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Equine-Assisted Intervention for People with Dementia

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ABSTRACT The purpose of this exploratory study was to determine the feasibility and effectiveness of using guided interactions with horses as a nonpharmaceutical intervention to improve the physiological and behavioral states of persons with dementia. A convenience sample of persons with dementia was recruited from an adult day health center (*n* = 16). A multi-component intervention was implemented comprised of opportunities for grooming, painting, and leading horses. Using a randomized pretest-posttest crossover design, researchers compared participants receiving the equine-assisted intervention with participants receiving treatment as usual. Older persons with Alzheimer's disease and related dementias engaged positively in animal-assisted therapy with horses. A reduction in behavioral problems was found post intervention in contrast to the comparison group. Pre-intervention measures showed that participants exhibited lower levels of disruptive behaviors compared with the control group on the days they were scheduled to work with the horses. Interestingly, cortisol levels, used as a physiological measure of coping with stress, were elevated after the intervention in participants with higher Mini Mental State Examination scores. Equine-assisted interventions are feasible and possibly beneficial for adults with Alzheimer's disease or a related dementia disorder, such as those enrolled in adult day health programs. Future studies should utilize multiple methods of assessing impact and include process measures to delineate which specific activities seem to provide the most benefit.

Keywords: adult day care, Alzheimer's disease, cortisol, dementia, elderly, equine-assisted therapy

The number of individuals with Alzheimer's disease (AD) has increased significantly over the last decade, and this number will likely increase as baby boomers age. Currently, there are 5.4 million individuals with AD in the United States, and by 2050, this number is predicted to grow to 16 million people (National Alzheimer's Association 2012). AD is characterized by progressive cognitive and behavioral decline, ultimately resulting in death. Significant personal, social, and financial costs are associated with AD. Pharmaceutical interventions are used to reduce symptoms. However, for those with dementia, side-effects from medication can diminish their quality of life. Although pharmacological therapy is the mainstay of treatment, non-pharmacological interventions often are suggested for physiological (e.g., anxiety, depression, irritability) and behavioral challenges (e.g., agitation, aggression, sleep disturbances) associated with AD. Behavior management therapies, cognitive stimulation, caregiver support, and staff education show the most promise of impacting mood, thought, and behavior of persons with dementia (Livingston et al. 2005).

Caregivers and care recipients with dementia may utilize adult day services (ADS) to receive care and respite. ADS programs provide health, social, nutritional, and recreational services during day-time hours. Approximately 47% of ADS participants nationally have some level of dementia. Many participants also face physical disabilities (42%) and various chronic health care conditions such as diabetes (31%) and cardiovascular disease (34%). ADS are the primary community-based care option for caregivers and individuals with dementia (Anderson, Dabelko-Schoeny and Johnson in press) and can act as a platform for testing innovative non-pharmacological interventions for persons with dementia.

Animal-assisted therapy or AAT is a sub-type of "animal assisted interventions" that corresponds to practices that generate change (or learning), allowing people to improve their quality of life (Grandgeorge and Hausberger 2011). AAT has been defined as "a formal goal-directed intervention in which a therapy animal is an integral part of the treatment process. This service is delivered by a health or human service professional working within the scope of his or her professional role" (Fine 2002). AAT is expected to have three effects: (1) psychological (e.g., relaxation, motivation); (2) physiological (e.g., improvement of vital signs through neuroendocrine modulation), and (3) social (e.g., stimulation of communication among patients and caregivers).

The aim of this exploratory study is to evaluate the feasibility and the effect of equine-assisted therapy on the physiological and behavioral states of persons attending ADS with AD or related dementias.

Background

AAT has been used in nursing homes with older adults for the purposes of rehabilitation and positive engagement (Gammonley and Yates 1991). Specifically for older persons with dementia, the presence of therapy animals has been useful in reducing agitated behavior, decreasing episodes of verbal aggression and anxiety, and increasing social interaction (Fick 1993; Fritz et al. 1995; Richardson 2003). Evidence suggests that AAT with dogs can reduce agitation, irritability, anxiety, depression, and sleep disturbances in persons with dementia. In addition, when persons with AD engage in canine AAT, they experience an increase in social engagement and communication (Kogan 2001; Sellers and Smith 2002; Richeson 2003; Filan and Llewellyn-Jones 2006). What is not clear is whether individuals with AD could also experience similar benefits through equine-assisted therapy. Many unanswered questions remain about the complexities of the human–horse relationship and associated patterns of hormonal and behavioral responses to this relationship (DeVries, Glasper and Detillion 2003).

