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Effect of animal assisted interactions on activity and stress response in children in acute care settings

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ABSTRACT

Objective: Determine the effects of animal assisted interactions (AAI) on activity and stress response in pediatric acute care settings.
Design: Randomized treatment control design.
Setting: Inpatient pediatric acute care units (PICU, CVICU and Hematology/Oncology).
Patients: Eighty pediatric inpatients (49% male) age 2–19 years.
Intervention: The AAI experimental group patients interacted with therapy dog teams for 5–10 min and the comparison group patients continued their current activity without an AAI visit.
Measurement and results: Salivary cortisol, activity level, and mood were assessed before and after AAI. AAI was associated with a decrease in cortisol levels and increases in mood and activity.
Conclusion: AAI benefits children in pediatric acute care units.

1. Introduction

Stress and trauma experienced by children in the hospital is associated with longer hospital stays, delayed recoveries, and the expression of psychosocial stress [15]. Advances in our understanding of the social neuroscience of human-animal interaction [1,3,14,17] suggest that animal assisted interactions (AAI) may be a viable treatment option in pediatric hospital settings [8]. Studies report AAI is linked to decreased anxiety [4,24], increased positive affect for a limited time [20,22] and increased activity [16]. One recent study reports adolescents may be more motivated to participate in therapeutic ambulation with AAI [23]. Other research suggests interdisciplinary collaboration, such as physical, occupational, or child life play therapy, may facilitate early mobility services and improve patient outcomes [7,10].

Several knowledge gaps and a need for more rigorous, well-designed studies, including randomization and controls [8,20] on the influence of AAI are identified in recent literature [5]. One author specifically calls for more research to examine the influence of medication on findings [2]. In addition, infection control guidelines for AAI in health care settings do not recommend interactions in intensive care due to insufficient research [19]. This study addresses these gaps.

In this study, patients were randomly assigned to a single 5- to 10-min AAI visit or a wait list comparison group. Saliva was collected before, 5, 20 and 60 min after AAI and later assayed for cortisol. Observers rated mood, and parents rated activity levels. We hypothesized AAI would improve mood, increase activity levels, and decrease levels of salivary cortisol.

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2. Material and methods

2.1. Participants and procedures

Prior to data collection, a power analysis was conducted based on a repeated measure ANOVA design. In this power analysis, we assumed a medium (0.25) effect size (Cohen's f, 1998) based on two of the previous studies on AAT effects [1,13] and used a two-tailed test with an alpha level at 0.05 and a power of .80 for detecting intervention effects. The sample size required to detect a medium intervention effect size was 24. By recruiting 80 participants in total, we were able to detect an effect size of 0.13. During a 4-year period (2014–2018), 5963 inpatients at a tertiary pediatric hospital were screened for eligibility by a physician, nurse or nurse practitioner. They were blinded to the control vs. AAI group randomization. The program coordinator confirmed eligibility and obtained parental permission and child assent. Eligible patients were in pediatric intensive care, cardiovascular intensive care and hematology/oncology units, between the age of 2 and 19 years. Following Granger et al. [11], patients taking glucocorticoids, catecholamines, alpha- or beta-adrenergic blockers, and anticholinergic agents were excluded because of their effect on the assay results. Participants had to be awake for at least 30 min before sampling, not have eaten for 1 h, or had anything to drink for 15 min, before saliva sampling. Saliva sampling for both groups occurred 1 h before or after noon to account for the natural diurnal decline of cortisol. The team randomly scheduled 94 study days during which all ICU and Hematology/Oncology in-patients were screened. Of the 5963 patients screened, all but 86 were excluded for age, isolation precautions, mechanical ventilation, excluded medications, sedation, medical complications, fear/allergy to dogs, mouth or swallowing issues, cognitive/behavioral issues, or scheduling conflicts with procedures or treatments. Also, 34 patients declined to participate; six were excluded from the analysis due to missing data samples (Fig. A.1). The study sample included 80 children (39 boys; M age 11.78 years, SD = 4.50; range = 2 to 19; 21.3% Latino/Hispanic, 55% Caucasian; 73% had a pet in the home). Five research assistants and 14 therapy dog teams participated in the study. The hospital's Institutional Review Board approved the study.

