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Animal-Assisted Therapy in Children Living with Autism Spectrum Disorder: A Literature Review of Randomized Controlled Trials

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Abstract

Introduction: *Autism spectrum disorder (ASD) is a prevalent neurodevelopmental condition with significant impacts, and the benefits of animal-assisted therapy (AAT) in this population are unclear. This review aims to inform clinical decision-making and guide future research in AAT for children with ASD.*

Methods: *We conducted a comprehensive search across PubMed, Cochrane Library, Embase, and ScienceDirect of randomized controlled trials of AAT in children with ASD, published until July 2023. Other inclusion criteria involved English-language articles and full-text availability. The selection process adhered to PRISMA 2020 guidelines, and the Cochrane Bias Assessment Tool was used for quality appraisal.*

Results: *45 studies were retrieved; six were included after removing duplicates and applying criteria. These studies included 300 children with ASD who received different AATs as an add-on therapy with a follow-up range of 7 to 16 weeks. Additional outcomes were measured with multiple scales. Overall, studies described that AAT has various benefits in this population, including improving cognitive, communication, and social skills, increasing adaptive behaviors, and reducing irritability and hyperactivity compared to control groups that did not receive AAT. The risk of bias measured with the Cochrane Bias Assessment Tool showed varied methodological quality among studies.*

Conclusion: *Whether involving dogs or horses, AAT can improve overall quality of life, reduce autism-related behaviors, enhance communication and cognitive skills, promote social development, and mitigate anxiety. While encouraging, further research is imperative to strengthen the evidence base and assess the long-term effects of AAT in this population.*

Introduction

Autism spectrum disorder (ASD) is a complex neurodevelopmental condition characterized by deficits in social interaction, communication, and repetitive patterns of behavior (American Psychiatric Association, 2013; Lai et al., 2014). Its prevalence is approximately 1 in 36 children, with an overall estimate of 2.8% among children eight years old (Maenner, 2023). Children with ASD often experience co-occurring diagnoses, including attention deficit hyperactivity disorder, oppositional defiant disorder, and anxiety (Sissons et al., 2022). These challenges can hinder their social and emotional development, impact their overall quality of life, and increase healthcare costs (Lord et al., 2018; Matin et al., 2022).

Animal-assisted interventions (AAIs) have become a complementary approach for individuals with ASD. AAIs involve incorporating live animals, such as horses and dogs, into therapeutic programming. Its proposed mechanisms include stress reduction, altered stress hormone levels, and providing a less complex social stimulus (Sissons et al., 2022). Animals may be appealing motivators for positive peer

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interactions and social skill development. AAIs include three categories: targeted therapeutic services (Animal-Assisted Therapy, AAT), enrichment visits (Animal-Assisted Activities, AAA), and educational programs (O'Haire, 2017; Williams White et al., 2007). It has garnered momentum in research and clinical practice, showing promise for symptom reduction and social development in individuals with ASD (O'Haire, 2013; O'Haire et al., 2015; Srinivasan et al., 2018). A recently published review found positive effects of AAT for children with ASD in behavioral, cognitive, social, emotional, and physical domains, but none has focused exclusively on randomized controlled trials (RCTs) (Rehn et al., 2023).

The focus of this literature review is on AAT in children living with ASD. The study aims to analyze the evidence from RCTs to assess the efficacy of AAT in various outcomes that encompass improved quality of life, positive changes in autism-related behaviors and interests, communication, cognition, social skills, and anxiety reduction. The review seeks to provide a comprehensive and up-to-date overview of AAT's current state of the art. This will contribute to informed clinical decision-making and guide future investigations in the field of AAI for children with ASD.

Materials and Methods

We conducted a literature search based on the updated 2020 PRISMA guidelines (Page et al., 2021). To identify studies describing AAT for children and adolescents living with ASD. The literature review involved a comprehensive search of various electronic databases, including PubMed, Cochrane Library, Embase, and ScienceDirect. The search was limited to studies published in English until July 2023.

Search Strategies

All the search strategies, the databases used, and the identified number of papers for each database are shown in Table 1.