Psychosocial benefits, such as improvements in self-confidence, among children with disabilities as the result of horseback riding, have been reported anecdotally as long ago as

1970 (Harpoth 1970). Recent studies on equine-assisted therapy have reported psychosocial benefits for various groups of younger persons including self-confidence, interest in learning/motivation to participate, improvement in attention span/concentration/listening skills and verbal skills (MacKinnon, Noh and Laliberte 1995; Wuang et al. 2010; Kwon et al. 2011). In these studies, equine-assisted activities range from handling, grooming, driving, longeing, riding and/or vaulting. What has not been studied is whether these derived benefits from equine-assisted therapy can be experienced by older individuals with dementia.

The hypothalamic-pituitary-adrenal axis (HPA axis) is the body's main physiological system that controls response to stress. It acts through the hormone cortisol, which is produced in the adrenal cortex and affects many tissues including the brain. Cortisol is secreted in a distinct daily diurnal pattern whereby cortisol levels rise rapidly after awakening, peaking around 30 minutes post-awakening and declining thereafter reaching a nadir in the evening (Pruessner et al. 1997). In the short term, following a stressful experience, blood cortisol levels rapidly increase, and its presence is helpful in improving short-term memory formation and adapting the body's physiology to deal with the situation effectively. However, long-term stress leads to prolonged elevated levels of circulating endogenous cortisol, which can have serious deleterious effects.

Advances in neuroendocrinology have refined our understanding of the relationships among stress, aging, and cortisol (McEwen 2007). Over 20 years ago it was discovered that patients with AD had elevated levels of circulating cortisol, compared with healthy individuals. Increased cortisol levels, as reflected by morning plasma cortisol concentrations, are associated with more rapid rates of disease progression as demonstrated by both clinical and cognitive measures (Csernansky et al. 2006; Huang et al. 2009). Therefore, incorporating equine-assisted therapy as a complimentary intervention with pharmaceutical therapy may prove beneficial in slowing the progression of AD.

To our knowledge, there are no published studies that investigate the use of equine-assisted therapy for elderly patients with AD or other related dementias. As different animal species may stimulate different effects on humans and might represent different therapeutic potential, we hypothesized that a short-term, non-pharmaceutical equine-assisted therapy would provide change to the cortisol levels and disruptive behaviors of individuals receiving services in a dementia care setting. The goals of the study were to develop an equine-assisted therapy intervention and test its effect on the physiological and behavioral symptoms of older adults with AD or other related dementias who attend ADS.

Methods

Design

This study employed a randomized pretest-posttest crossover design to gauge the effectiveness of a short-term intervention intended to provide equine-assisted therapy to ADS participants with AD. In this design, one randomly selected group received the intervention while the second group served as the comparison group, in this case receiving services as usual in the ADS program. Services as usual included: crafts, rest periods, exercise, or discussion groups. The second group then received the intervention while the intervention was withdrawn from the first group, for comparison purposes. This design is advantageous in that it allows for multiple periods of control and enables all participants to receive the intervention.

Participants

Participants included persons with AD who were attending one ADS center in a Midwest metropolitan area of the United States. All clients of the ADS have access to daily transportation via the center's shuttle bus service to the center and from the center to their homes. The same center shuttle buses and drivers were used for transportation of the clients to the farm for the intervention program. Participants were part of either the "Meadow" or "Glen" program. The Meadow program includes individuals with more limited functioning and communication skills, and the Glen program includes those who are higher functioning. Both programs include individuals with dementia diagnoses. The staff of the ADS center screened clients for participation. Inclusion criteria were: being able to ambulate (by walking or wheel chair), receiving a stable regimen of medications (including psychotropic medications), and being diagnosed with early to moderate stage AD or related dementia. Sixteen clients met the inclusion criteria. Both participant and proxy (primary caregiver) consent was received. Participation in the study was voluntary and the participant could withdraw from the study at any time. Once the pool of participants was identified, each individual was randomly assigned to either the first or second intervention period group using a computer-generated list of random numbers.

Demographic data were abstracted from each participant's medical record, including age, gender, ethnicity, medications, and diagnosis. Mini Mental State Examination (MMSE) was used to verify cognitive status. The MMSE is a widely used short mental status instrument that provides a total score ranging from 0 to 30, with the lower scores indicative of more severe cognitive impairment. Scores < 25 were considered indicative of dementia (Vertesi et al. 2001). Whether participants needed a wheelchair for mobility (yes or no) also was collected. Finally, history of past involvement with horses (yes or no) was determined based on telephone interviews with the participants' primary caregivers.

