A preliminary analysis of psychiatric service dog placements and sleep patterns of partners of veterans with PTSD

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Abstract

Partners of veterans diagnosed with posttraumatic stress disorder (PTSD) are at risk of a variety of challenges and it is unknown whether psychiatric service dogs will be disruptive to partner sleep or provide similar benefits that are seen in the limited literature for veterans. The goal of this study was to examine both objective and subjective measures of sleep of partners cohabiting with veterans who have psychiatric service dogs. As part of a larger clinical trial examining the efficacy of psychiatric service dogs for veterans with PTSD and their families, this study focuses on sleep patterns of veterans' partners (N = 88), incorporating both subjective (clinically validated self-report surveys) and objective sleep measures (actigraphy). Linear regression was used to analyze differences in relation to group (intervention versus control) at follow up, controlling for baseline score. Results reveal no significant differences between groups for both the subjective surveys ($p = .15$; $p = .75$) and the objective actigraphy measures ($p = .06$-$.98$). Findings suggest that the psychiatric service dog was not disruptive, nor did they provide any benefits to partner sleep. Partners had sleep patterns on par with national norms at baseline and remained at such levels at follow up. Ultimately, in this case, using both subjective and objective measures, we found no impact of psychiatric service dogs on the sleep of veterans' partners.

Keywords: assistance dog, human-animal interaction, military families, animal-assisted intervention

Posttraumatic stress disorder (PTSD), a diagnosis received by about one quarter of post-9/11 veterans involves symptoms including re-experiencing the event, avoidance behaviors, negative thoughts or feelings, hypervigilance, and disruption of sleep patterns (American Psychiatric Association, 2013). Approximately 89% of veterans are classified as "poor sleepers" and may experience challenges with sleep including shortened duration, disturbances, and/or recurrent nightmares (Luxton et al., 2011; Plumb et al., 2014). Sleep symptoms are of particular concern because prior research has identified negative associations between quality of sleep and persistence of PTSD symptoms (e.g., Short et al., 2017). Inadequate sleep has known consequential and significant effects on daily functioning and overall wellbeing; moreover, it has been associated with obesity, depression, anxiety, alcohol abuse, and psychosis among other negative outcomes (Hertenstein et al., 2019; Jean-Louis et al., 2014; Watson et al., 2015).

The influence of PTSD extends beyond individual veterans to affect their families and partners (i.e., spouses or cohabitating romantic partners) (Ahmadi et al., 2011; Fulton et al., 2015; Norris et al., 2018). Partners of military service members diagnosed with PTSD may themselves be at risk for a variety of psychosocial concerns including depression, anxiety, and PTSD symptoms (Sullivan et al., 2022). Since many veterans with PTSD struggle with sleep, it is not surprising that their partners also experience sleep challenges (Brooks Holliday et al., 2016; Mansfield & Morrissey, 2010; Plumb et al., 2014; Walters et al., 2020). In fact, the Centers for Disease Control and Prevention (CDC) reports that only about 61% of military partners met the healthy sleep goal, below the national average of 71% (Corry et al., 2019).

Given the influence of PTSD on veteran families and partners, recent literature suggests that identifying interventions to address the needs of military families is critical (Keeling et al., 2019). One potential complementary intervention is a psychiatric service dog. Psychiatric service dogs are trained to do specific tasks that help mitigate their handler's symptoms (Rodriguez et al., 2020).

Psychiatric service dogs & sleep

Thus far, the literature regarding sleep and psychiatric service dogs for PTSD has been focused on veteran outcomes. These outcomes are mostly positive, especially those derived from subjective measures. For example, veterans have reported less subjective sleep disturbance, better subjective sleep quality, and fewer nightmares when paired with a psychiatric service dog (Galsgaard & Eskelund, 2020; Rodriguez et al., 2018; Scotland-Coogan, 2019; van Houtert et al., 2022; Yarborough et al., 2018). Additionally, veterans reported their psychiatric service dogs help them to fall asleep and stay asleep, potentially as a result of the feelings of safety and security the service dog provides (Crowe et al., 2018; Scotland-Coogan, 2019). However, in contrast to reported subjective improvements, studies using objective measures (e.g., actigraphy) have suggested that there are no changes in veterans' motion-related sleep parameters following partnership with a psychiatric service dog (Lessard et al., 2020).