Study Criteria

The inclusion criteria were as follows: (1) articles written and published in English; (2) participants aged 3-18 years diagnosed with ASD with any degree of severity; (3) intervention involving AAT; (4) outcome measures related to quality of life, autism-related behaviors, communication, cognition, social skills, and anxiety reduction; (5) RCTs; and (6) full-text articles available. This review excluded inpatient children, different study designs, and sources other than those cited above.

Selection Process

The PRISMA 2020 flow diagram is shown in Figure 1. All articles were thoroughly checked, and GW removed duplicate articles. Titles and abstracts of the remaining articles were screened by three independent reviewers (KF, CS, and MS). Full-text papers were scrutinized, and the inclusion and exclusion criteria were carefully reviewed using the Rayyan app (Ouzzani et al., 2016). All co-authors agreed upon the preselected articles if eligibility criteria conflicted.

Quality Appraisal of the Studies

The Cochrane Bias Assessment Tool was used to assess the quality of randomized controlled trials (Higgins et al., 2011). All co-authors discussed any conflicts regarding the quality appraisal, and the final decision to include an article was based on mutual consensus. Figure 2 presents the results of the quality assessment of the included articles.

Data Extraction

Data extraction was conducted independently by MC, GW, FB, CS, TP, and AB. All reported outcomes were extracted. All authors then reviewed and verified data to ensure accuracy and completeness.

Results

Study Selection

A total of 45 studies were retrieved from the search following the strategy; 28 were duplicated. The eligibility criteria of 17 articles were analyzed; an article was not included in the Rayyan analysis due to the absence of published results (Collado-Mateo, 2021). From the assessed studies, ten were excluded: one because of not having full-text version available in English (also measured a different outcome)(Ortiz Sánchez et al., 2018), three for different study designs (Ghumman et al., 2020; Klein & Kemper, 2016; Peters, Pan, et al., 2022), three for diverse population (Germone et al., 2019; Wijker et al., 2020, 2021), one for being a conference abstract (Albasha et al., 2016), one for measuring a different outcome (Peters et al., 2021), and another one for including a further intervention (Amatachaya et al., 2015). Lastly, six articles were included, as previously shown in Figure 1.

Study Characteristics

No.	Search strategy	Database used	Number of papers identified
1.	“Autism Spectrum Disorder” AND “Animal-assisted therapy” AND randomized clinical trial	Cochrane Library	6
2.	"Animal Assisted Therapy"[Mesh] AND ("Child"[Mesh] OR "Adolescent"[Mesh]) AND "Autism Spectrum Disorder"[Mesh] (Article type: randomized controlled trials).	PubMed (MeSH)	6
3.	"animal assisted therapy" AND "autism" (Article type: randomized controlled trials).	PubMed	9
4.	“child” AND “ASD” AND “animal assisted therapy” (Article type: randomized controlled trials).	PubMed	4
5.	(Adolescent OR Child) AND autism AND animal assisted therapy (Article type: randomized controlled trials).	PubMed	8
6.	'child'/exp AND 'autism'/exp AND ('animal assisted therapy'/exp OR 'animal assisted intervention'/exp) AND ('randomized controlled trial'/exp OR 'controlled trial, randomized' OR 'randomized controlled study' OR 'randomized controlled trial' OR 'randomized controlled study' OR 'randomized controlled trial' OR 'trial, randomized controlled')	Embase	11
7.	animal assisted therapy AND autism spectrum disorder AND child AND randomized controlled trial	ScienceDirect	1
	Total number of research papers identified	-	45
	Number of articles after removing duplicates	-	17

Table 1: *Number of papers identified in accordance with corresponding search strategies.*

