Randomized Trial of Therapy Dogs Versus Deliberative Coloring (Art Therapy) to Reduce Stress in Emergency Medicine Providers

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ABSTRACT

Objective: Cognitive stress during shift work contributes to burnout in emergency department (ED) workers. We hypothesize that if physicians and nurses interact with a therapy dog for 5 minutes while on ED shift, both their perceived and their manifested stress levels will decrease.

Methods: In this single-center, prospective, randomized controlled clinical trial (NCT03628820), we tested the effectiveness of therapy dogs versus coloring a mandala and versus no intervention (control) on provider stress. Consenting emergency medicine physicians and nurses provided three self-reported assessments of stress and saliva samples at the start (T1), at the middle (T2), and near the end (T3) of shift. Thirty minutes prior to T2, participants were randomized to either interacting with a therapy dog or coloring for 5 minutes; controls had neither. Stress was assessed on visual analog scale (VAS, 0–100 mm) and with salivary cortisol (Salimetrics) and the modified Perceived Stress Scale (mPSS-10). To assess potential change in participant behavior, patients of providers in either group were asked to complete an internally derived survey of empathic behaviors displayed by providers at T1 and T3.

Results: We enrolled 122 providers (n = 39 control, n = 40 coloring, n = 43 dog); 48% were residents, and 60% enrolled on an evening shift. At T1, mean (±SD) VAS score was not different between groups (18.2 [±17.8] mm). At T3, VAS tended to increase with coloring (24.5 mm), remain unchanged in controls (20 mm), and decreased slightly with dogs (13.6 mm, p = 0.018 vs. coloring, Tukey's post hoc). Salivary cortisol levels were consistently highest at the beginning of each providers' shift and were significantly decreased versus control in both the dog and the coloring groups ($p < 0.05$, Tukey's). We observed no difference between groups for the mPSS-10 nor in patient reported survey of empathic behaviors.

Conclusion: This randomized controlled clinical trial demonstrates preliminary evidence that a 5-minute therapy dog interaction while on shift can reduce provider stress in ED physicians and nurses.

Physician and nurse burnout is common in emergency medicine and appears to be more frequent than other specialties.[1–3] Approximately 55% to 70% of emergency physicians, nurses, and residents in training are at risk of quitting their profession because of high levels of burnout, the rate of burnout among other specialties is 45% to 55%.[3–5] Burnout has been associated with loss of empathy and compassion

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toward patients, loss of coping ability, reduced career longevity, and lower physician satisfaction with career.[6,7] Causative factors directly related to the work stated by providers are psychological demands on shift, poor job control, long shifts, night shifts, lack of autonomy, and criticisms on shift.[3,4] Improving the well-being of providers may increase quality of patient care, inasmuch as happy providers generally evoke higher patient satisfaction[8]. This work therefore seeks to reduce provider stress while on shift in the emergency department (ED).

In this clinical experiment, we test the effectiveness of therapy dogs versus a coloring exercise versus no intervention on provider stress. The rationale for therapy dogs is supported by prior literature that demonstrates that human perception of stress and pain can be reduced with exposure to animals in multiple settings, including health care workplaces.[9–15] The rationale for coloring of mandalas centers on the potential for the exercise to cause a mental distraction from work concerns, potentially overriding cognitive stress responses (i.e., "mindfulness").[16,17]

The main study hypothesis is that emergency health care workers on shift who interact for 5 minutes with a therapy dog and handler will have lower perceived and manifested stress response compared with use of a time out that includes voluntary use of a coloring mandalas. The work will also address two exploratory hypotheses: The first is that salivary cortisol will correlate significantly with perceived stress and will increase from beginning to end of shift and that exposure to a therapy dog will blunt this increase.[13,18–22] The second exploratory hypothesis states that participants who interact with a therapy dog will display more empathic behaviors.

METHODS

Overview

This was a single-center, prospective controlled trial that approved by the Indiana University School of Medicine Institutional Review Board. The trial was registered (NCT03628820). All study procedures were performed in the ED at the Lois and Sydney Eskenazi Hospital, a safety net hospital with an ED volume of 105,000 visits in 2018. This hospital has an existing animal therapy department, managed by a coauthor (MF). All human and animal participants were unpaid volunteers, and this study was not funded by an external source. All dogs and handlers were therapy certified as a team through one of the following organizations: Alliance of Therapy Dogs, Therapy Dogs International, Pet Partners, Paws and Think, or Love on a Leash. All dogs and handlers are registered and badge-identifiable volunteers at the hospital.

