (both with the horse and the instructor), learning of social skills, and improved social motivation. Parents in this study describe witnessing a friendship-like relationship form between their children and the horses. One child even started interacting more with her peers and having playdates with them after attending group based EAA programs (Tan & Simmonds, 2018).

In one RCT, there were significant improvement in social motivation (Bass et al., 2009). This study used the Social Responsiveness Scale, Second Edition (SRS-2), which is a social skills assessment that denotes improvements as lower scores. The experimental group showed significant improvements when compared to their own pre-intervention scores and when compared to a wait-list control group.

One single-case pilot study determined that social motivation improved significantly compared to the pre-intervention levels (Peters et al., 2020). The median score for social

motivation increased from 14.0 on the pretest to a score of 12.0 post-intervention. A different preliminary RCT study had positive results for the social effects of occupational therapy using horseplay for children who participated in the program (Peters et al., 2022). Both studies showed significant improvements in social motivation (Peters et al., 2020; Peters et al., 2022). They both used the SRS-2 to measure their results. The control group of children in the 2022 study who received occupational therapy in a garden showed greater improvement in social motivation than those receiving occupational therapy utilizing horseplay.

One study found non-significant improvements in social motivation for children with ASD who completed EAA intervention (Gabriels et al., 2015). This study, like many within this review, used the SRS-2 to measure changes in their participants' outcomes. These social outcome scores were determined by participant's caregivers. These caregivers produced non-blinded reports via surveys.

Socialization

Six studies in this review measured socialization outcomes (Anderson & Meints, 2016; Borgi et al., 2016; Kalmbach et al., 2020; Tan & Simmonds et al., 2018; Ward et al. 2013; Zhao et al., 2021). Five studies showed notable improvements in socialization after EAAT intervention (Borgi et al., 2016; Kalmbach et al., 2020; Tan & Simmonds, 2018; Ward et al. 2013; Zhao et al., 2021). Two of these were qualitative descriptive studies that found more frequent social interactions to be a favorable influence of equine intervention according to the parents of participants (Kalmbach et al., 2020; Tan & Simmonds, 2018). The parents in Kalmbach and colleagues' study included socialization as an improved outcome of the intervention. Tan and Simmonds included outcomes such as social engagement and social interaction when describing the effects of the intervention. A single case experimental study showed significant

improvements in social interaction after a six week intervention, followed by a six week break, followed by a four week intervention, followed by a six week break, and finally an eight week intervention (Ward et al., 2013). These social interaction numbers returned to pre-intervention levels after seven weeks without TR or contact with the barn; however, after seven more weeks in TR, levels had significantly improved again. Two RCT studies showed significant improvements to participant's social interaction when compared to a control group (Borgi et al., 2016; Zhao et al., 2021). The results of Zhao and colleagues' study were based on scores from both the Social Skills Improvement System Rating Scales (SSIS), which is a social skills assessment method in which parents evaluate their child's social interactions with five subscales (communication, cooperation, assertion, responsibility, empathy, engagement, and self-control) and the Assessment of Basic Language and Learning Skills-Revised (ABLLS-R). Increased scores represent improvements for both of these measurements. Borgi and colleagues found significant improvements in socialization based on the Vineland Adaptive Behavior Scale (VABS). They found no improvement in socialization for the waitlist control group.

One study showed no improvements in socialization after EAA intervention. This study used the Vineland Adaptive Behavior Scale (VABS) to measure social behavior in its participants pre-EAT and post-EAT. The intervention lasted five weeks and included 15 participants (Anderson & Meints, 2016).

Social Functioning

Two single case experimental studies had promising results for social functioning of people with ASD (Anderson & Meints, 2016; Dawson et al., 2022). One of these studies showed that after treatment with horses, the participants scored an average of 22 points lower for negative social behavior than they did before completing the treatment (Dawson et al., 2022).

The average score on week one was 85.8 while the average score on week 15 was 63.8. The other study specifically measured increased empathizing and decreased maladaptive behaviors in its participants (Anderson & Meints, 2016). It found significant improvements in both empathy and maladaptive behaviors for participants.