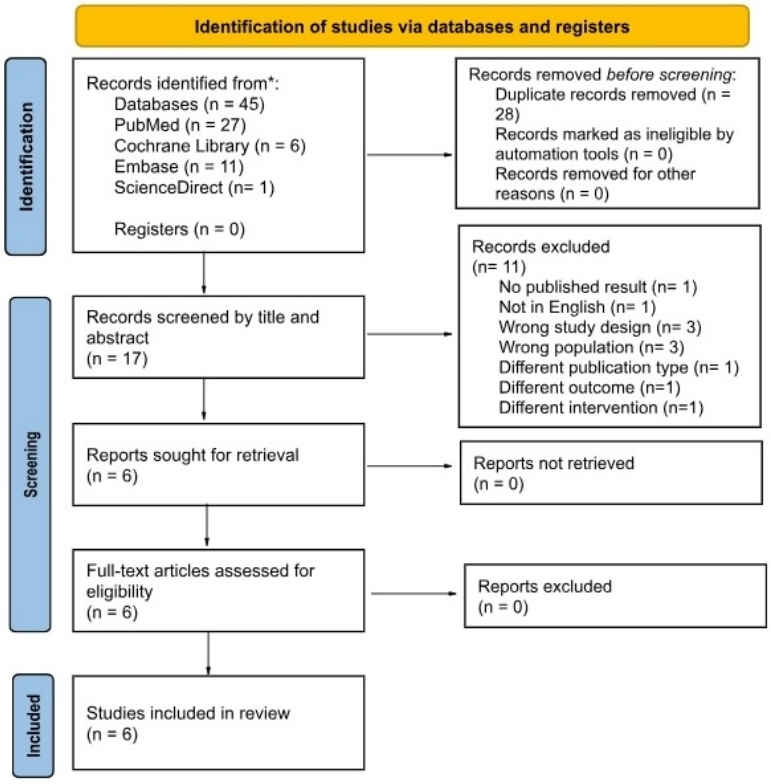

Figure 1: *PRISMA flow diagram of study selection.*

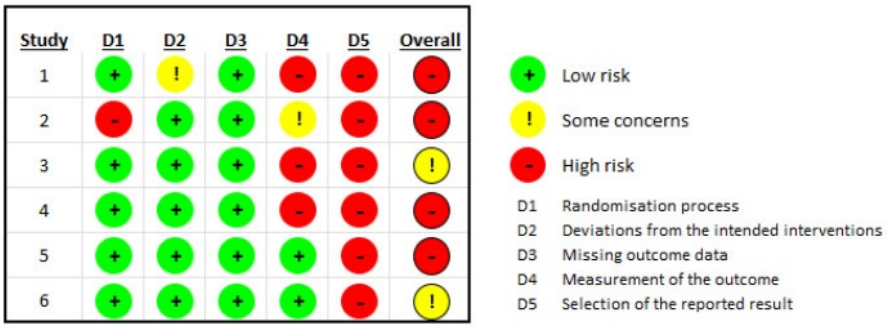

Figure 2: *Quality assessment of studies.*

The six studies included 300 participants aged between 4 and 16 years old. The follow-up varied from 7 to 16 weeks, and the studies were conducted in 4 different countries, as shown in Table 2. All studies used AAT as an add-on therapy. Five studies used horses, and one used dogs. Different scales were used to measure the primary and secondary outcomes.

Peters et al. (2022) showed that after horse-assisted therapy (OTee HORSPLAY) intervention, participants exceeded their goal attainment expectations (p=0.03; t(19)=2.32), showed improved social motivation (p=0.03; d=-0.51), and reduced irritability (p=0.04; d=0.49). There were no significant changes in social communication or hyperactivity (p=0.11, d=-0.37) (Peters, Wood, et al., 2022).

Hill et al. (2020) demonstrated an increase in on-task behavior of 2.6% with canine AAT in children with ASD compared to the control group. However, there was no significant statistical difference, with only a modest effect size of 0.31. Both groups improved performance and satisfaction from baseline to post-therapy ($p < 0.001$). Even though they observed a 0.2 increase in median scores for both performance and satisfaction within the treatment group, it was not statistically significant compared to the placebo group, with an effect size of 0.17 and 0.29, respectively (Hill et al., 2020).