A detailed description of the sample is presented in Table 2. The male to female ratio of the study population was approximately 1:1; however, the ethnicity of the population was predominately African American. Review of the participants' medical records indicated that seven different classes of medications that can affect cortisol levels were prescribed, with the majority receiving cholinesterase inhibitors. Roughly a third of the participants relied on wheelchairs for mobility. Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) scores suggested that participants needed some hands-on assistance with ADLs such as bathing, walking, and eating, and significant hands-on assistance with IADLs such as grocery shopping, cleaning, and paying bills. The mean MMSE score was 20.8, with a range of 11–28. One participant had a MMSE score above the expected 25 or lower score for this population. However, the participant's medical record did confirm a diagnosis of Alzheimer's disease. The MMSE scores for each of the two ADS residential groups were evaluated by a random-effects linear regression analysis. The MMSE scores were 7.14 units higher in residents of the Glen ADS group when compared with those of the Meadow residents ($p = 0.002$). Questioning of the caregivers regarding the participants' previous interactions with horses revealed that approximately 63% of the study population had experience with horses.

Procedures

To ensure validity and reliability of observational recordings, the principal investigators trained the research assistants in recording the behavior and affect of participants during the intervention. Training included written definitions and discussion of the affective characteristics of pleasure, interest, neutral, anxiety/fear, anger, and sadness as defined by the Philadelphia

Table 1. Characteristics of the horses used in the study.

Horse Name	Age (years)	Sex	Breed
Cactus Jack	12	Gelding	Paint
Shortie	19	Gelding	Quarter Horse
Wylan	14	Gelding	Quarter Horse
Grace	22	Mare	Pony

Table 2. Characteristics of the people in the study.

	Program Name			
Characteristic	Glen (*n* = 7)	Meadow (*n* = 9)	Total	*p**
Female	6 (85.7%)	3 (33.3%)	9 (56.3%)	0.060
Ethnicity				
White	1 (14.3%)	2 (22.2%)	3 (18.8%)	> 0.99
Black	6 (85.7%)	7 (77.8%)	13 (81.2%)	
NMDA Receptor Antagonists, Yes	3 (42.9%)	3 (33.3%)	6 (37.5%)	> 0.99
Cholinesterase Inhibitors, Yes	5 (71.4%)	7 (77.8%)	12 (75.0%)	> 0.99
Antidepressants, Yes	2 (28.6%)	6 (66.7%)	8 (50.0%)	0.315
Anticonvulsants, Yes	1 (14.3%)	1 (11.1%)	2 (12.5%)	> 0.99
Chemotherapeutics, Yes	2 (28.6%)	0 (0.0%)	2 (12.5%)	0.175
Antipsychotics, Yes	1 (14.3%)	2 (22.2%)	3 (18.8%)	> 0.99
Steroids, Yes	1 (14.3%)	0 (0.0%)	1 (6.3%)	0.437
Experience with Horses, Yes	4 (57.1%)	6 (66.7%)	10 (62.5%)	> 0.99
		Mean ± *SD* (Min–Max)		
Age	73.8 ± 10.1 (56.4–83.0)	81.5 ± 8.5 (72.6–96.2)	78.1 ± 9.8 (56.4–6.2)	0.315
MMSE	24.0 ± 3.0 (20.0–28.0)	18.0 ± 4.7 (11.0–25.0)	20.8 ± 5.0 (11–28)	0.034
Percent ADL	4.8 ± 8.0 (0.0–22.2)	9.3 ± 8.4 (0.0–27.8)	7.3 ± 8.3 (0.0–27.8)	0.095
Percent IADL	49.5 ± 28.2 (9.1–91.7)	77.2 ± 13.9 (55.6–100.0)	65.1 ± 25.0 (9.1–100.0)	0.034

*Based on Fisher's exact test of association for binary variables and the non-parametric Wilcoxson rank-sum test for continuous variables.

MMSE = Mini Mental State Examination; ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living.

Geriatric Center (PGC) Affect Rating Scale (Lawton, Van Haitsma and Klapper 1996). For example, pleasure included smiling, laughing, stroking, touching with "approach" manner, nodding, singing, arm or hand outreaching, open-arm gesturing, and eye crinkling. Research assistants practiced recording observations in a public setting, and compared their responses to establish inter-rater reliability, as well as at the ADS setting to allow assistants to utilize the recording instrument with the sample population. In addition, after each intervention session at the farm, observers debriefed on how they recorded the primary talking or touching behaviors including items related to the activity, horse, staff, or nothing, to ensure consistency.

Physiological and behavioral outcomes of interest were assessed prior to the intervention, weekly before and after engagement with horses or activities as usual, and after the intervention period using the following measures: salivary cortisol levels and a modified version of the Nursing Home Behavior Problem Scale (NHBPS).

Four therapy horses aged from 12 to 22 years were designated for the intervention activities (Table 1). Therapy horses needed to demonstrate the following for use in this study: 1) excellent ground manners, 2) no foot movement when startled, 3) history of being nonreactive to unusual stimuli including, but not limited to, wheelchairs and walkers, 4) toleration of loud noise, and 5) no startling with large arm gestures or rapid movement. The therapy horses used in this study were also used in therapeutic riding programs for autistic children and teenagers with behavioral and mood disorders.