Two RCT studies showed significant improvements in social functioning for children with ASD who participated in EAAT (Borgi et al., 2016; Lanning et al., 2014). One of these articles presented a hypothesis which stated that relationships with animals can dampen the effects of social isolation due to the unique type of social interaction that animals offer (Borgi et al., 2016). Borgi and colleagues found significant improvements in social functioning in their study. The other RCT also resulted in significant improvements in social functioning for its control group, which involved social circles (Lanning et al., 2014). Each social circle consisted of a group of two to three children who participated in educational and recreational activities guided by a psychology student trainee. The control group had greater improvements in social functioning than the treatment group, although both were significantly improved from baseline.

One preliminary study showed improvement in restricted and repetitive behaviors but not to a significant degree (Peters et al., 2020). This study included five participants who made it through the entire intervention. The researchers, Peters and colleagues, used a variety of methods to measure their results, including the Autism Diagnostic Observation Schedule, which assesses social skills and behaviors of individuals that may have ASD. Another measurement tool was the Adaptive Behavior Assessment System, Third Edition- a rating scale that measures 10 domains of adaptive behaviors completed by parents of the participants.

Discussion

Communication

The majority of studies (seven out of eight) produced some level of positive results in communication following various forms of EAAT. The scores from the Communicative Development Inventory-Down in regard to one RCT suggest hopeful outcomes for expressive and potentially receptive communication in response to hippotherapy (Gabriels et al., 2015). Although traditional therapy yielded greater improvements for receptive communication in Gabriel and colleagues' study, the length of therapy must be considered; the traditional language therapy was implemented three times as long as hippotherapy. Both therapies yielded significant improvements, so more research is needed to determine if these types of therapy are comparable when both are provided for the same length of time. Hippotherapy clearly yielded greater improvements in expressive language even with the timing difference (Gabriels et al., 2015).

Two single case experimental design studies which showed non-significant improvements in communication had limitations that could have caused these conflicting results (Anderson & Meints; Ward et al., 2013). The sample size of both was quite small and the intervention was short compared to other studies in this review. One study included only 15 participants, had no control group, and included only five weeks of intervention (Anderson & Meints, 2016). The other study included 34 EAAT participants and lasted only 6 consecutive weeks due to issues with inclement weather (Ward et al., 2013). Most of the other EAAT interventions in this review lasted 10 or more weeks. All of these factors make the two studies by Anderson, Ward, and colleagues less weighty and point to the possibility that clients may have needed more time participating in the intervention in order to reap the full benefits.

The RCT that showed no time-dependent improvements in communication depended on parent interviews for its results and did not include in-clinic observation measures (Borgi et al., 2016). This lowers the reliability of the results, especially considering the other studies included in this review and in Borgi and colleagues' own study which report increases in social communication. Parent interviews are a helpful tool to get the full picture of a child's results from EAAT, but they are most reliable when used alongside in-clinic measurements. Borgi and colleagues emphasize the importance of direct measurements of each participant apart from parent perspectives.

All four previous systematic reviews regarding EAAT and individuals with developmental disorders focused on communication as a potential outcome of improvement for EAAT (McDaniel Peters & Wood, 2017; Potvin-Bélanger et al., 2022; Srinivasan et al., 2018; Trzmiel et al., 2019). Most agreed that the communication results are hopeful, but some called for more research (McDaniel Peters & Wood, 2017; Srinivasan et al., 2018). McDaniel and colleagues specifically suggested that researchers continue to systematically review the data as more becomes available. Three of the communication-focused studies in the current review were randomized control trials and one used a single case experimental design including a control group (Gabriels et al., 2015; Jackson-Maldonado, 2021; Zhao et al., 2021). These studies addressed many of the concerns from previous reviews regarding sample size and lack of a control group. Two of these RCTs were published in 2021 (Jackson-Maldonado, 2021; Zhao et al., 2021), which was after all previous systematic reviews on EAAT were written (McDaniel Peters & Wood, 2017; Srinivasan et al., 2018; Trzmiel et al., 2019).