Given that psychiatric service dogs often share a bedroom, and in some cases a bed, with the veteran and their partner, it seems plausible any impact to sleep habits may extend beyond the veteran. Previous literature has suggested the influence of a psychiatric service dog may go beyond the veteran to influence the psychosocial health and wellbeing of the entire military family (Nieforth, Abdul Wahab, et al., 2022;

Nieforth et al., 2021; Nieforth, Miller, et al., 2022; Yarborough et al., 2018). To date, only two manuscripts have noted the potential influence of a veteran's psychiatric service dog on their partner's sleep, both of which used a qualitative design (Nieforth et al., 2021; Scotland-Coogan, 2019). In these manuscripts, partners mentioned allowing the dogs in the bed and shared that they appreciated how the dogs interrupted the veterans' nightmares. While psychiatric service dog placement may quantitatively improve sleep quality for veterans, it is unknown whether these influences extend to their partners (Lessard et al., 2020).

The impact of pet dogs on sleep

It is estimated that 68% of owners allow pets in the bedroom and up to 50% of owners sleep alongside their pets in their beds (Hoffman et al., 2018; Krahn et al., 2015; Zanen et al., 2022). Regardless of where pets sleep, they may influence their human's sleep patterns (Patel et al., 2017; Smith et al., 2018). Research has found variations in the association between pets and their human partner's sleep patterns depending on whether it is examined through subjective versus objective measures. Objective accelerometer (i.e., motion detection) data indicated that sharing a bed with a pet may have negative impacts on sleep quality, as they may increase sleep disturbances and decrease sleep efficiency (Patel et al., 2017; Smith et al., 2018). Individuals who sleep with their pets were more likely to take longer to fall asleep, and were more likely to wake up tired (Smith et al., 2014). On the other hand, findings from subjective measures (e.g., self-report survey measures) suggested that sleeping with pets may increase perceived comfort, companionship, and security during sleep (Brown et al., 2018; Hoffman et al., 2018). Additionally, subjective findings suggested people sleep better when sleeping with humans or pets (Andre et al., 2021). This disconnect between subjective and objective findings may suggest the perceived positives outweigh the negatives with regard to the influence of pets on human sleep (Smith et al., 2018).

The purpose of this manuscript was to conduct the first quantitative analysis of subjective and objective sleep outcomes for partners of veterans with psychiatric service dogs.

Methods

Procedure

This study was part of a larger, longitudinal, 3-month long clinical trial (clinicaltrials.gov ID NCT03245814) focused on the efficacy of psychiatric service dogs for veterans with PTSD, approved by both the Purdue University Institutional Review Board (IRB Protocol #1702018766) and the Institutional Animal Care and Use Committee (IACUC Protocol #1702001541). The study was supervised by an independent data and safety monitoring board (DSMB). Other outcomes from the larger clinical trial have been previously published: family-related qualitative findings (Nieforth et al., 2021), partner mental health and wellbeing clinical survey findings (Nieforth, Miller, et al., 2022), partner ecological momentary assessment findings (Nieforth, Abdul Wahab, et al., 2022), and canine findings (Jensen et al., 2022).

Veterans were recruited from an Assistance Dog International-accredited non-profit service dog provider, K9s For Warriors, that provides psychiatric service dogs free of charge to their clients. Veterans were paired with the psychiatric service dogs during a 2-week onsite matching program after the dogs underwent initial training at the organization. The psychiatric service dogs were mostly mixed breed dogs sourced from local shelters.

