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Effects of equine assisted activity on children and adolescents with autism spectrum disorder

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Abstract:

Background: Autism spectrum disorder (ASD) encompasses a spectrum of disorders which are characterized as having impaired communication skills, social skills and repetitive behaviors or body movements.[1, 2] Since every individual with ASD presents with different challenges, treatment modalities for ASD are quite diverse. Equine Assisted Activities (EAA) to include therapeutic horseback riding (THR) is a treatment modality that has been utilized more in recent years for children and adolescents with ASD, as it is thought the connection between the individual and the horse can facilitate emotional, behavioral, and cognitive growth.[3] **Objective:** To determine the effectiveness of Equine Assisted Activity (EAA) to include therapeutic horseback riding (THR) on behavior and adaptive functioning in children with Autism Spectrum Disorder (ASD). **Design:** Systematic Literature Review. **Methods:** A literature search of PubMed Database and Scopus using the search terms "equine therapy," and " autism." In PubMed and Scopus the following limits were used: published in the past six years, articles in English, randomized control trials, meta-analysis, human subjects, and free full text articles. **Results:** The following studies were included: a randomized controlled trial by Gabriels et al, a quasi-longitudinal study by Ward et al, and a quasi-longitudinal study by Lanning et al. All studies showed that various behavioral outcomes were improved in children and adolescents with ASD who participated in an EAA. **Conclusion:** EAA to include THR can be beneficial to those with ASD. However, due to the large spectrum of ASD, certain children and adolescents may benefit more from EAA than others. There are few studies on the effects EAA has on children with autism, and these published studies have small, predominantly male sample sizes. Future studies need to be conducted and must include a larger population and a more even distribution of males to females to determine both short term and long term effects EAA has on behavioral and adaptive functioning in children and adolescents with ASD.

Table 1.0 Table of Terminology

ASD	Autism Spectrum Disorder
EAA	Equine Assisted Activities (to include THR)
THR	Therapeutic Horseback Riding
CAM	Complementary and Alternative Medicine
BA	Barn Activity
PATH	Professional Association of Therapeutic Horsemanship International
DSM IV-TR	Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (American Psychiatric Association, 2000)

Introduction:

Autism spectrum disorder (ASD) is a complex neurological disorder characterized by having impaired communication skills, social skills, and repetitive behaviors or body movements.[1] The disorder

is often diagnosed in childhood, and can be recognized in children under 3 years of age.[2] According to the Centers for Disease Control, ASD is reported in all socioeconomic, ethnic, and racial groups, and has been identified in about 1 in 68 American children, affecting 1 in 42 boys, and 1 in 189 girls.[3]

Since 2000, the number of children with ASD has doubled per 1,000 children, from 6.7 in 2000, to 14.6 in 2012.[3] With increasing prevalence and as ASD is a spectrum of disorders, treatment modalities for ASD are as diverse as the behaviors exhibited by individuals with the disorder. According to Dr. Weissman and Dr. Bridgemohan, the goals of ASD therapy are to improve the quality of life through moving the child toward independence and maximizing functioning.[3] This is accomplished through improved social functioning and communication, as well as adaptive skills, a decrease in nonfunctional or negative behaviors, and promotion of cognitive and academic functioning. Evidence shows intervention is more effective when initiated early in a child's development, and when the therapy is targeted specifically to the individual's needs. Traditional treatment targets the core symptoms of ASD and focuses on educational and behavioral interventions. Symptom control can be achieved through pharmacological intervention, however medication does not treat the core deficits. Many families have chosen to pursue complementary and alternative therapies.[4]

Complementary and alternative medicine (CAM) treatment include those systems, practices and products that are not generally considered the same as conventional medicine, as defined by the National Center for Complementary and Alternative Medicine. Complementary medicine therapies are used in addition to traditional therapies, while alternative therapies are selected in lieu of conventional therapy. Many of the CAM therapies address the numerous biological symptoms of ASD beyond the core symptoms of social communication deficits, and restricted, repetitive behavior, interests and activities (gastrointestinal symptoms, sleep disturbances, food insensitivities and allergies, etc).[5]

One CAM therapy that has grown in popularity in recent years is equine assisted activity (EAA), which includes therapeutic horseback riding (THR). EAA is thought to have a broad impact on cognitive, social and gross motor functioning by stimulating these domains simultaneously.[5] It is a form of animal assisted therapy provided by a riding instructor specifically trained to teach a child with ASD how to control the horse, as well as basic riding skills. It is the emphasis of control, focus, sensory management, attention and both verbal and nonverbal communication that are at the core of the therapy. In general, EAA also provides contact with horses, stimulating a psychological, social and physiological response in the children and adolescents.[6] This systematic review will focus on the use of EAA and the effect it has on children and adolescents with ASD; primarily their behaviors and their level of adaptive functioning on a short term and long term basis.

PICO:

Figure 1.0: PICO

Population	Children and adolescents with Autism Spectrum Disorder
Intervention	Equine assisted activity
Comparison	Children and adolescents with Autism Spectrum Disorder not participating in equine assisted activity