Social Motivation

Four studies found that social motivation was significantly improved after EAAT intervention. One of these studies suggested that TR may have been a reinforcing stimulus which resulted in increased motivation levels and participation; this could make it a useful tool for those with developmental disorders who generally score lower for social motivation. The distinct, motivating nature of EAAT makes it stand out from traditional therapies (Bass et al., 2009).

One single-case study showed significant improvement in social motivation when compared to pre-intervention scores (Peters et al., 2020). Similarly, an RCT study showed significant improvements in social motivation in both the control group and intervention group (Peters et al., 2022); however, the control group's improvements were slightly higher. This could be because the control intervention, occupational therapy in a garden environment, was implemented with multiple participants who had similar communication abilities. These participants completed occupational therapy in a potentially motivating environment, a garden, side by side with their peers. This control environment may have been especially socially motivating, which would explain why both groups showed significantly improved social motivation (Peters et al., 2022).

The outcomes in one qualitative study suggest an increase in social motivation in the participating children: a desire to understand how the horse feels, a desire to play with other children in this environment, and a willingness to learn and follow boundaries for the horse (Tan & Simmonds, 2018). These factors suggest that social motivation can lead to a variety of social effects in participants that previously demonstrated deficits in social skills.

One RCT's results showed improvements in social motivation that were not found to be significant. This study contained a couple of limitations that may have affected the results. One

notable limitation was the caregiver self-assessment form used to measure results; this form was completed unblinded caregivers. Another limitation was the lack of objective observational measures. Both of these may have yielded unreliable results. This study would need to be repeated with more reliable and objective methodology to better determine if social motivation outcomes were reliable (Gabriels et al., 2015).

Socialization

The majority of studies that measured socialization outcomes found significant or notable improvements. One of these studies raised questions as to how long the outcomes of TR last (Ward et al., 2013). Ward and colleagues' single case experimental design study's results, which showed significant improvements in socialization but a return to pre-intervention levels after stopping treatment, could have multiple explanations. For example, the small sample size and data generated from only one source, teacher ratings, lower the reliability of this study. Another explanation is the inconsistency of the TR lessons. Ward and colleagues intended for the intervention to last ten consecutive weeks and eight consecutive weeks with a six week break in between. Most other studies within this review utilized interventions that lasted 10 or more consecutive weeks. However, due to weather and scheduling conflicts, each of their interventions lasted four to eight consecutive weeks with six week breaks in between. A longer study would be necessary to see if results of TR last after the intervention ends when the intervention is more long-term. If TR results proved not to be long-lasting on their own, the therapy may still be viable as a complement to traditional therapy (in order to maximize benefits) rather than a standalone therapy (Ward et al., 2013).

A single case experimental study found no improvements in socialization after its intervention. This could be a result of the small sample size ($n = 15$). It could also be due to the

short length of the program. The intervention lasted only five weeks, and it showed minimal changes to socialization and communication, while most studies of ten weeks or more showed significant improvements in these outcomes (Anderson & Meints, 2016).

One previous systematic review declared interpersonal interactions as the second most common outcome of each of the studies within their review, with the most common outcome being behavior. Specifically, interpersonal interactions accounted for 10 out of the 25 studies (40%) within the review (McDaniel Peters & Wood, 2017). The findings in McDaniel and colleagues' review regarding socialization (including improved relationships and increased social interactions) are in accord with the positive socialization outcomes found within the current study. Trzmiel et al., (2019) likewise found that socialization was one of the notably improved outcomes.

Social Functioning

Four out of five studies that measured social functioning showed significant improvements after EAAT intervention (Anderson & Meints, 2016; Borgi et al., 2016; Dawson et al., 2022; Lanning et al., 2014). The fifth study showed improvement that was not considered significant (Peters et al., 2020).