To be included in the larger clinical trial, veterans were required to meet the K9s For Warriors program inclusion criteria (i.e., post 9/11 military service, diagnosis of PTSD, traumatic brain injury or military sexual trauma from a community provider, honorable discharge/honorable service, no more than two pet dogs in the home, lack of current substance abuse, lack of conviction of crime against animals) and have a clinically validated PTSD diagnosis according to the Clinician-Administered PTSD Scale (CAPS-5) which was administered by independent raters during the study screening period. All participants gave informed consent prior to participation in the clinical trial. Inclusion criteria for partners was cohabitation with a participating veteran; legal marriage was not required.

Veterans and their partners were allocated to one of two groups: a control group, where participants continued usual care (and received a service dog after the study was completed), or an intervention group, where participants received a psychiatric service dog during the study in addition to their usual care. The intervention group was matched with their psychiatric service dogs immediately following the baseline assessment period. A total of 88 partners participated in this study (n = 40 usual care group, n = 48 psychiatric service dog intervention group). Partners participated in a variety of study activities including self-report surveys, actigraphy, saliva collection, and ecological momentary assessment at baseline (prior to service dog allocation for the intervention group), and then again 3-months later at follow-up. This manuscript will explore subjective measures of sleep from self-report surveys and objective measures of sleep from actigraphy data to explore the potential influence of the veteran's psychiatric service dog on their partner's sleep patterns.

Measures

Subjective sleep was measured using the Pittsburgh Sleep Quality Index (PSQI) and the Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance survey. Objective sleep was measured with wristband actigraphy.

Subjective. The PSQI (Buysse et al., 1989) is a 19-item questionnaire that measures sleep quality and sleep disturbance over the last month. Scores range from 0-21, where 21 is the worst possible sleep quality. The PROMIS-Sleep Disturbance (Cella et al., 2010) is an 8-item questionnaire measuring sleep quality, sleep depth, and sleep restoration over the past 2-weeks. T-scores range from 28.9-76.5 with higher scores indicating more sleep disturbance.

Objective. Actigraphy was used to measure sleep amount and fragmentation (Khawaja et al., 2014). The study used an Actiwatch Spectrum Plus (Philips Respironics) wristband which uses an accelerometer to record movement minute-by-minute during daytime activity and night-time sleep. The wristbands were worn for 10-14 consecutive days during both the baseline and follow up assessment periods. Participants were instructed to push the button on the side of the wristband when waking up, before going to sleep, and before and after removing the watch if it was going to be submerged in water (e.g., swimming). These button presses were incorporated into Actigraphy scoring, consistent with gold standard procedures. Additionally, morning sleep diaries collected through the LifeData RealLifeEXP mobile phone application were incorporated into scoring (LifeData Corporation, 2020). The morning sleep diary was 29 questions at baseline and 31 questions at follow up. All actigraphy sleep coders (*n* = 8) attained intercoder reliability above .80 on the target variables.

Data Analysis

Demographic variables for each group were compared using *t*-tests for continuous variables and Fischer's exact tests for categorical variables to identify whether demographic information was balanced across groups. Linear regression was used to analyze differences in relation to group (usual care vs. service dog intervention) at follow up, controlling for baseline score. All analyses were completed using R version 4.2.1 (R Core Team, 2022). Outcome variables included both survey variables (PSQI and PROMIS-Sleep) and actigraphy variables. Actigraphy variables included: sleep efficiency (percentage of time asleep while in bed), nighttime sleep duration (how long asleep in minutes), sleep onset latency (time to fall asleep in minutes), and wake after sleep onset (number of minutes awake between sleep onset and offset). Theory-driven covariates included: gender, presence/absence of children, socioeconomic status, education, relationship status, pet ownership status, whether they shared the bed with their partner, race/ethnicity, and treatment status (categories for each variable presented in Table 1). Bonferroni corrections were employed to account for multiple comparisons.