Outcome	Improved behavior and adaptive functioning

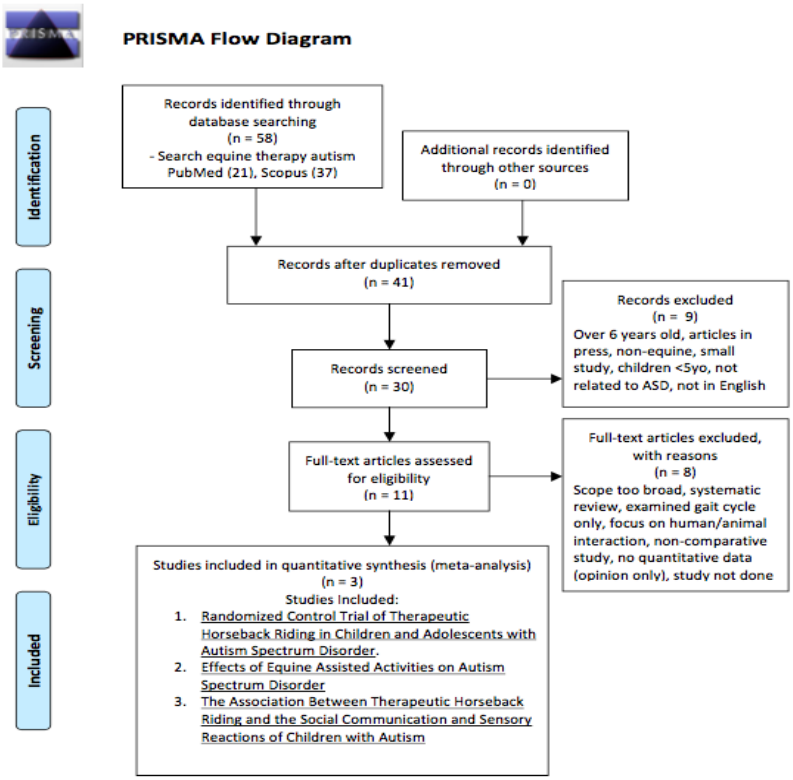
Clinical Question:

In a population of children and adolescents with Autism Spectrum Disorder, does equine assisted activity improve behavior and adaptive functioning, compared to children and adolescents with Autism Spectrum Disorder not engaged in equine assisted activity?

Methods:

An initial PubMed and Scopus search was performed in September 2017 using the search terms "equine therapy," and " autism," which yielded a total of 58 articles; 21 in PubMed and 37 through Scopus. The search was then refined to only include articles published within the past six years, articles in English, randomized control trials, meta-analysis, human subjects, and free full text articles, yielding a total of 30 articles. Nineteen of the 30 articles were subsequently excluded for various reasons, including studies that had too small of a sample size, those focused on children under the age of 5, articles that did not focus on ASD, and those that covered a scope too broad, including a systematic review that evaluated numerous types of pet assisted therapy versus only looking at equine therapy. The final 3 articles remaining were included in this study for a qualitative analysis. The PRISMA flow diagram is demonstrated in Figure 2.0.

Figure 2.0 PRISMA Flow Diagram[10]



Results:

Study #1

Randomized Controlled Trial of Therapeutic Horseback Riding in Children and Adolescents With Autism Spectrum Disorder. Gabriels et al.[7]

Objective:

To evaluate the effectiveness of therapeutic horseback riding (THR) in children with ASD by measuring their self-regulation, socialization, communication, adaptive, and motor behaviors.

Study Design:

This study was a randomized control trial that compared the behavioral effects of children and adolescents with ASD participating in THR to participating only in barn activities (BA) without a horse. A total of 116 participants ages 6 to 16 years old with a previous diagnosis of ASD were evaluated over a 10 week period. The subjects were first stratified based upon their nonverbal IQ scores (>85/<85), and then randomized to either participate in THR or BA. Fifty eight participants were assigned to each group. Each session for both the THR intervention and the BA intervention lasted a minimum of 45 minutes. A volunteer was assigned to the two to four participants that were present for each session. A certified Professional Association of Therapeutic Horsemanship International (PATH) advanced therapeutic instructor taught all of the THR lessons, while a THR instructor and a masters level therapist co-led the BA intervention group. Those in the BA group had no direct interaction with the horses. Table 2.0 outlines the studies inclusion and exclusion criteria. Those who met any of the exclusion criteria were excluded from the study. Table 3.0 demonstrates the characteristics of participants who completed the study including average age, gender, and average IQ.

Table 2.0: Inclusion and Exclusion Criteria for Gabriels et al [7]

INCLUSION CRITERIA	EXCLUSION CRITERIA
● Ages 6 to 16 years old ● Met or exceeded the ASD screening cut-off (≥ 15) on the Social Communication Questionnaire ● Confirmed diagnosis of ASD ● Determined by meeting the clinical cut offs for ASD on the Autism Diagnostic Observation Schedule or the Autism Diagnostic Observation Schedule- second edition ● Combined score on the Irritability and Stereotypy subscales of the Aberrant Behavior Checklist-Community of ≥ 11 ● Leiter-R37 Brief nonverbal IQ (NVIQ) standard score of ≥ 40	● Previously diagnosed with a genetic disorder to be similar to ASD ● History of disruptive behavior ● History of animal abuse ● History of a fear or phobia of horses ● More than two hours of equine assisted autism therapy within the past six months ● Weight exceeding the horse riding centers recommendation

Table 3.0: Summary of Participants Characteristics [7]

	Therapeutic Horseback Riding	**Barn Activity**	**Total**
Gender M/F	49/9	52/6	101/15
Mean Age	10.5	10.0	10.2
Mean IQ	86.7	86.1	86.4

Data on behavioral outcomes were provided by a speech therapist and occupational therapist who were both blinded to the study, as well as the participant's unblinded caregiver. The speech therapist and occupational therapist performed behavioral assessment measurements and evaluations within one month of pre and post intervention in order to evaluate the participants baseline and post study functioning, while the caregivers rated participants' behaviors weekly.[7] Table 4.0 discusses the assessment measurements used by the speech and occupational therapist and caregivers.