One study showed a significant improvement in social functioning for both the treatment group and the comparison group (Lanning et al., 2014). However, the comparison group had a greater change in social functioning than the EAA treatment group. This could be an effect of the potential bias of parents/teachers who scored the outcomes of these children. It could also be due to the especially social nature of the control group, which consisted of a social circle attended by peers and led by a psychology graduate student. More research should be conducted comparing

EAA participants and a control group of participants in group therapy in order to determine the most effective method or combination of therapies.

The hypothesis presented in one RCT regards the positive effects of interacting with animals for the socially isolated (Borgi et al., 2016). This may provide the explanation of improvements in social skills present in individuals with ASD who participate in EAT. Borgi and colleagues' findings supported their hypothesis; they found significant improvements within the outcome of social functioning after intervention with a horse, suggesting that the horse may have had positive effects on participants in the EAT intervention. The study that showed nonsignificant improvements in restrictive and repetitive behaviors had a focus on the preliminary efficacy of EAAT, so some of its design characteristics were limiting (Peters et al., 2020). These limitations included a small sample size and differences in nonverbal IQ scores between the control group and experimental group. Because of these limitations, other research should be considered when determining whether improvements in restricted behavior are generally significant.

One systematic review included both communication and socialization outcomes in the category of social functioning (Trzmiel et al., 2019), while the current systematic review looks at each of these categories separately; this is because the current review focuses on social outcomes while the previous review studies a broad range of outcomes for children with ASD. Trzmiel and colleagues report a high effectiveness of EAAT on the improvement of social functioning. Due to the differences of definitions in their review and the current review, these results in social functioning will be taken under consideration but not given the same weight as the individual outcomes of communication and socialization.

Strengths

This review includes seven studies written after 2019 which add to the research pool for EAAT and help provide more up to date and conclusive results. Two more randomized control trials (RCTs) were reviewed which were written after three of the previous systematic reviews. These RCTs therefore, the small sample size described by previous systematic reviews was addressed in some of the newer studies included in the current review. One RCT was not included in any other reviews. The current review includes individuals of all ages with a variety of developmental disorders. The broader focus will include more studies and will be more inclusive as to who might benefit from EAAT. The broad range of EAAT interventions set this review apart from previous systematic reviews.

Limitations

Although the broadness of EAAT is a strength, the heterogeneity of the studies was also one of the major limitations of this review. Before determining which types of EAAT meet the specific needs of individuals, there is a need for more studies with common methodology and stricter parameters in order to more fully and reliably understand the effects of EAAT therapy on individuals with developmental disorders. Some heterogeneous parameters from present studies include sample size, length of intervention, presence of a control group, and outcomes measured. The most notable limitations for this review were the various lengths of interventions and outcomes measured within the studies. In future studies, it would be helpful to standardize the outcomes measured under specific topics; these broad topics might include social, cognitive, and physical outcomes. More long-term intervention and measurements are also necessary to determine the lasting effects of EAAT. This need for long-term studies was mentioned in other systematic reviews as well (Srinivasan et al., 2018; Trzmiel et al., 2019).

Conclusion

EAAT had an overall positive effect in the majority of studies included in this review. These results suggest that various forms of EAAT are beneficial for the social skills (including communication, social motivation, socialization, and social functioning) of people with developmental disorders. Communication and socialization outcomes stood out above the others. These two outcomes were measured by more articles and supported by more RCT studies than the other outcomes. The findings in the current review promote the usage of EAAT either independently or as a complement to traditional therapy for individuals with developmental disorders. Some of the studies included in this review had conflicting findings regarding how long the effects of EAAT lasted (Bass et al., 2009; Ward et al., 2013). More research is needed to determine how long-lasting the effects of EAAT are. Due to the slight variation in outcomes between studies, EAAT does not yet stand as a viable stand-alone therapy. More research is needed to determine whether it would be an effective therapy when used independently, but many studies suggest that it would be. Given the large quantity of positive results within the 18 studies in this review, EAAT would be a beneficial complementary tool alongside traditional therapy.

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