

Title: The Feasibility, Acceptability, and Preliminary Efficacy of Occupational Therapy in an Equine Environment for Youth with Autism Spectrum Disorder

Authors: B. Caitlin Peters¹, Wendy Wood¹, and Susan Hepburn¹

Introduction: About 10% of youth with autism spectrum disorder (ASD) participate in equine-assisted services (Lindly et al., 2018), which are diverse services that incorporate horses in order to improve participants' health and wellbeing. Yet, research supporting equine-assisted services for youth with ASD, while promising, remains in early stages of development marked by small pilot studies and a lack of standardized protocols (McDaniel-Peters & Wood, 2017). To address the need for more rigorous research, our team has followed Smith et al's (2007) phased approach to developing and evaluating occupational therapy in an equine environment for youth with ASD (OT^{ee} HORSPLAY). A Phase 1 study demonstrated that OT^{ee} HORSPLAY improved participants' goal performance and social functioning, and decreased some participants' irritability and hyperactivity (Peters et al., 2020). In Phase 2, we created an intervention manual to standardize procedures. The current study aimed to assess the feasibility, acceptability, and preliminary efficacy of the newly manualized OT^{ee} HORSPLAY intervention for youth with ASD.

Method: A multi-site randomized controlled trial was implemented. Participants included 24 youth with ASD aged 6-13 who demonstrated irritable or hyperactive behaviors and had a nonverbal IQ ≥ 55 . Youth and caregivers participated in an occupational therapy evaluation that resulted in 3 treatment goals in the domains of social communication, social play, and self-regulation. Youth were randomized to OT^{ee} HORSPLAY or an active waitlist control group of occupational therapy in a garden environment. OT^{ee} HORSPLAY was provided by 5 trained occupational therapists at 2 facilities. Sessions occurred for 45-60 minutes for 10 weeks and followed a general structure of greetings, activities with horses, goodbyes, and parent debrief. Occupational therapists designed each session based on the following critical elements: a) using horses to optimize youth's attention and engagement in the therapy session b) designing therapeutic activities with horses that elicit the youth's goal behavior, c) providing positive reinforcement for goal behaviors, d) scaffolding goal performance using behavioral techniques, e) arranging the environment to best support goal performance. Participants in the active waitlist control received 10 weeks of occupational therapy in a garden environment, and then received 10 weeks of OT^{ee} HORSPLAY. The first author assessed fidelity to the interventions by rating more than 20% of experimental and control sessions.

Parents and occupational therapists completed surveys about acceptability of the interventions. Outcome measures were completed at baseline, after occupational therapy in a garden environment (waitlist control participants only), and after OT^{ee} HORSPLAY. Parents provided reports of a) social functioning using the Social Responsiveness Scale, Second Edition (SRS-2), b) irritability and hyperactivity using the Aberrant Behavior Checklist, Community (ABC-C), and c) adaptive behaviors using the Pediatric Evaluation of Disability, Computer Adaptive Test, Autism Spectrum Disorder Version (PEDICAT-ASD). An occupational therapist blinded to study purpose conducted semi-structured interviews with parents to determine goal attainment.

To assess feasibility, we calculated descriptive statistics for recruitment, attendance, attrition, fidelity, and assessment completion. To assess acceptability, we calculated parent and therapist satisfaction ratings. To assess preliminary efficacy, we conducted a per-protocol analysis and excluded participants who attended 6 or fewer experimental or control sessions from analysis. Mann-Whitney *U*, Fisher's exact tests, and Chi-square tests were used to test for differences in demographic and baseline clinical variables between groups. Paired-samples t-tests were used to test within-subject changes in all outcome variables before and after OT^{ee} HORSPLAY ($n = 20$). Fisher's exact test was used to compare the number of participants that met or exceeded their goals after OT^{ee} HORSPLAY ($n = 20$) in comparison to after the control condition ($n = 9$). Mann-Whitney *U* test was used to compare outcomes after OT^{ee} HORSPLAY ($n=20$) to outcomes after the control condition ($n = 9$).