[Insert Table 1]

Results

Demographic variables are presented in Table 1. There were no significant differences between groups for demographic variables except for socioeconomic status ($p = .03$) which was controlled for in the final analysis. Group means for all measures in both the usual care control and psychiatric service dog intervention groups are presented in Table 2.

[Insert Table 2]

There were no significant differences between the intervention and control group for any of the subjective standardized survey measures, nor the objective actigraphy measures (Table 3). Regression analysis for subjective standardized survey measures revealed no significant difference for the PSQI ($\beta = 0.05$, $p = .15$) or PROMIS Sleep ($\beta = -0.25$, $p = .75$). Regression analysis for objective actigraphy measures also did not reveal any significant differences between groups (sleep efficiency: $\beta = -0.21$, $p = .37$; nighttime sleep duration: $\beta = 0.004$, $p = .98$; sleep onset latency: $\beta = -0.17$, $p = .63$; and wake after sleep onset: $\beta = 0.45$, $p = .06$).

[Insert Table 3]

Discussion

The overarching goal of the current study was to employ quantitative analyses to explore both objective and subjective measures of sleep for partners cohabiting with veterans and their psychiatric service dogs. Due to limited prior literature, it was unknown whether a psychiatric service dog would be disruptive to a partner’s sleep patterns or provide similar benefits as those seen in the veteran literature. Findings for both objective and subjective measures were null, potentially suggesting that psychiatric service dogs do not meaningfully influence sleep for veterans’ partners. Null actigraphy findings are aligned with one prior actigraphy manuscript within the service dog literature that found no significant impacts of a psychiatric service dog on objective sleep in veterans (Lessard et al., 2020).

In contrast to our findings, most of the previous sleep literature (including both general sleep literature and literature focused on co-sleeping with pets) reported disagreement between subjective and objective measures. Specifically, subjective measures were often significantly associated with improved sleep, whereas null or negative findings were most often reported for studies employing objective measures (Brown et al., 2018; Hoffman et al., 2018; Patel et al., 2017; Smith et al., 2018). The same has been found in the limited psychiatric service dog literature, as a recent study suggested that while actigraphy measures identified no change in sleep patterns of veterans, there were significant improvements to the subjective PSQI scores (Lessard et al., 2020). Findings from the current study do not follow these patterns, having both null objective and subjective findings for partners.

There are multiple explanations for the null objective and subjective findings. First, psychiatric service dogs are trained and matched specifically with the veterans, not their partners. Nonsignificant findings could be a result of the difference between the role of a psychiatric service dog relative to that of a pet dog from the perspective of veterans' partners. Psychiatric service dogs share a unique bond with veterans, and therefore also have a different relationship with other partners than a pet dog would. Many service dog organizations put a strong emphasis on the veteran being the primary person in the psychiatric service dog's life. This strong bond between psychiatric service dogs and veterans could be an important component of subjective sleep changes. In many situations, in order to avoid interfering with the primary bond between veteran and psychiatric service dog, partners are encouraged to not interact and care for the service dog in the same way that they would a pet dog (Nieforth et al., 2021). In this interaction, the bond may be not as present, thus potentially interrupting the process of influencing subjective sleep changes. Previously reported quantitative data from this same study suggested that the veterans had a 33% stronger bond with their psychiatric service dogs in comparison to the bond between spouses and the dogs, based on the Inclusion of Others in Self (IOS, range 1-7) scale (Partners: M = 4.07, SD = 1.7; Veterans: M = 5.68, SD = 1.45; Jensen et al., 2022; Nieforth, Miller, et al., 2022). This key difference in the bond felt by partners, coupled with the expectations for how partners are to interact with psychiatric service dogs could potentially underly the lack of influence of psychiatric service dogs on partners' sleep patterns. For example, the physical placement of the dog during veteran and partner sleep is unknown. The dog may have been situated next to veteran either in bed or on their side of the bed, such that the dog is not functionally a part of the partner's sleep.