Table 4.0: Study 1 Data Assessment Measurements [7]

Collection of Data	**Data Assessment Measurements**
Speech Therapist	Peabody Picture Vocabulary Test, 4th edition (PPVT-4); PPVT-4A used for pre-evaluations; PPVT-4B used for post evaluations Systematic Analysis of Language Transcripts (SALT): *Number of different words used, Number words used*
Occupational Therapist	Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2) Sensory Integration and Praxis Test (SIPT) *Postural praxis, Praxis on verbal command*
Caregiver	Vineland Adaptive Behavioral Scales, 2nd edition (VABS-II) Aberrant Behavior Checklist- Community (ABC-C): *Irritability, Lethargy/Social Withdrawal, Stereotypy, Hyperactivity, Inappropriate speech* Social Responsiveness Scale (SRS): *Social Awareness, Social Cognition, Social Communication, Autistic Mannerisms, Social Motivation*

All of the assessments used evaluated different aspects of the participants behavior. The Social Responsiveness Scale (SRS) is a questionnaire that asks 65 items in order to measure social impairments of ASD including awareness, social cognition, social motivation, social communication, and autistic mannerisms. The Aberrant Behavior Checklist-Community (ABC-C) is a symptom checklist which evaluates the participants irritability, lethargy/social withdrawal, stereotypy, hyperactivity, and inappropriate speech behaviors.[7] The assessment in total asks 58 questions. Systematic Analysis of

Language Transcripts (SALT) was utilized in order to provide guidelines for analyzing the language samples provided by the participants, and measured the number of different words and total words used. The Bruininks-Osertski Test of Motor Proficiency 2nd edition (BOT-2) and two subscales of the Sensory Integration and Praxis Test (SIPT).

In order to statistically assess all of the results from the study, a software program was used for all analyses. Power of the study was conducted using a linear mixed effects model, which ensured 80% power at 5% significance using the sample size of 116 participants.

Study Results:

Out of the 127 participants who enrolled in the trial, 4 participants dropped from the THR group, and 7 participants dropped from the BA control group. Significant post intervention improvements were seen for those participating in THR, specifically in irritability, hyperactivity, social cognition, social communication, and spoken language.

The ABC-C showed that the subjects in the THR intervention improved more than the BA intervention in reducing irritability and hyperactivity with effect sizes of 0.50 (p=0.02) and 0.53 (p=0.01) respectively. The subjects irritability and hyperactivity significantly improved at the beginning of week 5 of therapy. According to the SRS, those who participated in the THR also had better improvement in social cognition and communication than those in the BA control group with effect sizes of 0.41 (p=0.05) and 0.63 (p=0.003). There were no other significant differences detected regarding other aspects of both the ABC-C and the SRS that were not mentioned above. SALT was used to assess communication skills between the two interventions, and those who were in the THR intervention spoke more, and expanded their vocabulary with an effect size of 0.54 (p=0.01) after the study was completed. Table 5.0 demonstrates results found in THR vs. BA.

Table 5.0 Significant results found in THR vs. BA with a p value ≤ 0.05 [7]

Measurement	**Average Change (THR)**	**Average Change (BA)**	**P value**	**Effect Size**
ABC- irritability	-6.3	-2.6	0.02	0.50
ABC- Hyperactivity	-7.5	-2.9	0.01	0.53
SRS- Social Cognition Impairment	-2.4	-0.5	0.05	0.41
SRS- Communication Impairment	-6.1	-1.2	0.003	0.63
SALT- # of different words used	15.7	-3.7	0.01	0.54
SALT- # of words used	40.5	-14.9	0.01	0.54

Study Critique:

This study is the only a randomized control trial included in this meta analysis. To date, the Gabriels et al study is one of the largest studies conducted to analyze the human-equine relationship and how it impacts those with ASD. The children participating in the study were first stratified by their

nonverbal IQ scores and then randomized. Although randomization was not concealed, both groups are comparable as participants were first stratified based on their level of cognition and then randomized, which is important for the validity of the study. The study also describes the efforts that were made to keep the volunteer and the horse assigned to the child consistent throughout the duration of the study. This is important as children with ASD are often found to struggle with change. The study was able to measure outcomes from three different sources, which included non-blinded caregivers, blinded occupational therapists and blinded speech therapists. The specialists who were blinded to the case helped to minimize investigator bias. The study also evaluated numerous aspects of behaviors exhibited by those with ASD, and utilized different behavior assessment scales to reflect this.

Limitations of the study include the fact that caregivers were not blinded, which may have reflected the results of the ABC-C, SRS, and the VABS-II. This could have contributed to a placebo effect and possible bias among caregivers. The study also limited its' sample to a narrow window of IQs, which could have influenced the outcomes. The author defined all of the statistically significant study results as having p value <0.05, however this was not definitively stated in the article. Also not mentioned specifically in the article is what the participants in the BA intervention did during their sessions, so it is difficult to assess how differently the two treatment groups were treated, and whether or not this could have affected the results of the study. The intent to treat population was originally 127, but 4 of the participants in the THR group and 7 from the BA group dropped from the study after intervention was initiated. It does not comment on when or why these individuals dropped from the study, which would be useful in drawing a thorough conclusion from the study's results. Most importantly, the study could have been much stronger if it also incorporated a control group without any intervention at all, to further analyze the effects of THR.

Study #2:
The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. Ward et al.[8]

Objective:

To investigate the association between therapeutic horseback riding and the sensory reactions and social communication skills of elementary school students.

Study Design:

This study used a single group quasi-experimental interrupted timed series design to determine the impact of therapeutic riding and the sensory processing and social communication skills of elementary students with autism.[8] Quasi experimental designs use statistical controls (or in this study, scales), as a way of measuring longitudinal data. Since this study used quasi-experimental interrupted time series design, data was measured several times- during the study, after the study, and following interruption or breaks within the study.[11] Twenty one students from a Williamsburg, Virginia public elementary school participated in the study. To qualify, each participant had to meet the DSM IV-TR criteria for autism, as well as qualify for services in the public school division. The therapy was provided by Dream Catchers at The Cori Sikich Therapeutic Riding Center, also in Williamsburg, Virginia. The 15 males and 6 females formed a sample of children attending the school group program at Dream Catchers, and had a mean age

of 8.1 years old, ranging from Kindergarten to fifth grade. Experience with horses was not a qualifying criteria in this study, as thirteen of the participants had never participated in therapeutic riding (horse naïve). The participants were grouped into four groups of four to six children each.