Theoretical Construct

The primary theoretical construct that informed the study design and motivated our use of dogs to reduce stress in emergency care arises from the biophilia hypothesis, which states that humans have an innate desire to focus on nature.[23] Surgical patients who could view a garden had a shorter length of stay in the hospital and required fewer analgesics than those who had a view of a brick wall.[24] People interacting with a dog have a larger drop in blood pressure in children compared to interacting with a person or even just resting.[25] Conscious neurosurgical patients observed dozens of photographs of animals, famous people, or recognizable places while their amygdala was being monitored for activity. The amygdala's primary role is in the processing of memory and emotional reactions. Photographs of animals triggered greater activation of the amygdala than views of famous people, landmarks, or common objects, indicating a category-specific recognition that animals are important to people.[26] The use of dogs also harnesses cognitive distraction—a common psychological strategy to reduce focus on stress.[27] Moreover, the dog is a special contact with nature that not only is an immediate contact with nature but fosters the health benefits associated with social support, including lower anxiety.[28,29] Because the primary objective in the present work is the short-term alleviation of stress in persons without diagnosed anxiety trait, we submit that our use of dogs represented the interface of "dog-assisted support" (DAS) rather than "dog-assisted therapy," as previously differentiated.[14] Accordingly, from a study design standpoint, the biophilia hypothesis, and the social support theory both suggest the need to isolate the study subjects with the dog in a separate room, away from the work space.

Emergency Care Participants and Trial Design

Study subjects were emergency care providers, including nurses, residents, and physicians on duty in the ED of Eskenazi hospital. The only exclusion criteria were provider statement of dislike, allergy, fear or other reason to not interact with a therapy dog, and

prior enrollment. Enrollment occurred 7 days per week on shifts between 7 AM and 2 AM and was timed according to when therapy dogs were reliably available from May 28, 2018, until August 8, 2019. All participants provided verbal informed consent and were randomized by preprinted random sequence to receive either exposure to a therapy dog or to coloring a mandala. The control group that received no intervention was enrolled in a convenience sample that was performed after completion of randomization of 80 subjects between therapy dog and coloring groups. The reason for not triple randomizing was the desire to avoid the nocebo effect in the control group (disappointment in getting randomized to usual work process).[30] To enroll unique providers, and reduce the chance of volunteer handlers showing up only to have a potential study participant decline, study associates gained access to schedules and precontacted potential participants to ensure their interest and willingness to participate.

Interventions

Providers in both the therapy dog and the coloring groups were asked to leave their shift approximately midway and were escorted by study personnel to a designated room with two doors. In the case of the therapy dog, study personnel coordinated to surreptitiously position the handler and dog in the room without interaction with any staff in the ED (hence the need for two doors in the room). Dogs remained on a 5-foot-long leash held by the handler during the entire encounter. Providers were freely able to touch or pet the dog if they wished. In the case of the coloring group, the study associate notified the provider that he or she was assigned to the coloring group and presented the provider with three mandalas to choose to color (Figure 1) and a complete palette of coloring pencils. The room was physically separate from the clinical care area and contained no electronic devices, telephone, window, or overhead speaker. Providers were asked to stay in the room with either the dog or the coloring exercise for 5 minutes. The study associate left the room during this time.

Measurements

The primary measurements obtained to assess provider cognitive stress were emergency physician reported stress on a 0- to 100-mm linear, visual analog scale (VAS) with vertical lines at the 0- and 100-mm ends, guidance that 0 mm = no anxiety, 20 mm = slight fear and worry, 40 mm = mild fear and worry, 60 mm = moderate worry with physical agitation, 80 mm = strong agitation with inability to sit still, and 100 mm = out of control behavior with self-harm. Providers also completed the 10-item Perceived Stress Scale (PSS-10;score range 0-40), with each question modified to reflect the "past several hours" rather than months.[31] Hereafter, we refer to this scale as the "mPSS-10" (modified Perceived Stress Scale; see Data Supplement S1, available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13939/full). Physiological effects of stress were measured with salivary free cortisol measured from 100 μL of saliva using a commercial kit (Salimetrics 1-3002 [5PK 1-3002-5]).[22] Additionally, we measured provider-reported stress using the FACES scale (see Data Supplement S1).[32] These four measurements were made at the beginning of the shift (T1), 30 to 40 minutes after intervention (T2), and near the end

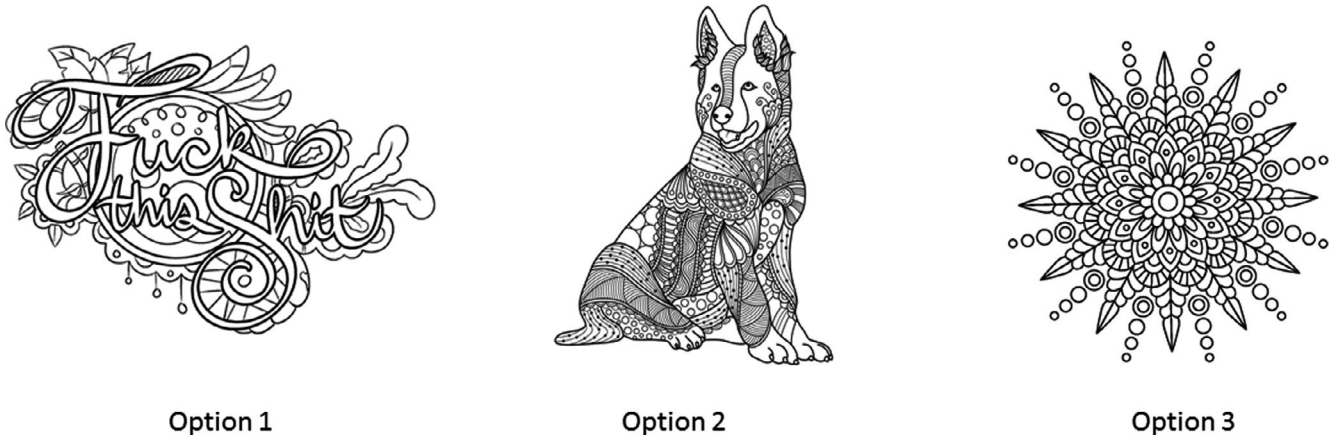

Figure 1. Mandala options for coloring.