Standard safety precautions for AAI visits were followed, including hand-sanitizing volunteers, staff, family and participants before and after interactions, placing a clean sheet or blanket between the participant and the animal, avoiding surgical sites, tubes, drains and no contact with open wounds or incisions. All animals were bathed within 24 h of visits and were healthy and current on their vaccinations at the time of the visit. AAI dog handler teams were registered with a national therapy dog registering organization. In addition to the training required by national therapy animal registering organizations, all AAI teams (dog and handler) had one year of AAI team experience prior to volunteering in this hospital program. They receive a minimum of 30 h of patient interaction training with a staff trainer in areas of safety, infection control, safe practices with animals and patients, potential therapeutic interactions, verbal and non-verbal communication, and how to encourage communication and interaction with patients in an intensive care setting. The staff trainer is the program coordinator, a licensed professional counselor and certified service dog/therapy dog trainer since 2000, who has trained all AAI program teams since 2004. The 14 AAI teams who participated in the study had a minimum of one year of volunteer experience with ICU and Hematology/Oncology patients. The welfare of the therapy animals was considered throughout the study; they were monitored and observed for stress signals and given regular breaks.

2.2. Study design

Participants were randomly assigned to either the AAI group (N = 44) or a wait list control group (N = 36). All participants were told they would have an AAI visit. The AAI group had a visit in the next 1–2 h. The control participants had a visit in the next 4–5 h, after all study measures were obtained. In the AAI group, baseline samples and measurements were taken, a therapy dog, dog handler and team escort entered the room, and positioned the dog on the bed/bedside. For 5–10 min, the handler and escort engaged patients in conversation about dogs and/or their pet, and encouraged eye contact, verbal, visual and tactile interaction with the dog. Participants pet the dog and talked to the dog and volunteers. The volunteers ended the interaction and left the room. A research assistant entered the room to obtain samples. In the control group, the same baseline samples and measurements were taken as in the AAI group, participants continued their activity and care plan without an AAI team visit. A research assistant entered the patient's room, engaged the participant in conversation and obtained samples. Both groups continued their normal activities which included interactions with staff for regularly scheduled vital checks, phone calls, playing games, watching TV, or child life, physical, occupational or respiratory therapies for the next 3 h, when a final activity measure was taken.

2.3. Measurements

Saliva was collected from each participant before the AAI visit (baseline), and at 5, 20 and 60 min after the end of the visit [12]. Saliva samples were collected using a small cylindrical-shaped sponge the child placed under their tongue for 2 min. Immediately after collection, sponges were sealed in a tube and securely stored frozen at −80° C until the day of assay. Cortisol (ug/dL) was measured in duplicate using a commercially available assay without modification to the manufacturer's recommended protocol (see Salimetrics, Carlsbad, CA). Inter- and intra-assay coefficients of variation were, on average, less than 15% and 5%. Prior to analyses, a single cortisol outlier greater than 4 standard deviations from the mean was censored from the AAI group [21].

Cortisol reactivity and recovery were calculated by computing the differences between the 5- and 20-min sample for reactivity (or 20- and 60-min samples for recovery) and dividing by the time elapsed between samples [21]. The patients were taking a wide range of medications (e. g., opioids, benzodiazepines, acetaminophen, alpha-2 agonists and nonsteroidal anti-inflammatory drugs). A physician identified and classified medications into six groups with the potential to influence the HPA-axis from patient records (M = 2.14, range = 1 to 5) [11]. Number of medication and age were included as covariates in all analyses.