Participants were screened to ensure that they did not exhibit any symptoms of critical behaviors that would otherwise exclude them from the study. The clinical assessment battery teacher (CAB-T) rating form was used to measure clinical and adaptive behaviors in children 5 to 18 years old. All 21 students scored outside of the range on all scales except autistic spectrum behaviors, and therefore all were included in the study.[8]

As already discussed, this study used an interrupted treatment design to examine the effects of a ten-week intervention, as well as the maintenance of treatment benefits after a six week break from therapy. It also sought to examine the recoupment of benefits subsequent to another eight-week therapeutic riding session. The purpose of this design was to show improvement in participants' social communication and sensory processing during training, and regression during breaks.

Measurement of participant behavior was accomplished using the Gilliam autism rating scale-2 (GARS-2) to assess autism characteristics, and the sensory profile school companion (SPSC) to assess sensory responses. Both were completed by teachers at the school who were instructed to base their ratings on participant's behaviors in the classroom, not during their riding therapy session. The GARS-2 instrument evaluates three categories using 42 items in a scaled evaluation. The three categories include: stereotyped behaviors, communication, and social interaction. From the rates of frequency that the participant demonstrates a described behavior, a standardized score is computed and an overall autism index is obtained. The overall index and scaled scores are standardized interval level measures, where higher scores reflect more autistic behavioral symptoms (decreased scores show improvement).

The SPSC measures sensory processing abilities of three to eleven year old children across five sensory groups: behavior, visual, auditory, touch and movement. The frequency of these behaviors produce four quadrant scores (Registration, Seeking, Sensitivity, and Avoiding), four School Factor Scores (1, 2, 3, and 4), and five section scores (Auditory, Visual, Movement, Touch, and Behavior).[8] Quadrant scores represent sensory experiences, and school factor suggests translation to classroom participation. Higher scores on the SPSC show less sensory processing impairment (increased scores show improvement).

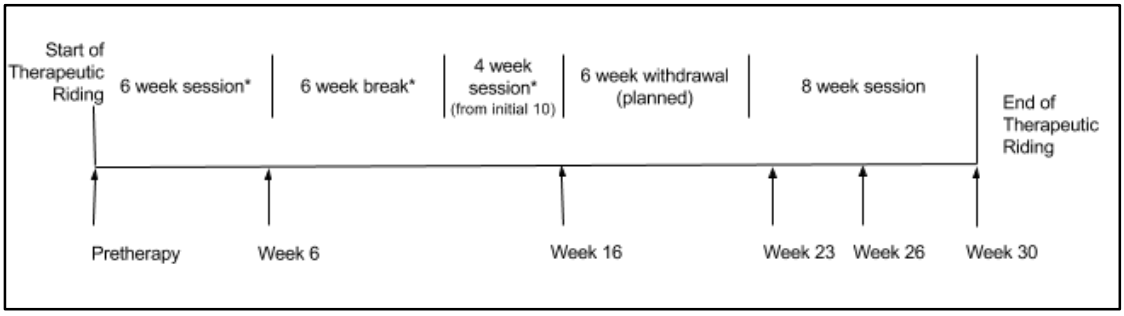
Based on the study design, teachers completed both measures at three points: prior to the first lesson, at the midpoint, and after the final lesson. Prior to the first session, a Professional Association of Therapeutic Horsemanship International (PATH) instructor, made a visit to the classroom to observe the participants in the class setting. Interviews with the teachers identified individual needs, past experience with large animals (including horses), communication abilities, and behaviors that could require special attention. During therapy, horse assignments were determined after considering horse characteristics and the specific characteristics of the child.

Pretesting with SPSC and GARS-2 served as a baseline measure. Participants engaged in ten weeks of lessons, a six week break (withdrawal) without barn contact, followed by eight weeks of lessons

(Figure 3.0). GARS-2 and SPSC scores were obtained at six points: Pre training, Week 6, Week 16, Week 23, Week 26, and Week 30. Distribution and collection of survey measures was conducted by the research coordinator at Dream Catchers. The results of instruments was examined by the lead author, Ward, and ratings confirmed that no children were rated in the clinical range of any other scale, allowing all data to be used in the analyses.

Multivariate, repeated measures ANOVAs were performed in this study, as this statistical technique is used to measure changes in participants' behavior over the course of the study.[8] Both GARS-2 and SPSC produce standardized scores, allowing the use of ANOVA as a means-testing procedure, and this also controls the Type I error rate within each family of related measures. Due to the investigative nature of the intervention, a Type I error rate of 0.05 was chosen.[8]

Figure 3.0 Timeline of participant assessment.[8]



***** The initial 10 week training session was interrupted after 6 weeks by 6 weeks of inclement weather and schedule conflicts, causing the final 4 weeks to be continued from week 12 through 16 of the study. The evaluations were conducted and collected accordingly, following the completion of each session.

Results

Twenty-one participants started the study and all completed the therapeutic riding training. The GARS-2 instrument provided an Autism Index, and levels for Stereotyped Behaviors, Communication and Social Interaction which were compiled (six collection points) and submitted to a multivariate repeated measures analysis which indicated significant differences over time on the Social Interaction and Autism Index subtests. Both levels decreased between Pretherapy and Week 16. Levels returned to Pretherapy by Week 23, after the withdrawal period, but decreased significantly again from Week 23 to Week 30 after resuming therapeutic riding lessons. The mean scores on the autism index decreased from "Very Likely Autistic" to "Possibly Autistic" ranges (using the descriptive interpretation of the scales), and the mean of the social interaction subscale also declined in the same descriptive ranges.

Separate multivariate repeated measures analyses were used to analyze the SPSC Quadrant, School Factor, and Section subsets. Univariate ANOVAs indicated significant Time differences for all of the following: Registration, Sensitivity, School Factor 1 and 4, Auditory, Visual and Touch. Table 6.0 summarizes the results for the measures of the SPSC. Overall, there was a significant increase in participant scores between pre-lesson and Week 6, followed by a significant decrease at Week 16, and stability in scores during withdrawal. Though scores increased again after lessons resumed, they were not significant until the final (Week 30) measurement.[8]

Study Critique

Overall, this study looked at a variety of behaviors and responses of autistic children before and following horseback training, as well as following a withdrawal period from the training. The authors used two commonly used and comprehensive evaluation tools consistently for each participant throughout the program. The design of this particular study varies from prior studies in that these researchers examined the effectiveness of therapeutic riding at multiple time points during the riding sessions; previous studies only looked at pre- and post-riding measures.