of shift (T3). In the therapy dog group, we measured the time of exposure and we asked handlers to evaluate physician interaction with the dog and handler by asking four questions: 1) Did the subject touch the dog? (Yes or No); 2) Did the subject talk to you? (Yes or No); 3) To what extent would you grade the interaction with the dog? (Likert 1-5); and 4) To what extent would you grade the interaction with you? (Likert 1-5). We maintained a log of the identity of each dog used for each interaction to compare their performance in the coprimary outcomes. Patient participants completed a survey, designed with patient input, comprising 11 questions (Likert scale, 0-5; maximum score 55; see Data Supplement S1 for questions) assessing specific behaviors associated with patient perception of emergency physician empathy.[33]

Sample Size Computation and Data Analysis

The coprimary outcomes were the patient reported stress from the VAS and mPSS-10 and the salivary cortisol concentration. The secondary outcome was the comparison of the patient reported score on 10 empathic behaviors. We assumed that therapy dogs would produce one-third of the effect in providers as they provided in anxious patients;[34] therefore, the sample size of $n = 39$ per group was predicated on an effect size of a 10-mm difference between intervention groups for the VAS at T3, expecting a standard deviation of 20 mm with $\alpha = 0.05$ and $\beta = 0.20$. All data from patients, providers, and the medical record were recorded in the REDCap data archiving system.[35] Data from the scales were analyzed for normality using multiple tests (Shapiro-Wilk or D'Agostino and Pearson) and the F-test on variances prior to application of parametric testing. Data were analyzed at each time point using one-way analysis of variance (ANOVA) with post hoc analysis using Tukey's multiple-comparisons test. Within-group changes between times were compared with the paired t-test and chances from T1 to T3 were compared between groups with the time × group p-value from the mixed-effects repeated measures (RM) ANOVA. Data were plotted using GraphPad Prism version 8.3 for Windows. Statistical analyses were performed using SPSS, version 26.0.

RESULTS

Study associates approached 127 providers and obtained consent on all 127, but while on shift, five voluntarily withdrew from participation with all five citing that they were too busy on shift to participate. No provider refused consent because of issues with dogs. Thus, we enrolled 122 providers with complete data, with characteristics described in Table 1 (39 controls, 43 in the dog group, and 40 coloring). The largest proportion (48%) enrolled were residents, and 60% of all participants were enrolled on an evening shift, starting between 3 and 5 PM. Days of week for enrollment were relatively evenly distributed with the fewest on Fridays ($n = 12$, 10%), and the most on Tuesdays ($n = 26$, 21%).

Table 1
Work Roles, Demographic Data, and Shift Times of Participants

Group	Role (*n*)		Gender (*n*)		Race (*n*)		Age, Mean (±SD)	Shift Time (*n*)	
Control ($n = 39$)	Nurse	8	Male	19	Caucasian	33	33 (±7.2)	Morning	21
					African American	1			
	Resident	17	Female	18	Asian	2		Evening	18
					Multiple Races	1		Weekday	26
	Attending	14	Other	0	Other	1		Weekend	13
Dog ($n = 43$)	Nurse	9	Male	20	Caucasian	35	31 (±7.1)	Morning	11
					African American	0			
	Resident	24	Female	20	Asian	3		Evening	32
					Multiple Races	3		Weekday	30
	Attending	9	Other	0	Other	2		Weekend	13
Coloring ($n = 40$)	Nurse	19	Male	14	Caucasian	37	32 (±7.3)	Morning	12
					African American	1			
	Resident	16	Female	20	Asian	1		Evening	28
					Multiple Races	0		Weekday	25
	Attending	5	Other	0	Other	2		Weekend	15

Interaction Data

In the coloring group, 15 subjects chose option 1, 10 chose option 2, and 14 chose option 3, and all 40 spent at least 5 minutes coloring, with the median being 5 minutes 26 seconds, (range = 5:00–6:20). In the dog group, two providers spent less than 5 minutes (median = 5 minutes 49 seconds [range = 2:30–6:11]) and handlers noted that the provider touched the dog and spoke with the handler in all cases (100%). Regarding the Likert scale question 3, handlers rated the degree of interaction with the dog as 5 (highly engaged) in $n = 29$, 4 (engaged) in $n = 9$, and 3 (moderate) in $n = 2$ (data missing for $n = 2$); for question 4, handlers rated their interaction as a 5 (highly engaged, talking the entire time) in $n = 26$, 4 (engaged, talking >3 minutes) in $n = 12$, and 3 (talking >1 minute) for $n = 1$ (data missing for $n = 2$).