Results: One participant withdrew from the study after attending three weeks of the control condition. The remaining 23 participants attended 89% of OT^{ee} HORSPLAY sessions. Waitlist participants attended 88% of control sessions. Parents completed 100% of outcome measures, and occupational therapists obtained 100% of goal attainment ratings. The first author collected 100% of hair samples, but 5 samples did not contain adequate hair weight, and were dropped from analysis. Providers achieved

94% fidelity to both interventions. Mean parent satisfaction score was 90% for OT^{ee} HORSPLAY and 80% for the control condition. Mean therapist satisfaction was 91% for the OT^{ee} HORSPLAY evaluation and 93% for the OT^{ee} HORSPLAY intervention.

There were no significant differences between groups, except participants in the experimental group had higher nonverbal IQ ($p = 0.02$). After OT^{ee} HORSPLAY ($M=0.75$, $SD=1.45$), youth significantly exceeded their expected level of goal attainment on their primary occupational performance goal, $t(19)=2.32$, $p=0.03$. Participants also demonstrated significantly reduced irritability ($p = 0.04$) and a non-significant trend towards reduced hyperactivity ($p = 0.11$) after OT^{ee} HORSPLAY. In regards to social functioning, youth demonstrated significant improvements in social motivation ($p = 0.03$), and non-significant trends towards improved social communication ($p = 0.10$) and decreased restricted and repetitive behaviors ($p = 0.11$) after OT^{ee} HORSPLAY; youth did not significantly improve in social awareness or social cognition. Youth who participated in OT^{ee} HORSPLAY demonstrated non-significant trends towards improvement in adaptive behaviors in the mobility domain ($p = 0.11$) and social/cognitive domain ($p = 0.10$); they did not demonstrate improvements in the daily activities or responsibility domains. Finally, youth demonstrated a trend towards increased hair cortisol content ($p = 0.08$) after OT^{ee} HORSPLAY.

The waitlist control group enabled further analysis to determine if the observed within-group changes after OT^{ee} HORSPLAY were due to the inclusion of horses and the equine-environment in the intervention, or a different factor such as goal-directed occupational therapy intervention, time in a novel environment, or an unidentified factor. Participants were more likely to meet or exceed their occupational performance goals after OT^{ee} HORSPLAY in comparison to the waitlist control group ($p < 0.05$). Youth also demonstrated greater improvements in social/cognitive adaptive behaviors after OT^{ee} HORSPLAY in comparison to after the control intervention ($U = 27$, $p = 0.03$). All other between-subjects tests were not statistically significant.

Discussion: High fidelity and attendance ratings supported feasibility of implementing OT^{ee} HORSPLAY. In addition, high recruitment, low attrition, and 100% assessment completion by parents and study staff indicated that most of the assessment protocol was feasible to implement. Future protocols will necessitate collection of larger hair samples to allow for accurate analysis in children with thin hair. High satisfaction ratings by parents and occupational therapists suggest that OT^{ee} HORSPLAY was acceptable to them. Parents were most satisfied with the experimental condition, suggesting that horses and the equine environment were particularly appealing. Pre-post data provide preliminary evidence that OT^{ee} HORSPLAY can improve performance on individual occupational performance goals, social functioning, and behavioral regulation of youth with autism. In comparison to the control group, participants who received OT^{ee} HORSPLAY demonstrated greater improvements in goal attainment and social/cognitive adaptive behaviors, suggesting that occupational therapists' integration of horses and elements of the equine environment within tailored therapeutic activities most effectively helped children with ASD attain individualized goals and improve some adaptive behaviors. Overall, this study provides preliminary evidence that horses can be purposefully integrated into occupational therapy intervention for youth with autism to improve social and behavioral goals. Findings are limited by the small sample size, pre-existing differences in nonverbal IQ between groups, and use of multiple comparisons without correction. This study lays the foundation for large-scale efficacy trials that can further assess the effect of this novel intervention on goal attainment, behavioral regulation, and social functioning of youth with ASD.

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¹ Colorado State University, Fort Collins CO USA