The study is limited with its small sample size, (n = 21), but primarily by the fact that no control group was used. This is a major issue within this study as the control group, which received no treatment and allowed for direct comparison with the experimental group, is essential as it allows for the reader to fully assess the effectiveness and/or downfalls of the intervention being used. Although it was not mentioned in the study, it appears that the study adhered to a per protocol analysis.

Other limitations of the study were that participants were not randomized, and the participants were overwhelmingly male with only 6 of the 21 participants being female. The study did not state the ages of all the participants, but only discussed that ages ranged from kindergarten to fifth grade, with an average age of 8.1 years. It can be implied that the intellectual functioning and maturity of a kindergartener is vastly different from that of a fifth grader, so perhaps providing the actual ages of each participant may be useful and more informative for the reader. An overwhelming 13 of the 21 participants never participated in horse therapy, leaving 7 of the participants interacting with horses at some point during the course of the study. It was not discussed how extensively the 7 participants had worked with horses in the past, but it is likely that this could have caused bias and inaccurate results.

All data generated was from a single source, and while teacher ratings demonstrated improvement, it would have been meaningful to compare a measurement from another source, perhaps the caregiver, as had been done in other studies, to show any consistencies or discrepancies with previous results.

Table 6.0 Means of GARS-2 and SPSC subscales over time. [8]

	Pretherapy	**Week 6**	**Week 16**	**Week 23**	**Week 26**	**Week 30**
GARS-2						
Autism Index*	**90.5**	**85.4**	**80.8**[d]	**89.1**	**81.8**[d]	**82.6**[d]
Stereotyped behavior	7.9	7.4	7.6	8.1	7.5	8.1
Communication	9.6	9.0	8.1	9.5	8.3	8.5
Social interaction*	**7.9**	**6.6**[d]	**6.3**[d]	**8.2**	**6.0**[d]	**6.5**[d]

SPSC						
Registration*	**57.8**	**62.9[d]**	**57.2**	**57.6**	**60.1**	**61.9[d]**
Seeking	37.5	40.8	38.8	38.6	39.6	40.2
Sensitivity*	**55.3**	**61.0[d]**	**55.7**	**56**	**57.6**	**58.4[d]**
Avoiding	61.6	65.3	63.9	62.7	62.8	63.5
School factor 1*	**67.3**	**74.5[d]**	**67.9**	**69.2**	**72.4[d]**	**74.5[d]**
School factor 2	45.2	48.5	45.1	44.8	45.5	46.3
School factor 3	61.0	65.3	60.7	61.9	61.1	62.5
School factor 4*	**38.8**	**41.7[d]**	**42.3[d]**	**39.4**	**41.2**	**41.9[d]**
Auditory*	**30.9**	**34.6[d]**	**31.5**	**31.5**	**32.1**	**32.7[d]**
Visual*	**36.6**	**40.1[d]**	**35.6**	**37**	**37.5**	**39.7[d]**
Movement	48.5	51.1	51.2	51.0	52.2	52.9
Touch*	**42.3**	**47.7[d]**	**42.4**	**42.8**	**44.5**	**45.9**
Behavior	53.6	56.9	54.7	53.5	53.8	53.9

Note**:** GARS-2 scores that decrease and SPSC scores that increase show improvement.

***** Indicates a significant overall effect for time ($p < 0.05$)

[d] Indicates that the mean is significantly different from the Pretherapy score

Study #3:
Effects of Equine Assisted Activities on Autism Spectrum Disorder.[9]

Objective:

To assess quality of life changes in children with ASD who participated in equine assisted activities (EAA) versus those who participated in social circles therapy, over a 12 week period.

Study design:

This was designed as a longitudinal, quasi-experimental study based on two hypotheses proposed by the researchers. The first hypothesis was that children and adolescents with ASD who were placed in an EAA program would show improvements in their quality of life domains. The second hypothesis was that children and adolescents engaged in EAA would have greater positive changes in their quality of life domains than children and adolescents not engaged in EAA. The study also sought to address a need for a comparative study that had not existed. To accomplish their goals, the authors recruited 25 children ages 4 to 15 with ASD to participate in a 12 week study to determine the impact of EAA on their quality of life, compared to non-equine social circles therapy.[9]

Criteria for participants were threefold: (1) child must have had a diagnosis of ASD, (2) both child and parent must have been able to communicate with therapy staff, and (3) the child could not have participated in EAA within 6 months of the start of this study. The participants were allowed to self-select between the experimental (EAA) group, and the comparison (social circles) group. The EAA group consisted of 13 (n = 13) children (four males and nine females), ages 4-15 years old; the social circles group had 12 participants (n = 12) (all males), ages 5-14 years old. Equine assisted therapy was performed at two therapeutic facilities using the same protocol, and occurred once per week for 12 weeks. Social circles provided support and education for children with ASD in groups of two or three children who participated in facilitated recreational and educational activities one day a week for 12 weeks.

Quantitative data was obtained using the Pediatric Quality of Life 4.0 Generic Score Scales (PedsQL) and the Child Health Questionnaire (CHQ). Both the participants and their parents completed the PedsQL, while only the parents completed the CHQ for both study groups. Data from these scales was collected before the study began, and then again at weeks 3, 6, 9, and 12.

The PedsQL is used to measure quality of life in children and adolescents, while the CHQ measures physical and psychosocial factors. Quality of life uses a Likert scale response (0, never a problem to 4, almost always a problem) measured by assessing behavior in four domains: Social functioning, emotional functioning, physical functioning and school functioning, as well as two summary scores, psychosocial and physical. The PedsQL is valid in distinguishing severity of disease in chronic conditions with a high reliability.