Provider-reported Stress

At the beginning of shift, providers in all three treatment groups had an identical mean (±SD) VAS score of 18.2 (±17.8) mm. Figure 2 (top row) shows that VAS score in providers who performed the coloring exercise tended to increase ($p = 0.12$, paired t-test), whereas with exposure to therapy dogs, the reported VAS tended to decline such that T3 mean for the therapy dog group was significantly lower by the ANOVA ($p = 0.015$) with Tukey's pairwise comparison of means showing $p = 0.018$ for coloring versus dog and $p = 0.08$ for dog versus control ($p = 0.03$ for time × group from RM ANOVA). However, the bottom row of plots in Figure 2 show that the mPSS-10 increased significantly in only one instance: from T1 to T3 in controls ($p = 0.045$, paired t-test). When stratified by provider status (resident, faculty, or nurse), we found that residents had slightly higher reported stress at T1 (Figure 3); when these means were compared with a one-way ANOVA, the only significant difference was resident mean VAS was higher than nursing VAS at T1 (Tukey's $p = 0.02$).

Providers generally reported low numbers for the FACES scale (all mean values from all groups at all

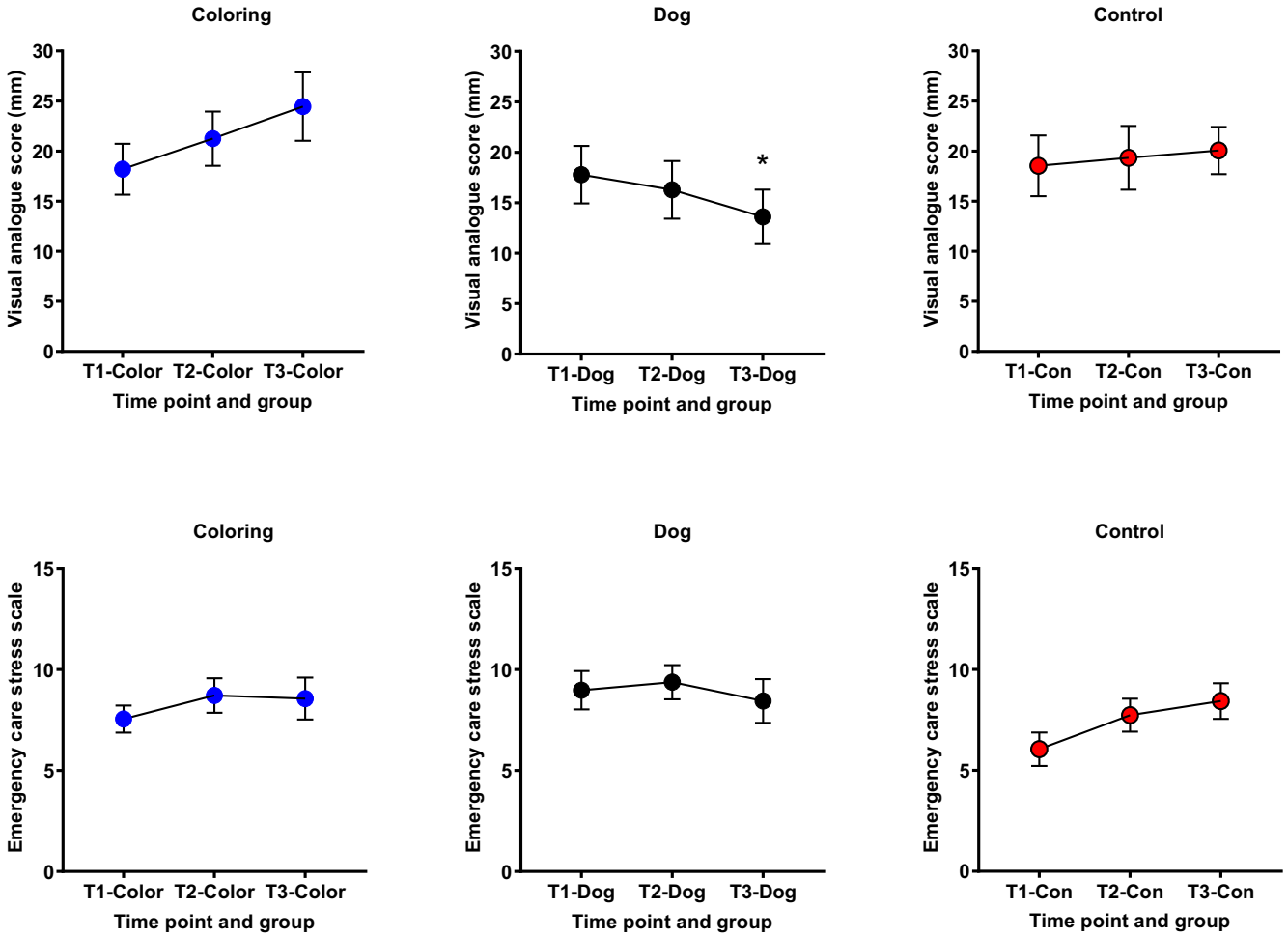

Figure 2. Plots of mean (±standard error of mean) visual analog scale (VAS) scores of participant reported stress (top row) and the modified Perceived Stress Scale (mPSS) scores (bottom row; *p = 0.018 Tukey's post hoc for T3, dog vs. coloring).