Parents/caregivers completed the Lansky play performance/activity tool to assess activity level at baseline, 1-h and 3-h post AAI visit. The performance tool was completed at the same time intervals for the control group. The Lansky scale has been shown to be a valid and reliable play performance activity measure for children, with higher scores indicating more physical activity [18]. This scale rates activity from 0 to 100 with 0 indicating no activity to 100 indicating normal daily activity. Children's mood was assessed using a Wong-Baker faces scale, modified with permission by Wong to measure mood. The modified scale rates the face as an expression of mood rather than pain. The original faces scale shows the happiest face as "no pain" and the saddest face as "worst pain." The modified faces scale rates from the "best feeling" (indicated by a smiling happy face) to the "worst feeling" (indicated by a frowning face with tears) (D. Wong, personal communication, Sept. 15, 2004). This scale has been used in this hospital, measuring mood for more than 100,000 patients since 2005. Observed mood is used rather than asking the child to rate their mood to get a more accurate "before" mood rating. Staff and volunteers have noted that children's mood will change simply by asking them about their mood and explaining the mood scale. Observing the child for mood before the child knows that AAI is coming results in a mood that represents the child's current state.

2.4. Statistical analysis

Preliminary analyses were conducted to prepare the data and

determine possible covariates. Next, using SPSS 25, analysis of co-variances (ANCOVAs) were employed to examine if change in activity level and mood across the visit differed by group. Linear regression was used to examine if AAI group predicted children's activity level. A repeated measures ANCOVA was conducted to examine if there was an interaction between group and mood over time. Last, ANCOVAs were executed to examine if cortisol recovery scores differed by group.

3. Results

3.1. Activity and mood level

AAI groups differed significantly in change in activity level between the start of the visit and 3 h after the visit, and between 1 h and 3 h after the visit (Table A.1). A linear regression including all covariates and baseline activity level revealed that receiving the visit significantly predicted children's activity level 3 h after the start of the visit, $F(4, 45) = 16.202, p < .001$. Activity levels at 3 h after the visit were, on average, 9.825 points higher for children who received the AAI visit, than children who did not receive the visit (B = 9.825, SE = 3.760, $p < .001$; β = 0.689). There was a significant interaction between mood and group ($F(1, 45) = 79.05, p < .001$) indicating children in the AAI group showed more positive mood after the visit compared to before the visit (Table A.1).

3.2. Salivary cortisol

There were no significant group differences for cortisol reactivity. There was a significant difference in cortisol recovery levels between the groups (Table A.1). On average, children in the control group showed an increase in cortisol levels with respect to time, whereas children in the AAI group showed a decrease in cortisol levels with respect to time (Fig. A.2).

4. Discussion

In this randomized, wait list control study of AAI in the context of pediatric inpatient acute care hospital settings, the effects of AAI on mood, activity and salivary cortisol levels were measured. AAI increased mood, increased activity levels and decreased salivary cortisol. In addition, these effects were maintained when controlling for medication utilization, a previous gap in the researched expressed by Barker [2]. There was also a sustained mood elevation effect for a longer duration, as compared to a duration of minutes shown in Tsai et al. [22]. The study included patients from a wide variety of diagnoses, ages and medical complexities, raising the possibility to generalize to a wide range of patients. No adverse events occurred.

The cortisol findings are interesting in that the effect of AAI appeared to reduce cortisol levels more quickly after the end of the visit. There was an unexpected increase in cortisol in the control group, where cortisol returned to baseline levels. It is possible the control group had an expectation of AAI, even though blinded to the group, then returned to previous levels as they returned to the environment that induced stress without the mitigating effect of AAI. Although the study groups were blinded, after an hour of collecting samples from them without an AAI visit, control participants may have suspected they had been placed in the control group and would not have an AAI visit for several hours. These results are similar to the results of an art therapy study where the control group showed an increase in cortisol in pre-post comparison despite expected diurnal decrease in cortisol in the afternoon [25].

Our findings are similar to other studies showing an increase in positive affect [4,20,22] and increased activity [6,16,23]. This study had the larger numbers, control group and randomization called for in previous research, as well as similar limitations noted in those studies.

Small but significant effects were seen even with the standard short and single visit form of AAI measured in this study. Our results add to the existing literature surrounding AAI delivery, and are particularly important to support the use of AAI in intensive care settings where there is hesitancy due to insufficient research [19]. The publication of null results or results with small significance is important to advancing the science, avoiding the bias that can result [9].