The CHQ measures 14 different physical and psychological aspects of the child's life and how the child's health impacts the overall functioning of the family unit. As only ten of the concepts have standardized scales, the researchers followed only those concepts, including: Role/Social Limitations-Physical (RP), Role/Social Emotional/Behavior (REB), Physical functioning (PF), Behavior (BE), Bodily Pain/Discomfort (BP), Mental Health (MH), Self Esteem (SE), General Health Perception (GH), Parental

Impact- Time (FT), Parental Impact- Emotional (FE), and two aggregate summary scores which included Psychosocial (PsyS) and Physical (PhyS). In this study researchers chose to use the 28 question parent form at the same intervals as the PedsQL assessment. The CHQ is often used to assess quality of life subscales through scores that have been normed to the population in the United States.

Study Results:

Though all 25 students who began the study finished it, clerical error occurred during week 12, so no data analysis could be made at that time. Additionally, several questionnaires were incomplete. Only 18 of the original 25 subjects provided complete data for analysis. The sample sizes for the comparison and intervention groups were n=8 and n=10, respectively.

Due to the lack of data collected from week 12, responses from weeks one, three, six and nine were analyzed. Child health questionnaires were standardized to a 0-100 scale, where higher scores are indicative of a higher level of health. In addition to the ten concepts, an aggregated Physical Summary Score (PhS) and Psychosocial Summary Score (PsS) were developed and norm based to compare with the general US population.

The comparison group (social circles) parents reported an increase in six of the ten subscales and the PsS from week 1 to week 9, with the largest increase in the self-esteem domain. The intervention group (EAA) parents reported an increase in six of ten subscales, and in both the PhS and PsS scores, between week 1 and week 9. The largest increase in the treatment group was in the general behavior domain as shown in Table 7.0.

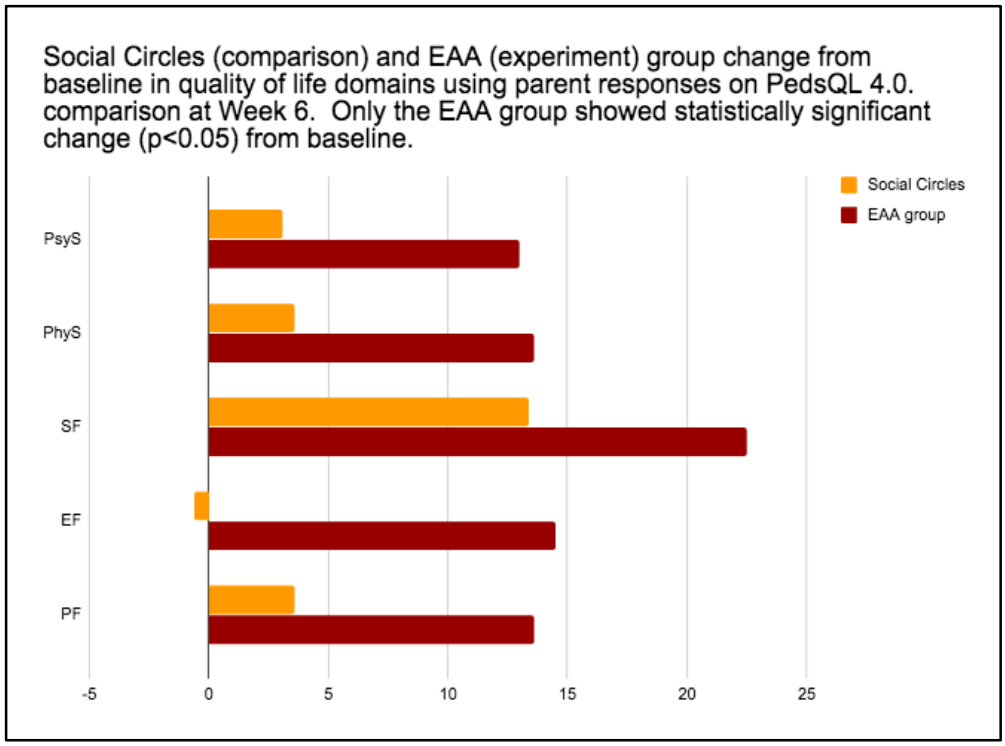
Table 7.0 CHQ subscales with increases in Week 1 to Week 9 assessments; Social circles (comparison) and EAA (intervention) groups.[9]

Subscales showing increases Social circles Week 1 to Week 9	**Subscales showing increases EAA Week 1 to Week 9**
RP: Role/Social Limitations-Physical	PF: Physical Functioning
REB: Role/Social Emotional/Behavioral	GH: General Health Perception
PE: Parental Impact-Emotional	PT: Parental Impact-Time
SE: Self Esteem*	SE: Self Esteem
MH: Mental Health	MH: Mental Health
BE: General Behavior	BE: General Behavior*
PsyS: Psychosocial Summary Score	PsyS: Psychosocial Summary Score
	PhS: Physical Summary Score

*Subscale of greatest improvement

This study used a p value of <0.05 to determine if the results collected were statistically significant. Regarding the study's first hypothesis, the parents' CHQ scores of both study groups showed improvement on certain subscales at various times in the study, however none of these results were statistically significant. The PedsQL parent responses from the comparison group (social circles) also showed improvements at various times in the study, but also were not statistically significant. Only the PedsQL parent responses from the experimental group (EAA) showed statistically significant findings at week 6 of the study, which included improvements in physical functioning (PF), emotional functioning (EF), social functioning (SF), and both summary scores psychosocial (PsyS) and physical (PhyS) (Figure 4).

Figure 4 Change of baseline comparison, PedsQL 4.0 parent response, between EAA and social circles groups at Week 6.[9]



Note: The study provided no exact data points for the comparison group, so the data in this table are estimates based upon Figure 4 of the authors' original research report.[9] The numbers are displayed here for comparison purposes only.