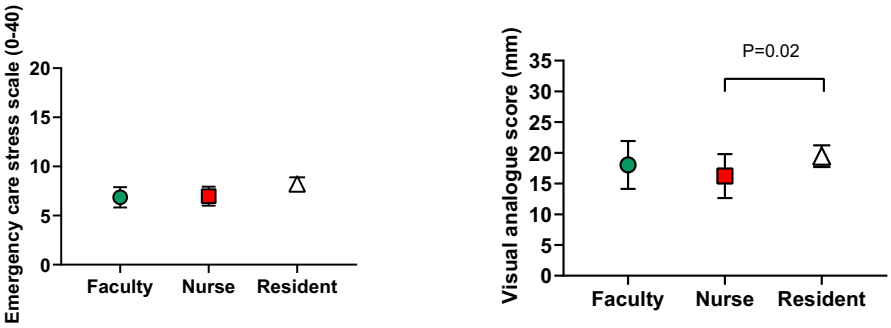

Figure 3. Comparison of self-reported stress by participant role at start of shift (T1). Error bars show standard error of the mean. p-Value from Tukey's post hoc test after one-way analysis of variance.

times was <2) and as a result the data were not normally distributed. After examining the data post hoc, the authors believe that most revealing way to analyze the FACES results is by calculating the proportion of providers with a score >3 (Mild fear and worry). Figure 4 plots these proportions with associated 95% confidence intervals (CIs), indicating no significant difference between either controls versus coloring group or control versus dog group (p = 0.29 for both comparing, exact binomial formula).

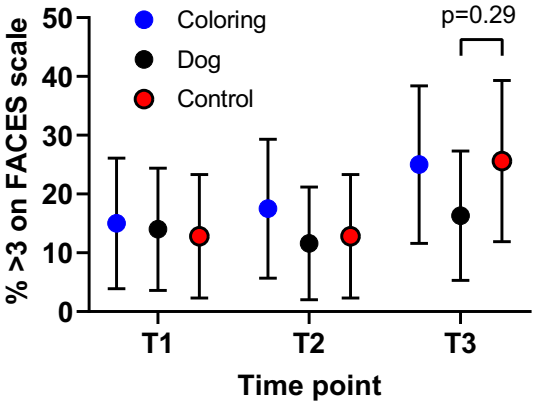

Figure 4. Proportion of providers with mild fear or worry, defined as a FACES score >3 (error bars represent 95% CI for proportions, p-value from exact binomial).

Provider Salivary Cortisol

Figure 5 provides a dot plot of all salivary cortisol values. The means were not different between groups at T1 (p = 0.23, one-way ANOVA) and were also not different based on role (resident, faculty, or nurse). Unexpectedly, salivary cortisol was the highest at T1 in all groups and progressively decreased in all three groups (p < 0.001 for comparison of T1 to T2 by paired t-test in all three groups). The salivary cortisol concentrations indicate a greater decrease with either intervention compared with control (p = 0.02 by

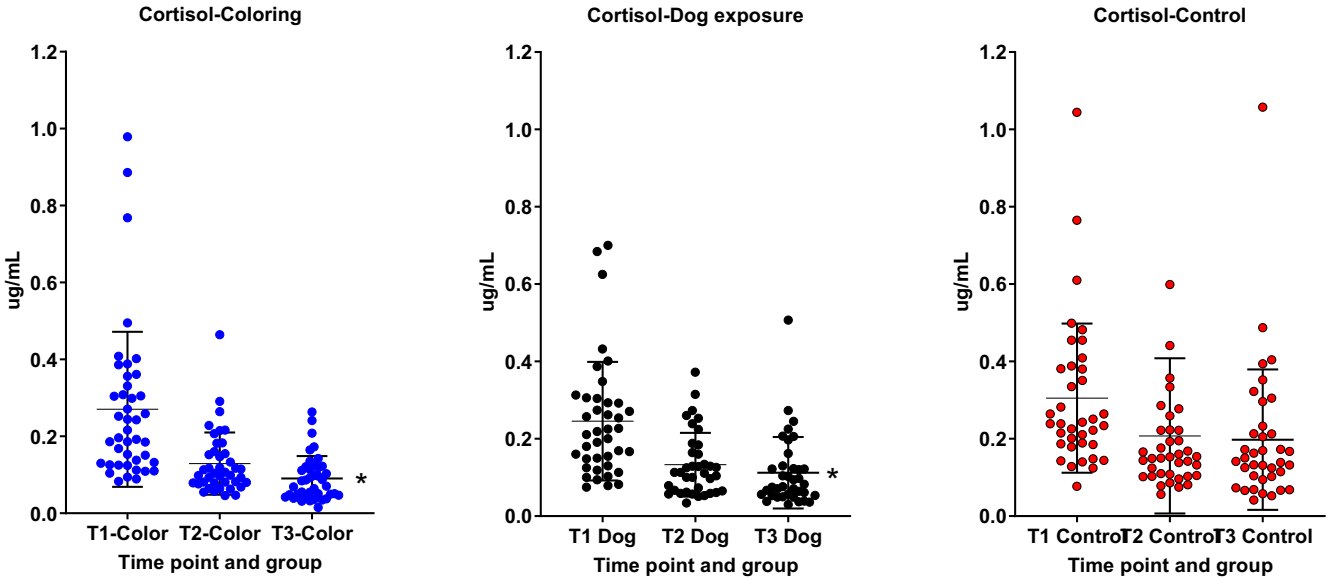

Figure 5. Salivary cortisol concentrations. The bars show means and SDs (*p < 0.05 vs. control, Tukey's post hoc).