Research and ADS staff attended an initial training session with the equine assisted-learning certified and horse-handler staff at an equine education center prior to the initiation of the intervention program. Training included horse safety and working with individuals with dementia. The equine-assisted therapy intervention program occurred once a week on the same day for four weeks and consisted of three specific intervention activities. At each weekly visit, activities experienced on the first visit remained the same as did the horses at each activity station. Activities were repeated in the same sequence at each consecutive visit. Each activity was a 15-minute hands-on experience with the horse followed by 5 minutes of rotation to the next activity. All interventions were ground-work only. Activity groups had two or three members who remained in the same group for the duration of the study. One ADS staff person per activity group was available to assist participants with wheelchair mobility, standing, or walking. Additionally, each participant was aided by one equine assisted-learning staff to ensure safe engagement with the horse. A 10-minute demonstration of safety measures was given to the participants before the intervention sessions commenced. The guiding principle for the intervention was that the client controls his/her interaction with the horse.

Intervention: In the first activity session, the participant learned how to groom the horse. Specifically, this included rubbing, brushing, as well as combing and braiding the mane and tail. The second activity allowed observation of horse to horse interactions as well as allowing the participant to seek interaction with the horse. In this rotation, horses were turned loose in the indoor arena and participants were free to interact with them or watch the horses interact with each other. The participants were educated on horse anatomy and given an explanation of the use of a halter and how to place it on the horse. The clients were given the option of leading the horse around the arena and when finished, removing the halter. The participants also were given the opportunity to photograph the horses during this period.

The last activity session provided a brief explanation of how the American Indian protected his war horse by painting tribal symbols on the animal's body. Participants were asked to paint the horse with symbols reflective of their thoughts and feelings for the animal. Non-irritating, biodegradable finger paint was used. After all groups had rotated through the sessions, the equine handler held the "painted" horse while all of the participants took turns washing the horse. The program ended with all of the participants offering the horses buckets of hay cubes as a "thank you" for their participation.

Two trained observers recorded each participant's behavior and affect every 30 seconds throughout each of 15-minute periods allowed for the grooming and painting intervention activities only. As is the ADS center's protocol with all activity programming, if the participant became agitated, fearful, or anxious, they would be taken away from the horse by direct care staff.

Behavioral Observation Recording: Two trained research observers made recordings of participant behavior and affect every 30 seconds during the 15-minute intervention at two of the stations: grooming and painting. Observations were not taken at the third station in the indoor arena because activities varied from week to week and by individual physical abilities. Observers recorded whether participants talked or touched a) nothing, b) things related to the activity (halter, brush, comb, mane and tail clips, or bands and paint), c) horse, d) staff, or e) other participants. At the same time, they recorded the participants' affect by using a modified PCG Affect Rating Scale including recording expressions of pleasure, interest, neutral, anxiety/fear, anger, or sadness. The PGC Affect Rating Scale has been found to have high reliability among nursing home residents with AD, and measures of positive and negative affect were affirmed against other measures (Lawton, Van Haitsma and Klapper 1996).

Salivary Cortisol: Salivary cortisol levels were used as an indicator of physiological stress. Individuals diagnosed with AD can have alterations in the hypothalamic-pituitary adrenal axis resulting in prolonged hypercortisolemia, which may contribute to the underlying pathophysiology of AD. Studies consistently report high correlations between serum and saliva cortisol, indicating that salivary cortisol levels reliably estimate serum cortisol concentrations (Hiramatsu 1981; Vining et al. 1983; Francis et al. 1987). Pre-intervention baseline salivary cortisol samples were collected at two time points (11:30 am and 1:30 pm) from all participants at the ADS center one week prior to the scheduled four intervention sessions. The baseline cortisol samples were collected on the same week day and at the same times as scheduled for the cortisol sample collection during the intervention. Participants had salivary samples taken shortly after arriving at the equine therapy center (11:30 am) and then immediately after they had participated in the intervention sessions (1:00 pm). Once the intervention commenced, participants who were in the ADS center cross-over phase of the study had two salivary samples taken at times close to the scheduled times for the participants in equine-assisted therapy. The afternoon sample at the day center was adjusted to occur at 1:30 pm instead of 1:00 pm to accommodate a scheduled snack, thus preventing contaminating substances in the saliva from interfering with the immunoassay. The 30-minute difference in salivary cortisol collection between the two groups would not interfere with the mean diurnal cortisol pattern decrease for the elderly population during the day (Heaney, Phillips and Carroll 2010).