Some limitations of this study include no control for medical staff interruptions or family presence which may have affected the dog's interaction with the children as well as the children's mood. This study team had difficulty enrolling participants, a limitation also seen in Walden [23], due to clinical complexities in an intensive care setting. Patient issues, staff schedules, and complex clinical challenges caused some limitations to be unavoidable, such as an inability to blind all research assistants who were also scheduling therapy dog teams. A large percentage of patients had multiple therapies and procedures, causing many to be excluded and the study enrollment period to span 4 years. Our modest sample size precluded us from including the handler or research assistants as a covariate and maintain statistical power. Future research with a larger sample could address some of these limitations and investigate characteristics surrounding handlers/dogs as they relate to child-outcomes in AAI studies. Lastly, we did not categorize children's behaviors during the AAI interaction, which some work has shown to influence cortisol levels (11); future studies could incorporate both biological data and behavioral data in AAI studies.

5. Conclusion

Our findings demonstrate short-term benefits of AAI for children in pediatric critical care and acute care units. The effects were significant for several hours, rather than minutes as seen in other studies. Repeated AAI visits may reduce children's stress and increase activity, and perhaps mobility, in the critical care hospital setting. Further studies are needed to determine if longer duration or repeated AAI influences length of hospital stay, recovery rates and post-discharge psychosocial outcomes.

Declaration of competing interest

In the interest of full disclosure, Dr. Granger is founder and President of Salimetrics, LLC. No other authors have any actual or potential conflicts of interest to disclose.

Appendix

Table A.1
Means and Standard Deviations for all Study Variables.

	Control Group (N = 36) Mean (SD)	AAI Group (N = 44) Mean (SD)	ANCOVA Results
Activity Level			
Baseline	43.684 (13.238)	45.778 (17.900)	
60 Minutes	43.947 (12.636)	51.364 (18.501)	
180 Minutes	47.67 (16.835)	56.591 (19.283)	
Δ Baseline to 60	.278 (5.600)	5.00 (13.725)	$F (1, 45) = .594, p = .445.$
Δ Baseline to 180	4.167 (12.734)	10.227 (13.891)	$F (1, 45) = 5.925, p = .019$
Δ 60 to 180	3.889 (11.282)	5.2275 (13.205)	$F (1, 45) = 4.198, p = .046$
Mood			
Before the Visit	4.583 (1.248)[a]	5.600 (1.528)[b]	
After the Visit	4.417 (1.316)	2.560 (1.228)	
Cortisol			
Baseline	.316 (.321)	.319 (.322)	
5 min post	.311 (.485)	.281 (.274)	
20 min post	.274 (.386)	.266 (.276)	
60 min post	.310 (.440)	.225 (.179)	
Cortisol Recovery	.0008 (.0047)	-.0006 (.0022)	$F (1, 39) = 4.682, p = .037$