time × group, RM ANOVA) such that the means were significantly different between groups at T3 ($p < 0.001$, one-way ANOVA), with Tukey's pairwise comparison of ranks yielding $p < 0.0001$ for coloring versus control and $p = 0.003$ for dogs versus control and $p > 0.9$ for coloring versus dogs. Thus at T3, the coloring and dog groups were associated with significant lowering of salivary cortisol compared with control.

We also asked all participants explicitly if they used other methods of stress reduction on shift and, if so, to identify the method. Fifteen (12%) indicated yes; regarding the method, seven said they listened to music, three said interacting with colleagues, three said food/eating, one said getting away from the work area, and one said deep breathing. We also asked each participant to provide unstructured commentary. The most frequent theme in responses was disappointment of being assigned to the coloring group, exemplified by this comment: "I was excited about the dog and then got the coloring book instead and was pretty mad which made me anxious/irritable." The authors perceived only one comment about the dog as negative "Mentioned dog was very creepy and not friendly."

Patient-provided Data

We obtained surveys from 137 patients, which assessed patient perceptions of 10 behaviors thought to be associated with increased perception of empathy. We only obtained these surveys for patients cared for by providers in the coloring and therapy dog groups. Table 2 shows the demographic features and distribution of their chief complaints. We found no significant difference in any comparison of mean or median scores, either between or within groups (Table 3). We did not obtain these data for controls. The Cronbach's alpha was 0.77 (95% lower confidence limit = 0.71), indicating only fair internal reliability.

Table 2
Descriptive data of patients

Feature	*N* or mean	% or SD
Total number	137	100%
Age	52	15
Female sex	65	47%
White race	55	40%
Chief complaint		
Chest pain	43	31%
Dyspnea	12	9%
Syncope	11	8%
Trauma/wound	11	8%
Dizziness	7	5%
Abdominal pain	7	5%
Abnormal laboratory values	7	5%
Psychiatric	6	4%
Other	33	24%

Table 3
Patient-reported Scores of Empathic Behavior of Physicians*

	Pre		Post		
	Mean	SD	Mean	SD	p (T1 vs. T2)
Coloring	47.2	5.2	46.9	2.9	0.660
Dog	47.1	6.0	46.1	6.3	0.492

*Questionnaire in Data Supplement S1; maximum score 55 points.

DISCUSSION

We found that 5-minute interaction with a therapy dog and handler was associated with provider-reported reduction in stress by the end of shift (T3), when measured on a VAS, but not when using an adaptation of the well-studied PSS-10. The adaption was to reword questions to reflect perceptions over the past few hours, rather than months. When compared with controls, the salivary cortisol concentrations decreased significantly in both the coloring and the therapy dog participants. We studied both nurses and physicians and found minor differences in the reported stress levels between the providers at T1, but not for salivary cortisol concentrations. Handlers indicated that the majority of participants were highly engaged with the dog, and participants who were randomized to coloring expressed discontent. Findings from this controlled, randomized clinical trial demonstrate preliminary and novel evidence that DAS can reduce provider perception of stress and physiological stress response in the emergency care setting. The VAS data and the unstructured comments (and the implicit message in the participants' frequent choice of the first mandala) support the biophilia hypothesis—that emergency care providers used the dogs as social support to reduce stress on shift and would rather have DAS than a mindfulness exercise to distract them from work-related stress.[23,29]

The issue of work stress contributing to emergency provider burnout has received considerable attention.[1,3,4,8,36] Approximately two-thirds of emergency residents satisfy criteria for burnout.[3,37] Cognitive

contributors include emotional exhaustion, high depersonalization, and low personal accomplishment, present in 40% to 50% of emergency nurses and physicians.[1,37] Burnout scores appear inversely correlated with emergency physician self-perception of empathy.[38] It has widely been assumed that cognitive stress on shift is manifested as physiological stress, reflected by increased heart rate, blood pressure, and salivary cortisol concentrations.[18–20] Within this context, of depersonalization and emotional and physical exhaustion, preliminary work in other nonemergent health care settings has suggested that exposure to a therapy dog will lower physiological stress manifestations on shift, including salivary cortisol.[22] One group previously found that ED patients with moderate to severe anxiety had greater reductions in anxiety after exposure to a therapy dog compared with control conditions.[34] In addition to the previous literature, unplanned observations during that study helped formulate the hypothesis that exposure to therapy dogs might reduce provider stress. These unplanned observations of research staff were the consistent and persistent request of providers who ostensibly asked "why do the patients get a dog and we don't?" We believe that the present study supports the hypothesis that therapy dogs reduce provider stress, given that the mean T3 VAS and salivary cortisol concentrations were significantly lower in the therapy dog group. This work is preliminary and raises three points for discussion and future study.