Care was taken when collecting saliva to avoid collection immediately after mouth cleaning, meals, snacks, or medications. In order to ensure validity and reliability for the cortisol measures, the principal investigators trained the research staff in saliva collection and labeling. The following protocol was used: (1) an explanation of the procedure was given to the participant; (2) the participant was asked to open his/her mouth; (3) the assistant placed a small inert polymer swab (Salimetrics® Children Swab P/N5001.06) under the tongue of the participant with a gloved hand; (4) the participant was asked to allow the saliva to pool and collect on the cotton under his/her tongue for a minimum of 60 seconds; (5) research assistants remained with the participant during the entire procedure. If signs of gagging were observed or if the participant fell asleep, the swab was removed immediately; (6) the swab was removed from the participant's mouth and placed in a clean pre-labeled (Salimetrics® Bar-coded Labels P/N 5007.00) swab storage tube (Salimetrics® Swab Storage Tube P/N5001.05); (7) the sample was dated and the exact time of collection recorded; and (8) the collection tube was placed in a cooler with ice packs and transported to the analytical laboratory within two hours of collection. The samples were centrifuged at 4°C, aliquotted into eppendorf tubes, and immediately stored at –80° C. Samples from all participants at all time points were assayed for salivary cortisol at the same time using Salimetrics® High Sensitivity Salivary Cortisol Enzyme Immunoassay (EIA) kit (Salimetrics®, LLC, State College, PA USA), approved for use by the Food and Drug Administration as a diagnostic measure of adrenal function. The kit was used according to the manufacturer's protocol. The range of detectable salivary cortisol concentrations were 0.003 to 3.0 μg/dL while using 25 μl of saliva per test. If the sample volume was < 25 μl, the sample was diluted 2–5 fold. All reported values take the dilution into account. Study samples were assayed in duplicate. The inter-assay precision as reported by the variability coefficient of variation (CV) was 6.41% across 12 separate runs. The intra-assay variability CV was 3.65% across 14 replicates. Normal ranges for salivary cortisol concentrations in μg/dL are as follows: morning—adult females, ages 51–70 (0.149–0.739); adult males 51–70 (0.112–0.812); and afternoon—adult females, ages 51–70 (0.022–0.254); adult males 51–70 (< 0.004–0.228) (Aardal and Holm 1995). Normal ranges of salivary cortisol concentrations in μg/dL for the separate sexes of elderly adults are not specified in the published literature. However, salivary cortisol concentration ranges reported for combined sexes between the ages of 79 and 95 in the mid-morning (10:00 am) are 0.13–0.59 μg/dL, and for mid-afternoon (2:00 pm) 0.070–0.53 μg/dL (Hodgson et al. 2004).

Modified Nursing Home Behavior Problem Scale (NHBPS): The NHBPS is an inventory of 29 behavioral problems encountered in care facilities (Ray et al. 1992). Each behavior, such as resists care, becomes upset or loses temper easily, and fidgets, is scored on a Likert scale ranging from 0 (Never) to 4 (Always). Inter-rater reliability ranges from 0.754 to 0.827 in nursing homes and is highly correlated with other behavioral scales including the Nurses' Observation Scale for Inpatient Evaluation (NOSIE) (–0.747) and the Cohen-Mansfield Agitation Inventory (CMAI) (0.911). On a weekly basis, day center staff completed a modified version of the NHBPS at pre-test, immediately following the intervention, and at post-test. The scale was modified to include questions that were relevant to an adult day population. The final scale included 22 items (range of scores = 0–88).

Statistical Analysis

Participant characteristics are presented as frequencies and percentages for categorical variables, while continuous variables are presented as means, standard deviations, and the range (minimum to maximum). NHPBS scores are presented as means and standard deviations over day, period, and treatment (intervention [farm] vs. comparison group [center]). A random-effects linear regression model was used to establish the relationship between NHBPS scores and study parameters in this cross-over design. The model included terms for treatment (farm vs. center), time (a one day increase in the days of participation), time of day (end of day vs. 11:30 am), sequence (farm to center vs. center to farm), community program (Meadow vs. Glen), period (second vs. first), and an interaction variable for community program and period. The initial modeling process included gender of the participant; however, its p value was 0.868 and was thus removed from the model. Similarly, age was removed from the model as its p value was 0.190.

A random-effects linear regression model estimates random slopes and intercepts for each individual in the model and then estimates an overall effect for the various terms in the model. Thus, slopes were estimated directly from linear contrast statements after fitting the model. The data collected in this study tended to be highly variable, and so it is common for the standard deviation to be larger than the mean. Using this approach, we estimated the effects on an individual basis or on a group basis (a specific term in the model such as program). The latter is reported in the results as this was the aim of our study. The reported slopes are the change in the NHBPS score per day and were estimated directly from the regression model. Random-effects linear regression was used since the cross-over design has repeated measures nested within a participant and thus allows for the within- and between-participant variability along with an unstructured correlation when estimating the standard error used to test regression coefficients. All analyses were run using Stata 12.0 (Stata Corporation, College Station, TX, USA).