Souza-Santos et al. (2018) compared dance and Equine-Assisted therapy (EAT) in 3 different groups. They observed improvements in communication (p=0.01), psychosocial adjustments (p=0.02), and functional independence (p=0.03) by the dance intervention. Still, in intergroup analysis, the Dance & EAT group had considerably better improvements in the classification of functioning (p=0.0001) (Souza-Santos et al., 2018).

Petty et al. (2017) showed a significant difference at baseline in AATS (Animal attachment score) (13.59 vs. 15.78, p=0.02). The AATS score of participants in the THR group significantly improved from 13.59 to 15.4 after intervention (p=0.003), while the score of control participants showed no trend of improvement (p=0.69). The between-groups difference in the post-THR change is statistically significant (0.74, p=0.013), indicating that THR positively affects AATS scores (Petty et al., 2017).

In Steiner & Kertesz (2015), the horse therapy group showed significant improvements in communication skills, socialization/adaptive skills, self-care, and gait parameters. The experimental group displayed a significant improvement in all mental skills measured by the PAC test ($p < 0.001$), whereas the non-riding group did not show changes. This research suggests that THR is a novel therapeutic approach and is thriving as an add-on therapy in children with ASD, even when other interventions have not had favorable results (Steiner & Kertesz, 2015).

Gabriels et al. (2015) significant improvements were observed in the THR group in irritability (p=0.02, d= 0.5), hyperactivity (p= 0.01, d=0.53), social cognition (p=0.05, d= 0.41), and communication assessed by SRS score (p=0.03, d= 0.63) Communication considered with SALT presented a significant increase in the use of different words (p= 0.01, d= 0.54) and speaking more words (p= 0.01, d=0.54) (Gabriels et al., 2015).

Assessment of Risk of Bias in Individual Studies

The risk of bias revealed that the included studies varied in methodological quality. The randomization and allocation concealment domains were rated as low risk of bias. However, blinding of participants and personnel and blinding of outcome assessment were often rated as unclear or high risk of bias. Incomplete outcome data and selective reporting also showed variability across the studies.

Discussion

AAT, including interventions involving horses and dogs, has increasingly gained recognition as a complementary approach to support individuals with