First, it remains possible that the questions in the PSS-10 are insensitive to cognitive stress induced on shift in the ED. While the PSS-10 is well validated in general public, its questions may lack construct validity in emergency care. Second, we learned that providers disliked the experimental design that required them to leave their work area at a prescribed time. Based on provider comments, we believe that the ideal design to reduce provider stress would be better described as a "dog on demand." In future work, we are planning a paradigm that allows providers to interact with a therapy dog in or near their workspace whenever they wish, at least during part of their shift, and for the same dog(s) to be available to patients experiencing stress. Third, and perhaps most unexpectedly, we learned that salivary cortisol values were consistently highest at the start of shift and decreased during the shift. This effect was remarkably consistent, regardless of the time of shift, between sexes and nurses and physicians. We do not believe that this represents a problem with sampling as we used rigorous methods of collection, including denying our subjects of food or water for 30 minutes prior to collection. We speculate that this is a result of activation of the hypothalamic–pituitary axis from uncontrolled anticipatory stress, as emergency care providers never know what type of shift they will encounter, ranging from easy to punishing, depending on variables that are completely out of provider control.[39]

LIMITATIONS

Limitations include the obligatory simultaneous interaction of research subjects with human handlers and dogs. Hospital policies prohibit therapy dogs without a leash and hander. The interaction data show that the majority of providers were highly engaged with the handlers, suggesting the possibility that a 5-minute break with another person could also be effective. The degree to which this work reflects human-facilitated dog support, versus dog-facilitated human therapy, or the mix in between remains uncertain. The real-world ED setting precluded multiple correlative measurements of physiological stress, such as blood pressure, heart rate, or skin resistance. Also, the authors are aware that many of our participants drink caffeinated beverages before each shift. Caffeine use clearly affects cortisol secretion, although chronic use appears to produce a tolerance effect.[40] We did not systematically control, nor record, caffeine intake. We did ensure that providers did not drink anything for 30 minutes prior to sampling. We rationalized not performing triple randomization of the control group to avoid the nocebo effect.[30] Instead we sought to understand stress patterns in the "wild-type" condition, when the subject was aware that he or she had no chance of seeing a dog or coloring mandala. Moreover, a true control would require placing a busy provider in an empty room with nothing to do might be viewed as punishment. Nonetheless, it could be argued that randomizing the controls would have been a better experimental design.

CONCLUSIONS

In conclusion, in this three-arm trial, we found that emergency providers randomized to a 5-minute interaction with a therapy dog and handler had a significant reduction in self-reported anxiety using a visual analog scale compared with patients randomized to deliberate

coloring. Emergency providers had lower end-of-shift salivary cortisol with either coloring or therapy dog exposure compared with controls. These findings suggest that therapy dogs can reduce cognitive and physiological stress experienced by emergency care providers while on duty in the ED.