Along the same lines, it is possible that the measures used in the current analysis did not accurately capture the unique relationship between partners and psychiatric service dogs. For example, qualitative findings suggested a perceived improvement to partner sleep based upon feelings of their own safety and the dog's role in interrupting veterans' nightmares from this same group of participants, as well as participants from another study (Nieforth et al., 2021; Scotland-Coogan, 2019). It is possible that the measures employed for partners in this study did not capture the feelings of safety or the perceptions of the nightmare disruption task described in these qualitative findings. Future studies should consider using a measure such as the Fear of Sleep Inventory (Pruiksma et al., 2014) to better target feelings of safety expressed by partners in prior qualitative literature.

Second, in comparison to overall population values, partners do not have clinically disturbed sleep indicating less room for improvement over the course of the study in comparison to the veterans. Mean values for the PSQI in all groups at baseline (service dog = 7.73, control = 7.88) and follow up (service dog = 6.45, control = 7.90) were slightly higher (indicating slightly worse sleep) than the average population values (*M* = 5.00, *SD* = 3.37; Hinz et al., 2017) and values reported by previous studies of dog owners (*M* = 6.43, *SD* = 3.45; Hoffman et al., 2018), but were still quite low on the 0-21 scale. Likewise, mean values for the PROMIS Sleep Disturbance in all groups at baseline (service dog = 50.92, control = 52.95) and follow up (service dog = 49.05, control = 50.77) were similar to average population values (*M* = 49.8, *SD* = 10.3; Cella et al., 2010). The means for nighttime sleep duration ranged from 6.7 - 6.9 hours. In a representative US sample, the 50^{th} percentile for nighttime sleep duration was 7 hours/night (Barreira et al., 2022). The means for sleep efficiency ranged from 83.86 - 85.94%, overlapping with findings of a large study of US adults (85.6%; Cespedes Feliciano et al., 2017). Overall, average population values and the values of partners in the study were quite similar indicating relatively "normal" sleep patterns for partners. The addition of the psychiatric service dog did not disrupt or reduce sleep quality based on the findings that partners did not have poor sleep patterns or sleep disruptions after pairing.

Finally, psychosocial attributes and emotional affect may influence sleep measures (Jackowska et al., 2011). For example, one study of military couples engaged in cognitive behavioral therapy explored the influence of veterans' PTSD symptoms on their own insomnia and their partners' insomnia (Khalifian et al., 2022). Veterans' PTSD symptoms (specifically negative cognition and mood symptoms) were indirectly related to partners' insomnia through complete mediation by the partners depression symptoms (Khalifian et al., 2022). Given the potential interplay of psychosocial, emotional, and sleep measures, it is worth noting that psychosocial findings from this same population of veterans and partners suggested that partners of veterans with psychiatric service dogs had higher caregiver burden and lower caregiver satisfaction (Nieforth, Miller, et al., 2022). Additionally, quantitative data, also from this same population, suggested that partners of veterans with psychiatric service dogs had higher positive affect, specifically higher confidence, and calmness, but had no difference in negative affect (Nieforth, Abdul Wahab, et al., 2022). These psychosocial and emotional attributes, among others, may also play a role in the interpretation of and contextualization of one's own sleep. Alternatively, psychiatric service dogs may influence partner daily functioning, but not sleep patterns. This preliminary analysis suggests that psychiatric service dogs do not appear to disrupt sleep, but they also do not appear to benefit sleep.

Ultimately, the current findings suggest that psychiatric service dogs do not meaningfully influence sleep for partners. Possible explanations for why this may be include: (1) psychiatric service dogs are trained and paired specifically for veterans and thus may not have the same influence on partners, (2) partners in the study had similar sleep patterns to average population values and therefore may not have much room for improvement, and (3) the interplay between psychosocial outcomes and sleep outcomes for partners may play a role in partner experiences.