Study number: Reference	Sample (location)	Intervention	Control	Primary outcome Measures	Secondary outcome	Period Follow-Up	Main findings
1 (Peters, Wood, et al., 2022)	n=24 (USA)	Occupational Therapy in an Equine Environment: Harnessing Occupation to Address Self-Regulation, Social Communication, and Play and in Youth with Autism" (OTee HORSPLAY); relevant practice guidelines in occupational therapy for youth with ASD integrated (n=12).	Occupational therapy in a Garden Environment (n=12)	*Goal Attainment Scaling* (GAS), parent-filled irritability and hyperactivity subscales of the Aberrant Behavior Checklist-Community (ABC-C), and Social Responsiveness Scale, Second Edition (SRS-2), Pediatric Evaluation of Disability Inventory Computer Adaptive Test, Autism Spectrum Disorder Module (PEDI-CAT ASD).	Hair Cortisol Content (HCC).	10 weeks	The OTee HORSPLAY group showed greater improvement in goal attainment and social/cognitive adaptive behaviors when compared to the control group.
2 (Hill et al., 2020)	n=22 (Australia)	Canine-assisted occupational therapy (n=11). Seven, one-hour sessions with an occupational therapist and a therapy dog.	Usual care occupational therapy (n=11). Seven, one-hour sessions with an occupational therapist and no dog.	On-task behavior (defined as verbal and non-verbal behaviors directed towards task completion. Coders were trained in the use of the on-task behavior checklist developed by the first author.	Assessment of goal attainment by Canadian Occupational Performance Measure (COPM).	7 weeks	Canine-assisted occupational therapy provided similar outcomes in on-task behaviors and goal attainment for children on the autism spectrum when compared to goal-directed occupational therapy on its own.
3 (Souza-Santos et al., 2018)	n=45 (Brazil)	(1) dance group (DG); (2) Equine-Assisted therapy (EAT) (24 sessions twice a week for 60 minutes) group (EG) and, (3) Dance and EAT group. The dance intervention involved a special dance program developed for people with disabilities. The program focused on improving social responsiveness, motivation, language, and communication, reducing behavioral and stress problems. The session took place in an outdoor location and included activities such as horse approach, touch stimulation, riding, and courses with varied riding. The participants were actively rode with verbal commands and visual clues.	Active: Dance intervention and EAT and dance at the same time.	Childhood Autism Rate Scale (CARS). A 15-item scale used to assess aspects related to autism graduation that allows for the differentiation between mild-moderate and severe autism.	Functional independence measure. (FIM). Childhood Autism Rate Scale (CARS).	12 weeks	Communication, psychosocial adjustments, and functional independence were all improved by the dance intervention. After the intervention, the Dance group's functioning improved (p=0.04). Intergroup analysis showed that the Dance & EAT group had considerably better improvements in the classification of functioning (p=0.0001).
4 (Petty et al., 2017)	n= 67 (USA)	Therapeutic horseback riding (THR) children from 6 to 16 years old with autism or Asperger's disorder diagnosed, with one or more family pets: 31 children in the experimental group taking 1-hour session with animal care/riding for 10 weeks with their caregivers.	The control group (36 children) also consisted of a one-hour lesson at the same riding center but with no horse contact.	A consistent caregiver completed questionnaires about participants' interactions with their household pets pre and post-intervention using the caregiver report "Child's Attitude and Behavior toward Animals" (CABTA).	Increase in social interaction.	10 weeks	Caregivers of THR group participants reported significant improvements in participants' caring actions with the family pet compared with the control group.
5 (Steiner & Kertesz, 2015)	n= 26 (Hungary)	Therapeutic horse riding (THR) in scholars from 10 to 13 years old with autism: 13 children in the experimental group taking 30-minute sessions a week of riding a horse in a saddle, guided by a therapist.	Non-riding control group. 13 children who were in the same riding hall but received physical therapy one hour a day instead of THR.	Gait cycle analysis was measured by the APAS system, before therapy, 1 month after therapy, and 3 months later without any intervention.	Mental skills measured by the PAC test, which include communication, self-care, motor skills, and socialization.	1 month of therapy + a control period of 3 months without any intervention.	The mental skills of the riding group (communication, socialization, and self-care) were significantly better in all parameters of the PAC test in each item, in comparison to the non-riding group which showed no change. The horse therapy group also showed significant differences related to larger gait cycles and better stability than the control group. Effects size was not reported.
6 (Gabriels et al., 2015)	n= 116 (USA)	Therapeutic Horseback Riding Intervention guided by an instructor with advanced therapeutic certification (PATH) (n=58).	Barn Activity Control Intervention: led by a therapeutic riding instructor and a master's level therapist with experience working with children with ASD. Participants had no contact with horses; teaching of riding skills was with a life-size stuffed horse.	Self Regulation with ABC-C scale.	Social Measure with SRS Scale, Communication with SALT and PPVT-4 scale, adaptive behavioral with VABS-II scale, motor behavioral with BOT-2 and SIPT scale.	10 weeks	Equine-assisted therapy in children with autism spectrum presented beneficial results in the control of Irritability and Hyperactivity evaluated with ABC-C from the fifth week of intervention when compared to the control group.

ABC-C scale: Aberrant Behavior checklist-Community; Irritability, Lethargy/Social Withdrawal, Stereotypy, Hyperactivity and Inappropriate Speech subscale score. **APAS:** Ariel Performance Analysis System. **BOT-2:** Bruininks-Oseretsky Test of Motor Proficiency. **CABTA:** Child's Attitude and Behavior toward Animals. **PAC:** Pedagogical Analysis and Curriculum. **PPVT-4:** Peabody Picture Vocabulary test, 4º Edition. **SALT scale:** Systematic Analysis of Language Transcripts. **SIPT:** Sensory Integration and Praxis test. **SRS scale:** Social Responsiveness Scale; Social Awareness, social Cognition, social Motivation, social Communication and Autistic Mannerisms subscale score. **THR:** Therapeutic Horse Riding. **VABS-II:** Vineland Adaptive Behavior Scale - 2º Edition.