Note. SD = standard deviation; ANCOVA = analysis of covariance. a Main effect analysis for the control group was not significant F (1, 21) = 3.565, p = .070. b Main effect analysis for the AAI group was significant F (1, 22) = 8.357, p = .008.
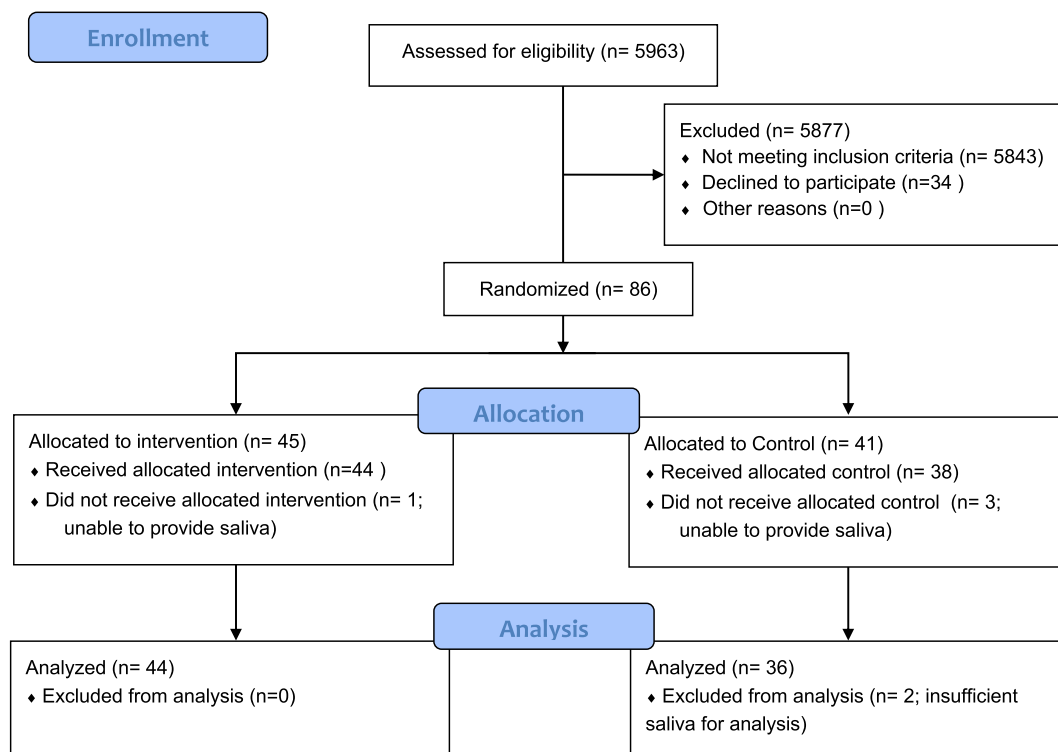

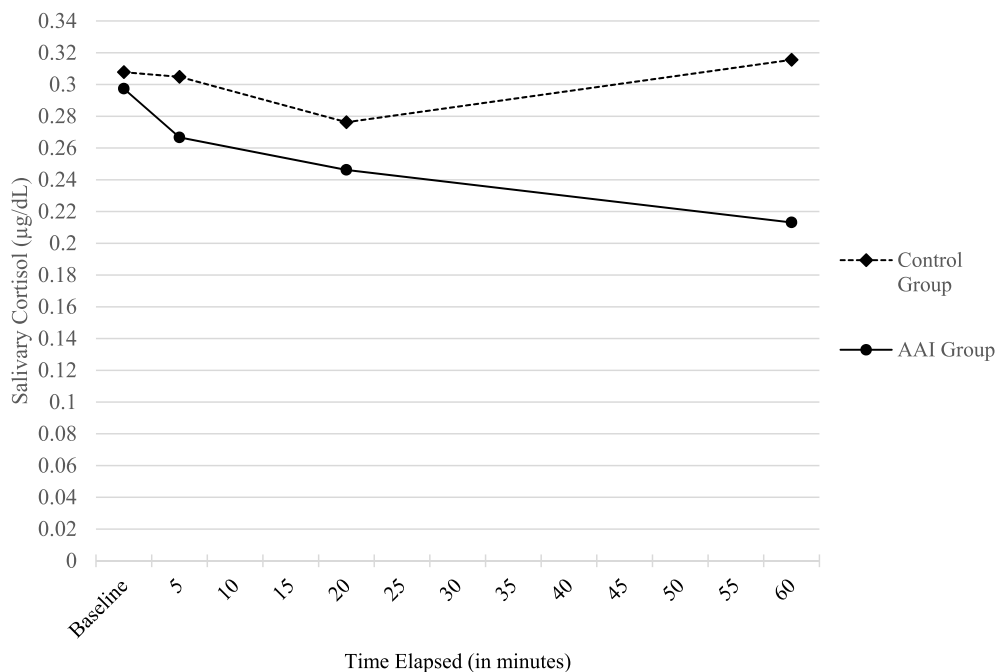**Fig. A.1.** CONSORT 2010 flow diagram.

Fig. A.2. Pattern of Cortisol by Animal Assisted Interaction (AAI) Group.

Figure note: There were no significant mean level cortisol differences by group within each time, $F_{(3, 36)} = 0.926$, $p = .438$.

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