Results

Effects of the Intervention on Behavior and Affect of Participants

To evaluate the participants' experiences with equine-assisted therapy, the mean percent of time a particular affect (pleasure, interest, neutral, anxiety, anger, sadness) and behavior (talking or touching nothing, things associated with the activity, the horse, staff or other participants) for the grooming and painting activities were calculated, along with the slope and p values for the mean scores across the four intervention days. One participant became fearful and agitated and expressed fear of the horses during the first week of the intervention. This client returned the following week and engaged in activities the remaining three weeks. No clear pattern of affect or engagement over the four-day intervention was found, as one-third of the participants' time was spent expressing pleasure (31.4–46.1%) or interest (37.5–46.7%) during painting and grooming sessions (pleasure = 31.8–38.7%; interest = 37.5–43.9%). The majority of participants' time was spent interacting with things (35.3–69.5%), the horse (48.4–67.7%), or staff (68.7–81.7%) during the grooming activities. Participants engaged positively in the activities beginning week one and the following three weeks of the intervention. Of note, was a significant decrease in touching things (slope = –5.8; $p = 0.047$) and the horse (slope = –5.9; $p = 0.004$) during painting activities over time. This finding is consistent with the qualitative comments made by participants in the last two intervention sessions, questioning the purpose of the painting and how the horse feels about being painted.

Effects of the Intervention on Salivary Cortisol Concentrations

As a measure of stress, within-person mean daily cortisol values were calculated within the day and across each time period and then pooled across all participants within the group, providing a gross estimate of salivary cortisol concentrations for each group. No salivary samples had to be discarded due to participant choking, gagging, or falling asleep. Using linear contrast statements to estimate the treatment effect of the equine-assisted therapy vs. ADS as usual for the groups, the group with the higher mean MMSE scores had a statistically significant increase in cortisol levels when attending the farm intervention compared with when they participated in ADS ($p = 0.006$). However, the group with the lower mean MMSE scores had decreased cortisol levels (by 0.022 μg/dL) at the farm intervention compared with activities as usual at ADS, although this was not statistically significant ($p = 0.304$). When considering salivary cortisol levels at the farm intervention site only, the center group with the higher MMSEs had a statistically significant overall increase in cortisol levels compared with the overall cortisol levels of the center group with lower MMSE scores, ($p = 0.030$). However, when the clients were at ADS, there was no difference in cortisol levels between the two groups ($p = 0.999$). No overall changes in cortisol levels could be found when considering the sequence of participation in the farm intervention vs. ADS or the number of visits to either place.

Table 3. Mean Nursing Home Behavior Problem Scale scores.

Treatment	Time	Day 1		Day 2		Day 3		Day 4	
		Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Period 1									
Intervention	11:30 am	3.50	4.81	2.00	2.00	0.50	0.76	1.00	1.07
	End of day	3.50	8.00	1.00	1.60	1.13	1.55	0.50	0.93
Comparison	11:30 am	6.75	6.41	5.88	4.29	4.25	3.45	4.00	3.55
	End of day	4.25	4.62	4.50	2.39	3.88	3.00	3.75	3.37
Period 2									
Intervention	11:30 am	2.38	2.20	2.50	2.20	2.13	3.48	–	–
	End of day	0.88	1.36	1.38	2.20	1.50	2.83	–	–
Comparison	11:30 am	0.88	1.13	2.50	3.46	0.25	0.71	–	–
	End of day	0.88	1.13	2.88	3.27	0.25	0.71	–	–

Table 4. Results from the random-effects linear regression analysis.

Variable	Coefficient	95% CI		*p*
Treatment: Farm vs. Center	–1.11	–1.67	–0.55	< 0.001
Day, One Unit Increase	–0.62	–1.05	–0.20	0.004
End of Day vs. 11:30 am	–0.52	–1.07	0.04	0.067
Sequence: Farm/Center vs. Center/Farm	1.71	0.38	3.03	0.012
Program: Meadow vs. Glen	2.49	1.04	3.94	0.001
Period: Second vs. First	–0.18	–1.01	0.66	0.679
Program × Period Interaction	–3.24	–4.36	–2.12	< 0.001
Constant	3.27	1.38	5.16	0.001
First Period: Meadow vs. Glen	2.49	1.04	3.94	0.001
Second Period: Meadow vs. Glen	–0.75	–2.20	0.70	0.310

The salivary cortisol profiles of the participants followed the natural diurnal cortisol rhythm by decreasing in the afternoon compared with the morning throughout the evaluated time period. The time effect (afternoon vs. morning) showed a decrease of 0.008 units in cortisol in the afternoon compared with the morning; however, the result is not statistically significant (p = 0.555). For each one-year increase in age, the cortisol concentration increased by 0.003 units, but this result did not obtain significance at the 0.05 level (p = 0.068). Our statistical model controlled for seven classes of medications that were prescribed to the clients and were known to affect cortisol levels (Table 2). Only antidepressant use decreased cortisol levels in this study population and this result was not statistically significant (p = 0.264).