Table 2: *Characteristics of included studies.*

ASD by reducing stress, enhancing social/cognitive adaptive behaviors, and improving overall well-being (Gabriels et al., 2015; Peters, Wood, et al., 2022). Rigorous selection criteria were applied to the 6 RCTs yielded by the literature search. While the methodological quality of the included studies varied, there was a consistent focus on assessing the potential benefits of AAT for children and adolescents with ASD.

One of the key findings across the studies was the notable improvement in communication, socialization, and self-care for children with ASD participating in AAT interventions (Steiner & Kertesz, 2015). This finding highlights the potential holistic benefits of AAT beyond symptom-specific approaches. Several studies, particularly those involving horses, demonstrated the capacity of AAT to substantially reduce repetitive behaviors and improve social interaction scores in individuals with ASD (Peters, Wood et al., 2022; Souza-Santos et al., 2018; Steiner & Kertesz, 2015). These findings have important implications for daily life, as reducing autism-related behaviors can lead to meaningful improvements in the lives of individuals with ASD and their families (Estes et al., 2019).

Effective communication is a significant area of focus for children with ASD (Hutchins & Prelock, 2014). One study demonstrated notable improvements in communication skills following AAT with horses (Steiner & Kertesz, 2015). This suggests that AAT may improve communication, which can significantly impact ASD patients' functioning and quality of life. Studies highlighted the potential of AAT to improve multiple cognitive abilities in children with ASD (Petty et al., 2017). Cognitive development is crucial for academic and life skills, and these findings suggest that AAT may contribute positively to this aspect of functioning.

Another fundamental challenge for children with ASD is developing social skills (Badiah, 2018; Bellini & Peters, 2008). One study found significant improvements in social interaction and peer relationship scores following AAT with dogs (Hill et al., 2020). This implies that AAT may assist children with ASD in overcoming social challenges and fostering positive interactions with their peers (Hill et al., 2020; Souza-Santos et al., 2018; Steiner & Kertesz, 2015). Also, for individuals with ASD, anxiety is a common co-occurring issue (Hossain et al., 2020; Vasa & Mazurek, 2015; White et al., 2009). One study's reduction in anxiety levels, particularly in interventions involving horses, is a significant finding (Gabriels et al., 2015). Decreasing anxiety levels can have substantial benefits, as it may lead to improved overall well-being and functioning for individuals with ASD (Capriola-Hall et al., 2021; Mazefsky et al., 2013; White et al., 2009).

While these findings suggest that AAT holds promise as a complementary approach for children with ASD, it's important to acknowledge certain limitations of the current review. Variability in methodological quality, blinding procedures, and incomplete outcome data across the studies introduce some uncertainty. Often, the blinding of participants and personnel and the blinding of outcome assessment presented a high or unclear risk. However, there was a low risk in domains like randomization and allocation concealment. Additionally, the heterogeneity in the animals used in AAT interventions and the varied measurement scales employed for assessing outcomes may influence the generalizability of the results. Also, the limited selection of databases and excluding grey literature and non-RCTs might have limited our findings.

The improvements in quality of life, reduction in autism-related behaviors, enhancement of communication and cognitive skills, development of social skills, and anxiety reduction indicate that AAT could be a valuable adjunctive intervention. However, further research with larger sample sizes, standardized methodologies, and extended follow-up periods is necessary to confirm and refine these findings. This endeavor will facilitate the development of evidence-based clinical guidelines and support informed decision-making concerning the use of AAT for children with ASD.

Conclusion

This review has shed light on the potential of AAT as a promising adjunctive intervention for children with ASD. The findings suggest that whether involving horses or dogs, AAT can significantly improve overall quality of life, reduce autism-related behaviors, enhance communication and cognitive skills, promote social development, and mitigate anxiety. While encouraging ASD management, further research is imperative to strengthen the evidence base and to assess the long-term effects of AAT in this population.

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Conflicts of Interest

The authors declare no conflict of interest.

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