Limitations & Conclusion

A few limitations should be considered with this exploratory study. First, though this study was a longitudinal study, future studies should consider increased follow up timing as the psychiatric service dog may not be fully integrated into the home by three months. Additionally, this study had a relatively small sample size. It is possible that this small sample size limited the ability to detect small effects. Lastly, partners were recruited after veterans were enrolled in the study, through the veteran participant. Future partner-focused studies should consider recruiting partners directly from the service dog providers to remove the veterans' participation in the study as a barrier to partner participation (e.g., if a veteran was not interested in this study, the partner was not recruited).

In conclusion, findings suggest that psychiatric service dogs of veterans with PTSD may not influence the sleep patterns of partners whether examined subjectively (PSQI & PROMIS Sleep Disturbance) or objectively (actigraphy). Previous studies suggest mixed findings on sleep and companion animals and no quantitative studies to our knowledge have explored psychiatric service animals and the sleep of the handler's partner. Though the limited studies focused on the influence of psychiatric service dogs on veterans' sleep patterns have suggested positive effects, our findings, both subjective and objective, found no impact of psychiatric service dogs on the sleep of veterans' partners.

References

Ahmadi, K., Azampoor-Afshar, S., Karami, G., & Mokhtari, A. (2011). The association of veterans' PTSD with secondary trauma stress among veterans' spouses. *Journal of Aggression, Maltreatment & Trauma*, *20*(6), 636–644. https://doi.org/10.1080/10926771.2011.595761

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5.* (Fifth edition.). American Psychiatric Association. http://purl.lib.purdue.edu/db/dsm-5

Andre, C. J., Lovallo, V., & Spencer, R. M. C. (2021). The effects of bed sharing on sleep: From partners to pets. *Sleep Health*, *7*(3), 314–323. https://doi.org/10.1016/j.sleh.2020.11.011

Barreira, T. V., Schuna, J. M., Jr., & Chaput, J.-P. (2022). Normative reference values for actigraphy-measured total nocturnal sleep time in the US population. *American Journal of Epidemiology*, *191*(2), 360–362. https://doi.org/10.1093/aje/kwab258

Brooks Holliday, S., Haas, A., Shih, R. A., & Troxel, W. M. (2016). Prevalence and consequences of sleep problems in military wives. *Sleep Health*, *2*(2), 116–122. https://doi.org/10.1016/j.sleh.2016.03.004

Brown, C. A., Wang, Y., & Carr, E. C. J. (2018). Undercover dogs: Pet dogs in the sleep environment of patients with chronic pain. *Social Sciences*, *7*(9). https://doi.org/10.3390/socsci7090157

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Cella, D., Riley, W., Stone, A., Rothrock, N., Reeve, B., Yount, S., Amtmann, D., Bode, R., Buysse, D., Choi, S., Cook, K., Devellis, R., DeWalt, D., Fries, J. F., Gershon, R., Hahn, E. A., Lai, J.-S., Pilkonis, P., Revicki, D., … PROMIS Cooperative Group. (2010). The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. *Journal of Clinical Epidemiology*, *63*(11), 1179–1194. https://doi.org/10.1016/j.jclinepi.2010.04.011

Cespedes Feliciano, E. M., Quante, M., Weng, J., Mitchell, J. A., James, P., Marinac, C. R., Mariani, S., Redline, S., Kerr, J., Godbole, S., Manteiga, A., Wang, D., & Hipp, J. A. (2017). Actigraphy-derived daily rest–activity patterns and body mass index in community-dwelling adults. *Sleep*, *40*(12), zsx168. https://doi.org/10.1093/sleep/zsx168

Corry, N. H., Radakrishnan, S., Williams, C. S., Sparks, A. C., Woodall, K. A., Fairbank, J. A., & Stander, V. A. (2019). Association of military life experiences and health indicators among military spouses. *BMC Public Health*, *19*(1), 1517–1517. https://doi.org/10.1186/s12889-019-7804-z

Crowe, T. K., Nguyen, M. T., Tryon, B. G., Barger, S., & Sanchez, V. (2018). How service dogs enhance veterans’ occupational performance in the home: A qualitative perspective. *Open Journal of Occupational Therapy*, *6*(3). https://doi.org/10.15453/2168-6408.1468