In regard to the study's second hypothesis, the parents of the subjects who participated in EAA felt there were significant improvements in the child's overall physical, emotional, and social functioning. Significant improvements were noticed after week 6 of the study, but these improvements slightly decreased throughout the remainder of the study. The parents of the children involved in social circles saw improvement in their child's functioning, but not to the degree of the children in EAA. Of greatest clinical significance, the authors used the data collected in a logistic model to estimate the probability of an increase from baseline in children participating in equine therapy. The results indicate that there was a 75% probability (high) that a child would experience an increase in both their social and physical functioning scores after nine weeks of EAA. They also

determined that there was a 42% probability of improvement in mental health, and a 45% probability of improved psychosocial scores after EAA (Table 8.0).

Table 8.0 Logistic model analysis estimating EAA group probabilities of change from baseline.[9]

PedsQL 4.0 Subscale	Week 3 Probabilities	Week 6 Probabilities	**Week 9 Probabilities**
Physical Functioning	.40	.59	**.75**
Emotional Functioning	.31	.44	.59
Social Functioning	.58	.67	**.75**
School Functioning	.30	.37	.46
Physical Health Summary Score	.40	.59	**.75**
Psychosocial Summary Score	.50	.60	.68
CHQ Subscale			
Physical Functioning	.25	.29	.34
Role/Social Limitation-Emotional	.37	.29	.23
Role/Social Limitation-Physical	.20	.15	.11
Behavior	.33	.36	.39
Mental Health	.13	.25	.42
Self Esteem	.17	.21	.25
General Health	.29	.36	.43
Parental Impact- Emotional	.04	.06	.09
Parental Impact- Time	.27	.29	.32
Physical Summary Score (aggregate)	.35	.38	.41
Psychosocial Summary Score (aggregate)	.29	.37	.46

Study Critique:

This study was unique in that it utilized social circles as a comparison group, as this type of group therapy could have a profound positive impact on the children and adolescents involved. The study was primarily limited due to the very small sample size of 25 children, therefore contributing to the study having Type II error. In addition, not only were the two comparison groups not equal in size (13

participated in EAA and 12 participated in social circles), but only males participated in the social circles while both males and females were involved in the EAA group.

The study did not discuss each child's level of functioning (i.e. their IQ scores), therefore making it hard for the reader to draw a full and reliable conclusion as to whether or not equine assisted therapy would perhaps benefit their child, and there was no clear indicator of the level of functioning the children had prior to therapy. It could be suggested that a child with a higher IQ would be able to better utilize horseback therapy because they are more cognitively aware of the horseback therapy, as compared to those with a lower IQ. In addition, some of the results from the study were not able to be analyzed because all the questionnaires were not completed to assess the participant's functioning, and a clerical error during week 12 automatically omitted the data collected at that time. The results of this study also strongly depended upon the data that the participant's caregiver provided, and since only the child's caregiver evaluated the child's progress (which likely impacted results), it could be suggested that caregivers would want to feel like their child is benefiting from the therapy they are receiving.

Another limitation was that two different therapeutic riding sites were used by the participants which may have impacted the results, as one facility may have slightly differed from the other. Children also either participated in EAA alone or with another participant. It was not discussed whether they kept this consistent or if it varied weekly which, again, could have impacted study results. Lastly, it was difficult to follow the study's results as some abbreviations were not defined, and certain graphs did not provide numerical evidence to support their data, making it difficult to analyze the final results. The authors of this study looked at multiple outcomes, and it was stated that a p value of less than 0.05 was statistically significant, however the authors should have considered incorporating the Bonferroni correction or Bonferroni type adjustment into the study. The Bonferroni correction is used in studies that use data from multiple sources and adjusts the P value accordingly to prevent Type I error. This ultimately helps to provide a better understanding of the overall data being presented.

Discussion:

Overall, each of the studies included in this review showed statistical significance favoring the use of EAA as a means of therapy for children with ASD. With this being said, the Gabriels et al study is the only randomized control trial in this meta analysis, and therefore was a more thorough and detailed study that collected results with less bias due to randomization of its participants, as compared to Study 2 and 3. An overview of all the studies is provided in Table 9.0; Table 10.0 contains an overview of the scales used to determine the conclusions and outcomes of each study.

The Gabriels et al study was, by far, the largest study in the review, as it evaluated 127 children and adolescents. A large study like this can ultimately help parents or caregivers of a child with ASD better determine whether or not equine therapy might benefit their child. The Ward et al and Lang et al studies are much smaller than Gabriels et al study, with sample sizes evaluating just 21 and 25 children respectively. In addition, the Gabriels et al study seemed to be stronger compared to the other two studies, as it utilized blinded professional practitioners to assess the behaviors of the subjects, while the Ward et al and Lang et al studies primarily focused on teacher, caregiver and participant analyses, which could have

caused bias and impacted results. In addition, all three studies had a higher patient demographic of males, which could also have affected the studies' results and clinical outcomes.

Table 9.0: Overview of studies

	Gabriels et al[7]	**Ward et al[8]**	**Lanning et al[9]**
Participants, N	127	21	25
Patient population	Children and adolescents ages 6-16 with a prior diagnosis of ASD	Children grade levels between Kindergarten to 5th grade with a prior diagnosis of ASD	Children between the ages of 5-15 with a prior diagnosis of ASD
Gender M/F	49/9	15/6	EAA= 9/4 Social Circles= 12/0
Primary Investigation	The effects of THR vs. only BA	The effects of THR- no control	The effects of EAA vs. participating in social circles
Duration of study	10 weeks	30 weeks	12 weeks
Assessments Used	7	2	2
Study Critique	Measurements used from non-blinded caregivers, limited information regarding what the BA entailed, narrow range of IQ level, group without any intervention not included in study	Small sample size, participants overwhelmingly male, percentage of patients with previous equine therapy/horse interaction, data results only from one source	Small sample size, only parents evaluated children possibly causing caregiver bias, different therapeutic riding sites, group without any intervention not included in study, treatment and comparison groups equal in size
Results	Statistically significant improvement in THR group in irritability, hyperactivity, social cognition, communication, and increased use of new words used and total number of words used	Statistically significant improvement in: Social interaction, autism index, registration, sensitivity, school factors, auditory, visual and touch	Statistically significant improvement in: Physical functioning, general health perception, parental impact, self-esteem, mental health, psychosocial, physical and general behavior
Conclusion	Improvement was seen in every assessment, in all three studies. Though each area assessed did not show statistically significant improvements, the overall results unanimously showed improvements following EAA to include THR therapy.		