Effects of the Intervention on Disruptive Behaviors Displayed at the Adult Services Day Center

The pre and post within- and between-group mean scores for the NHBPS were calculated and are presented in Table 3. Period one represents the first intervention period and period two includes the cross-over intervention period. Mean scores for day four in the second period are not reported because the data were erroneously not collected by program staff. Regardless of the test period, the overall mean number of problem behaviors tended to decrease after the visit to the farm. The pre-test scores on the farm days compared with the ADS days were also lower, suggesting that fewer behavior problems were present with the anticipation of interacting with the horses.

The results of the random-effects linear regression analysis are presented in Table 4. The NHBP scores for the intervention group were 1.11 points lower than the comparison group ($p < 0.001$) and this result is independent of the day (no interaction between treatment and day), suggesting that the AAT with horses has a positive impact on problematic behaviors commonly experienced by individuals with dementia. Regardless of whether the participants were in the treatment or control group, on average their NHBP scores dropped by 0.62 across each week ($p = 0.004$). Despite random assignment, there was a significant interaction between period and program. During the first period, the NHBP scores were 2.49 points higher in the Meadow program (limited functioning) compared with the Glen program (higher functioning) ($p = 0.001$). During the second period, the NHBPS scores were 0.75 points lower in the Meadow program compared with the Glen; however, the result was not significant ($p = 0.310$).

Discussion

This exploratory study developed and tested the impact of equine-assisted therapy for individuals with AD. Participants were able to positively engage in activities such as grooming, painting, and leading the horses. Our findings suggest engagement in equine-assisted therapy may reduce problematic behaviors that can be exhibited by individuals with AD attending ADS centers. Problematic behaviors such as wandering and resisting care exhibited by individuals with AD can be very stressful for formal and informal caregivers. In fact, individuals who are caring for persons with AD experience the highest levels of strain and mental and physical health complications compared with caregivers of individuals without dementia (Ory et al. 1999). Enrollment of an individual with AD in an ADS that provides equine-assisted therapy may offer an opportunity to temporarily relieve caregivers from problematic behaviors in formal care environments and at home.

When speculating about the nature of the process that could be impacting this behavior change in the participants, it could be that animals have particularities that may trigger interest and stimulate sensory functions: they convey multisensory stimulation through sounds, postures, smell, and touch, and they may be actively demanding in the interaction (Redefer and Goodman 1989). However, these benefits can be experienced through AAT with dogs and cats in ADS centers. So why horses? Recent research confirms the importance that enriched environments play in human neurobiological development (Affum et al. 2010). Furthermore, Bredy et al. (2003) found a partial reversal in delayed cognitive function through the use of environmental enrichment. Therefore, as suggested by Marino (2012), the impact could be the result of an enriched environment such as the barn with a woods environment used in this study. This provided a surrounding that was complex, facilitated learning, and was socially stimulating, and therefore was not reliant on a single factor such as the horse, but rather a combination and interaction of several factors that appeared to stimulate change. The participants often mentioned how relaxing it was to come to the "country" to spend time with the horses and eat lunch under large shade trees with no apparent noises of the city. This enriched environment is not available when a therapy pet such as a dog or other small mammal is brought into the existing care center.

On a practical level, can this equine-assisted therapy, when compared with other AATs, be shown to be effective enough to justify the expense and other practical considerations of instituting such a program? This question can only be answered by designing blinded, cross-over studies to determine how much more benefit an elderly population with AD derives from AAT with companion animals (dogs, cats) in routine care settings compared with those obtained through equine-assisted therapy in an enriched environment. Currently, these studies do not exist.