Fulton, J. J., Calhoun, P. S., Wagner, H. R., Schry, A. R., Hair, L. P., Feeling, N., Elbogen, E., & Beckham, J. C. (2015). The prevalence of posttraumatic stress disorder in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF)

Veterans: A meta-analysis. *Journal of Anxiety Disorders*, *31*, 98–107. https://doi.org/10.1016/j.janxdis.2015.02.003

Galsgaard, A., & Eskelund, K. (2020). An explorative clinical pilot study into the effect of service dogs on chronic posttraumatic stress disorder. *Traumatology*, 361–369. https://doi.org/10.1037/trm0000278

Hertenstein, E., Feige, B., Gmeiner, T., Kienzler, C., Spiegelhalder, K., Johann, A., Jansson-Fröjmark, M., Palagini, L., Rücker, G., Riemann, D., & Baglioni, C. (2019). Insomnia as a predictor of mental disorders: A systematic review and meta-analysis. *Sleep Medicine Reviews*, *43*, 96–105. https://doi.org/10.1016/j.smrv.2018.10.006

Hinz, A., Glaesmer, H., Brähler, E., Löffler, M., Engel, C., Enzenbach, C., Hegerl, U., & Sander, C. (2017). Sleep quality in the general population: Psychometric properties of the Pittsburgh Sleep Quality Index, derived from a German community sample of 9284 people. *Sleep Medicine*, *30*, 57–63. https://doi.org/10.1016/j.sleep.2016.03.008

Hoffman, C. L., Stutz, K., & Vasilopoulos, T. (2018). An examination of adult women's sleep quality and sleep routines in relation to pet ownership and bedsharing. *Anthrozoös*, *31*(6), 711–725. https://doi.org/10.1080/08927936.2018.1529354

Jackowska, M., Dockray, S., Hendrickx, H., & Steptoe, A. (2011). Psychosocial factors and sleep efficiency: Discrepancies between subjective and objective evaluations of sleep. *Psychosomatic Medicine*, *73*(9), 810–816. https://doi.org/10.1097/PSY.0b013e3182359e77

Jean-Louis, G., Williams, N. J., Sarpong, D., Pandey, A., Youngstedt, S., Zizi, F., & Ogedegbe, G. (2014). Associations between inadequate sleep and obesity in the

US adult population: Analysis of the national health interview survey (1977-2009). *BMC Public Health*, *14*(1). https://doi.org/10.1186/1471-2458-14-290

Jensen, C. L., Rodriguez, K. E., MacLean, E. L., Wahab, A. H. A., Sabbaghi, A., & O'Haire, M. E. (2022). Characterizing veteran and PTSD service dog teams: Exploring potential mechanisms of symptom change and canine predictors of efficacy. *PLOS ONE*, *17*(7), e0269186. https://doi.org/10.1371/journal.pone.0269186

Keeling, M., Borah, E. V., Kintzle, S., Kleykamp, M., & Robertson, H. C. (2019). Military spouses transition too! A call to action to address spouses' military to civilian transition. *Journal of Family Social Work*, *23*(1), 3–19. https://doi.org/10.1080/10522158.2019.1652219

Khalifian, C. E., Titone, M., Wooldridge, J. S., Knopp, K., Seibert, G., Monson, C., & Morland, L. (2022). The role of veterans' PTSD symptoms in veteran couples' insomnia. *Family Process*, *n/a*(n/a). https://doi.org/10.1111/famp.12835

Khawaja, I. S., Hashmi, A. M., Aftab, M. A., Westermeyer, J., & Hurwitz, T. D. (2014). Actigraphy in posttraumatic stress disorder. *Pakistan Journal of Medical Sciences*, *30*(2), 438–442.