While all three studies varied greatly, it can be concluded that all three of the studies resulted in statistically significant outcomes on behavioral and cognitive improvements and therefore were able to demonstrate the effectiveness of EAA as a treatment modality for children and adolescents with ASD. Interestingly, though, the Gabriels et al study and the Lanning et al study discussed how certain aspects of the participants (who were involved in EAA) overall functioning reached maximum effect about 5-6 weeks into the study. This could be due to disinterest in EAA after a certain amount of time or other factors that should be further investigated. Overall, while all the studies showed various improvements in the participants from their baseline, all three of the studies did not measure the same outcomes, which made interpreting overall effects of EAA on children and adolescents with ASD more difficult.

Table 10.0 Scales Used for Outcome Measurements For All Three Studies

Study #1: *Randomized Controlled Trial of Therapeutic Horseback Riding in Children and Adolescents With Autism Spectrum Disorder. Gabriels et al.*[7]	
Speech Therapist	
PPVT-4	Peabody Picture Vocabulary Test, 4th edition
SALT	Systematic Analysis of Language Transcripts
Occupational Therapist	
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition
SIPT	Sensory Integration and Praxis Test
Caregiver	
VABS-II	Vineland Adaptive Behavioral Scales, 2nd edition
SRS	Social Responsiveness Scale
ABC-C	Aberrant Behavior Checklist- Community
Study #2: *The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. Ward et al.*[8]	
GARS-2	Gilliam autism rating scale
SPSC	Sensory profile school companion
Study #3: *Effects of Equine Assisted Activities on Autism Spectrum Disorder*. [9]	
PedsQL	Pediatric Quality of Life 4.0
CHQ	Child Health Questionnaire

Conclusion:

All three of the studies above showed statistical significance in using EAA as a therapeutic intervention to improve child and adolescent behavioral functioning. With this being said, the Gabriels et al study was the only randomized control trial included in this meta analysis. One may be more skeptical of the findings found in the Ward et al and Lanning et al studies as these studies did not randomize their participants, had much smaller sample sizes (therefore increasing type II error), and did not discuss the similarities and differences of their participants from an intellectual standpoint level. Therefore, a parent of a child with ASD may draw conclusions after reading these studies that are not necessarily representative of their own child based upon the fact that their child does not appear similar or intellectually comparable to the participants that were in these studies.

Interestingly, certain positive aspects of EAA participants' behavior seemed to have a maximum effect at about 6 weeks. A study regarding the cause of this should be done, as addressing this will improve outcomes of the children and adolescents engaged in EAA. In addition, larger scale studies with an even distribution of males and females should be conducted in the future to determine both short term and long term effects EAA has on behavioral and adaptive functioning in children and adolescents with ASD. Future studies should have assessment personnel blinded when evaluating participants functioning, as this could prevent bias if caregiver and parents were to perform the evaluations.

From 2002 to 2010, ASD prevalence increased by nearly 123%.[3] As more children are being diagnosed with ASD, and because of the diverse nature of the disorder, a broad spectrum of treatment modalities are now available. Although EAA has shown improvement in children and adolescents behavior, cognitive, social and emotional functioning, there is still a limited amount of research available. As the studies already published analyze small sample sizes, there are still many unanswered questions about the extent of the effectiveness of EAA long term.

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References

1. What is Autism Spectrum Disorder? American Psychiatric Association Web site. https://www.psychiatry.org/patients-families/autism/what-is-autism-spectrum-disorder. Updated 2016. Accessed October 3, 2017.

2. Autism Spectrum Disorder (ASD): Data & Statistics Web Site. https://www.cdc.gov/ncbddd/autism/data.html. Accessed October 8, 2017.

3. Autism spectrum disorder in children and adolescents: Overview of management. https://www.uptodate.com/contents/autism-spectrum-disorder-in-children-and-adolescents-overview-of-management/print?source=search_result&search=autism%20spectrum%20disorder&selectedTitle=1~133. Accessed October 8, 2017.

4. Autism spectrum disorder in children and adolescents: Complementary and alternative therapies https://www.uptodate.com/contents/autism-spectrum-disorder-in-children-and-adolescents-complementary-and-alternative-therapies/print?source=see_link. Accessed October 8, 2017.

5. Equestrian therapy | horse therapy for children & adults with special needs. http://www.equestriantherapy.com/. Accessed October 8, 2017.

6. Gabriels RL, Pan Z, Dechant B, Agnew JA, Brim N, Mesibov G. Randomized Controlled Trial of Therapeutic Horseback Riding in Children and Adolescents With Autism Spectrum Disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*. Accessed September 27, 2017 2015;54(7):541-549. doi:10.1016/j.jaac.2015.04.007.

7. Ward, S.C., Whalon, K., Rusnak, K. et al. J Autism Dev Disord (2013) 43: 2190. Accessed September 27, 2017 https://doi.org/10.1007/s10803-013-1773-3

8. Lanning, B.A., Baier, M.E.M., Ivey-Hatz, J. et al. J Autism Dev Disord (2014) 44: 1897. Accessed September 27, 2017 https://doi.org/10.1007/s10803-014-2062-5

9. Varni, J.W., Seid, M. & Kurtin, P.S. (2001). PedsQL 4.0: Reliability and validity of the Pediatric Quality of Life Inventory version 4.0.

10. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

11. Regression based quasi-experimental approach when randomisation is not an option: Interrupted time series analysis. *BMJ 2015;350:h2750*. 2015. https://www.bmj.com/content/350/bmj.h2750.