References

1. Li H, Cheng B, Zhu XP. Quantification of burnout in emergency nurses: a systematic review and meta-analysis. Int Emerg Nurs 2018;39:46–54.
2. Soltanifar A, Pishbin E, Attaran Mashhadi N, Najaf Najafi M, Siahtir M. Burnout among female emergency medicine physicians: a nationwide study. Emerg Med Australas 2018;30:517–522.
3. Kimo Takayesu J, Ramoska EA, Clark TR, et al. Factors associated with burnout during emergency medicine residency. Acad Emerg Med 2014;21:1031–5.
4. Bragard I, Dupuis G, Fleet R. Quality of work life, burnout, and stress in emergency department physicians: a qualitative review. Eur J Emerg Med 2015;22:227–34.
5. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. Arch Intern Med 2012;172:1377–85.
6. Bellolio MF, Cabrera D, Sadosty AT, et al. Compassion fatigue is similar in emergency medicine residents compared to other medical and surgical specialties. West J Emerg Med 2014;15:629–35.
7. Lu DW, Dresden S, McCloskey C, Branzetti J, Gisondi MA. Impact of burnout on self-reported patient care among emergency physicians. West J Emerg Med 2015;16:996–1001.
8. Panagioti M, Geraghty K, Johnson J, et al. Association between physician burnout and patient safety, professionalism, and patient satisfaction: a systematic review and meta-analysis. JAMA Intern Med 2018;178:1317–30.
9. Braun C, Stangler T, Narveson J, Pettingell S. Animal-assisted therapy as a pain relief intervention for children. Complement Ther Clin Pract 2009;15:105–9.
10. Marcus DA, Bernstein CD, Constantin JM, Kunkel FA, Breuer P, Hanlon RB. Impact of animal-assisted therapy for outpatients with fibromyalgia. Pain Med 2013;14:43–51.
11. Barker SB, Dawson KS. The effects of animal-assisted therapy on anxiety ratings of hospitalized psychiatric patients. Psychiatr Serv 1998;49:797–801.
12. Sobo EJ, Eng B, Kassity-Krich N. Canine visitation (pet) therapy: pilot data on decreases in child pain perception. J Holist Nurs 2006;24:51–7.
13. Kertes DA, Liu J, Hall NJ, Hadad NA, Wynne CD, Bhatt SS. Effect of pet dogs on children's perceived stress and cortisol stress response. Soc Dev 2017;26:382–401.
14. Lundqvist M, Carlsson P, Sjodahl R, Theodorsson E, Levin LA. Patient benefit of dog-assisted interventions in health care: a systematic review. BMC Complement Altern Med 2017;17:358.
15. Binfet JT, Passmore HA, Cebry A, Struik K, McKay C. Reducing university students' stress through a drop-in canine-therapy program. J Ment Health 2018;27:197–204.
16. McConville J, McAleer R, Hahne A. Mindfulness training for health profession students-the effect of mindfulness training on psychological well-being, learning and clinical performance of health professional students: a systematic review of randomized and non-randomized controlled trials. Explore (NY) 2017;13:26–45.
17. Mantzios M, Giannou K. When did coloring books become mindful? Exploring the effectiveness of a novel method of mindfulness-guided instructions for coloring books to increase mindfulness and decrease anxiety. Front Psychol 2018;9:56.
18. Gonzalez-Cabrera JM, Fernandez-Prada M, Iribar C, Molina-Ruano R, Salinero-Bachiller M, Peinado JM. Acute stress and anxiety in medical residents on the emergency department duty. Int J Environ Res Public Health 2018;15:506.
19. Bedini S, Braun F, Weibel L, Aussedat M, Pereira B, Dutheil F. Stress and salivary cortisol in emergency medical dispatchers: a randomized shifts control trial. PLoS ONE 2017;12:e0177094.
20. Dias RD, Scalabrini Neto A. Acute stress in residents during emergency care: a study of personal and situational factors. Stress2017;20:241–8.
21. Nakajima Y, Takahashi T, Shetty V, Yamaguchi M. Patterns of salivary cortisol levels can manifest work stress in emergency care providers. J Physiol Sci 2012;62:191–7.
22. Barker SB, Knisely JS, McCain NL, Best AM. Measuring stress and immune response in healthcare professionals following interaction with a therapy dog: a pilot study. Psychol Rep 2005;96:713–29.
23. Kellert S, Wilson E. The Biophilia Hypothesis. Washington, DC: Island Press, 1993.
24. Ulrich RS. View through a window may influence recovery from surgery. Science1984;224:420–1.
25. Friedmann E, Katcher AH, Thomas SA, Lynch JJ, Messent PR. Social interaction and blood pressure. Influence of animal companions. J Nerv Ment Dis 1983;171:461–5.
26. Mormann F, Dubois J, Kornblith S, et al. A category-specific response to animals in the right human amygdala. Nat Neurosci 2011;14:1247–9.
27. Chambers CT, Taddio A, Uman LS, McMurtry CM. Psychological interventions for reducing pain and distress during routine childhood immunizations: a systematic review. Clin Ther 2009; 31(Suppl 2):S77–103.
28. Beck AM, Katcher AH. Future directions in human-animal bond. Research 2003;47:79–93.

29. Beck AM. The biology of the human–animal bond. Anim Front 2014;4:32–6.
30. Schedlowski M, Enck P, Rief W, Bingel U. Neuro-bio-behavioral mechanisms of placebo and nocebo responses: implications for clinical trials and clinical practice. Pharmacol Rev 2015;67:697–730.
31. Nielsen MG, Ornbol E, Vestergaard M, et al. The construct validity of the Perceived Stress Scale. J Psychosom Res 2016;84:22–30.
32. McKinley S, Madronio C. Validity of the Faces Anxiety Scale for the assessment of state anxiety in intensive care patients not receiving mechanical ventilation. J Psychosom Res 2008;64:503–7.
33. Pettit KE, Rattray NA, Wang H, et al. Coming in warm: qualitative study and concept map to cultivate patient-centered empathy in emergency care. AEM Educ Train 2019;3:136–44.
34. Kline JA, Fisher MA, Pettit KL, Linville CT, Beck AM. Controlled clinical trial of canine therapy versus usual care to reduce patient anxiety in the emergency department. PLoS ONE 2019;14:e0209232.
35. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009; 42:377–81.
36. Fernandez-Prada M, Gonzalez-Cabrera J, Iribar-Ibabe C, Peinado JM. Psychosocial risks and stress as predictors of burnout in junior doctors performing emergency guards. Gac Med Mex 2017;153:450–8.
37. Boutou A, Pitsiou G, Sourla E, Kioumis I. Burnout syndrome among emergency medicine physicians: an update on its prevalence and risk factors. Eur Rev Med Pharmacol Sci 2019;23:9058–65.
38. Wolfshohl JA, Bradley K, Bell C, et al. Association between empathy and burnout among emergency medicine physicians. J Clin Med Res 2019;11:532–8.
39. Engert V, Efanov SI, Duchesne A, Vogel S, Corbo V, Pruessner JC. Differentiating anticipatory from reactive cortisol responses to psychosocial stress. Psychoneuroendocrinology 2013;38:1328–37.
40. Lovallo WR, Whitsett TL, al'Absi M, Sung BH, Vincent AS, Wilson MF. Caffeine stimulation of cortisol secretion across the waking hours in relation to caffeine intake levels. Psychosom Med 2005;67:734–9.

Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1111/acem.13939/full

Data Supplement S1. Supplemental material.