Contrary to our expectation that equine AAT would lower salivary cortisol in both groups with AD, higher salivary cortisol levels were found in the AD clients with higher MMSE values during the farm intervention period. The rise in cortisol subsequently decreased when they participated in ADS as usual. The salivary cortisol levels were used as a measure of stress. The term "stress" conjures up negative connotations that imply emotional and physiological pathology when inefficiently managed. Chronic stress in animal models causes atrophy of neurons in the hippocampus and prefrontal cortex, brain regions involved in memory, selective attention, and executive function, but causes hypertrophy of neurons in the amygdale, a brain region involved in fear, anxiety, and aggression (McEwen and Chattarji 2004). Sustained increases in cortisol concentrations represent a biomarker for chronic stress. Conversely, "good stress" in popular vernacular refers to those experiences that are of limited duration and that a person can master, which ultimately leaves a sense of exhilaration or accomplishment and does not cause physiological damage (McEwen 2007). The observation of the temporary increase in cortisol levels in this AD group during the intervention possibly represents a biomarker for good stress. The premise of good stress relies on the mechanism of action of stress hormones, particularly cortisol. Good stress within the context of a learning experience induces focused attention and improves memory of relevant information (Joels et al. 2006). Behavioral evidence for cortisol in this group as an indicator of "good stress" is reflected in the statistically significant lower modified NHBPS scores found when the clients attended the intervention, as compared with the scores when they were at the ADS center.

An unexpected anecdotal observation in this study was the apparent role of equine AAT as a motivator to engage in physical activity. The participants in this study had moderate limitations to standing or rising unassisted and ambulating; however, when presented with the therapy animal, several of the clients rose without assistance, offered to try and walk the horses unassisted, and would ask for help to rise out of their wheelchair. Surprisingly, the ADS staff had not seen some of the clients ask to get out of their wheelchair or walk readily over steps or up ramps without assistance, all activities that they repeatedly demonstrated at the farm, with the frequency of these behaviors increasing at each successive session.

Risks associated with an equine-assisted therapy program for the elderly should be assessed for both the client and horse. The most common human risk is allergies comprising both skin and/or respiratory components. The medical records of our participants were thoroughly examined before enrollment, eliminating this as a potential reason for withdrawal from the study. Zoonotic risks (defined as "diseases and infections, which are naturally transmitted between vertebrate animals and humans"; World Health Organization) from horses to humans include, but are not limited to, the transmission of dermatophyte (fungal, "ringworm") or dermatophilosis, (bacterial) cutaneous infections. These infections are generally found in horses that inhabit filthy, moist, and crowded environments, but can also be spread rapidly by use of contaminated tack, saddle pads, and brushes, even in apparently healthy horses. Conversely, horses can be at risk of acquiring methicillin-resistant *Staphylococcal aureus (S. aureus)* from human contact and vice versa. Methicillin-resistant *S. aureus* (MRSA) is an important hospital and community associated pathogen which causes infection in people with risk factors such as recent hospitalization, surgery, antibiotic use, chronic illness, and residence in long-term care facilities. Horses are at higher risk of developing infection if they become sick, injured, or stressed for another reason, such as when they are admitted to an equine hospital. Horses can acquire MRSA from people and other horses. In colonized horses, MRSA is most often carried in the nose, so direct hand-to-nose contact between people and horses and nose-to-nose contact between horses are probably important routes of transmission (Weese 2011). Precautions to reduce the risk of transmission for both the horse and participant during therapy sessions should be to advise frequent washing of the hands or use of an alcohol-based hand sanitizer. Although these precautions are advised, it is impossible to completely prevent horses (or people) from being exposed to MRSA because so many people and animals carry it without any signs.

Future studies should investigate if the behavior changes exhibited at the ADS centers are recapitulated in the home environment. Additionally, research is needed to examine process-oriented measures to determine which elements of the equine-assisted therapy experience are beneficial and for which kind of participant. Specifically, additional studies need to address: 1) whether enough bonding is achieved through occasional encounters, 2) how the interaction works: modalities involved, active or passive presence, intentional cues, and 3) whether "a third party" should interfere, such as an ADS staff person, or whether the horses and humans should interact freely? It is reasonable to postulate that inter-individual variability is high and that species, situations, and modalities may have to differ according to the level of dementia.

Limitations

This exploratory study had several limitations. First, participants were not randomly selected. This may have resulted in a degree of selection bias, with those older adults who were most interested and capable choosing to participate in the study. Despite efforts to ensure reliability and validity of measures, there were risks of bias in the observational and behavioral measures. Research assistants and staff were not blind to who was receiving the treatment. In addition, participants may have received different experiences with the horses depending on the particular staff who worked with them during the intervention activities, and intervention activities could have varied by group and by individual. Despite these concerns, we do believe this study provides an important first step to exploring equine-assisted therapy for persons with AD.

Conclusion

Equine-assisted therapy is a feasible, non-pharmacological intervention to reduce problematic behaviors among people with AD, resulting in easier caregiving for formal and informal carers. This therapy may provide a tailored intervention that can positively impact the quality of life of the person living with AD and their caregivers. Future studies should include selection indicators, additional process measures, and additional outcome measures such as quality of life and mood.

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