Krahn, L. E., Tovar, M. D., & Miller, B. (2015). Are pets in the bedroom a problem? *Mayo Clinic Proceedings*, *90*(12), 1663–1665. https://doi.org/10.1016/j.mayocp.2015.08.012

Lessard, G., Gagnon, D. H., & Vincent, C. (2020). Changes in physical activity and sleep among veterans using a service dog as a rehabilitation modality for post-traumatic stress disorder: An open-label single-arm exploratory trial Using actigraphy-based measures. *Journal of Psychosocial Rehabilitation and Mental Health*. https://doi.org/10.1007/s40737-020-00187-4

Luxton, D. D., Greenburg, D., Ryan, J., Niven, A., Wheeler, G., & Mysliwiec, V. (2011). Prevalence and impact of short sleep duration in redeployed OIF soldiers. *Sleep*, *34*(9), 1189–1195. https://doi.org/10.5665/SLEEP.1236

Mansfield, A. J., & Morrissey, J. P. (2010). Deployment and the use of mental health services among U.S. Army wives. *N Engl j Med*, 9.

Nieforth, L. O., Abdul Wahab, A. H., Sabbaghi, A., MacDermid Wadsworth, S., Foti, D., & O’Haire, M. E. (2022). Quantifying the emotional experiences of partners of veterans with PTSD service dogs using ecological momentary assessment. *Complementary Therapies in Clinical Practice*, *48*, 101590. https://doi.org/10.1016/j.ctcp.2022.101590

Nieforth, L. O., Craig, E. A., Behmer, V. A., MacDermid Wadsworth, S., & O’Haire, M. E. (2021). PTSD service dogs foster resilience among veterans and military families. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues*. https://doi.org/10.1007/s12144-021-01990-3

Nieforth, L. O., Miller, E. A., MacDermid Wadsworth, S., & O’Haire, M. E. (2022). Posttraumatic stress disorder service dogs and the wellbeing of veteran families. *European Journal of Psychotraumatology*, *13*(1), 2062997. https://doi.org/10.1080/20008198.2022.2062997

Norris, D., Eichler, M., Cramm, H., Tam-Seto, L., & Smith-Evans, K. (2018). Operational stress injuries and the mental health and well-being of veteran spouses: A scoping review: Veteran spouses. *Journal of Family Theory & Review*, *10*(3), 657–671. https://doi.org/10.1111/jftr.12283

Patel, S. I., Miller, B. W., Kosiorek, H. E., Parish, J. M., Lyng, P. J., & Krahn, L. E. (2017). The effect of dogs on human sleep in the home sleep environment. *Mayo*

Clinic Proceedings, *92*(9), 1368–1373. https://doi.org/10.1016/j.mayocp.2017.06.014

Plumb, T. R., Peachey, J. T., & Zelman, D. C. (2014). Sleep disturbance is common among servicemembers and veterans of Operations Enduring Freedom and Iraqi Freedom. *Psychological Services*, *11*(2), 209–219. https://doi.org/10.1037/a0034958

Pruiksma, K. E., Taylor, D. J., Ruggero, C., Boals, A., Davis, J. L., Cranston, C., DeViva, J. C., & Zayfert, C. (2014). A psychometric study of the Fear of Sleep Inventory-Short Form (FoSI-SF). *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*, *10*(5), 551–558. https://doi.org/10.5664/jcsm.3710

Rodriguez, K. E., Bryce, C. I., Granger, D. A., & O’haire, M. E. (2018). The effect of a service dog on salivary cortisol awakening response in a military population with posttraumatic stress disorder (PTSD). *Psychoneuroendocrinology*, *98*, 202–210. https://doi.org/10.1016/j.psyneuen.2018.04.026

Rodriguez, K. E., Greer, J., Yatcilla, J. K., Beck, A. M., & O’Haire, M. E. (2020). The effects of assistance dogs on psychosocial health and wellbeing: A systematic literature review. *PLOS ONE*, *15*(12), e0243302. https://doi.org/10.1371/journal.pone.0243302

Scotland-Coogan, D. (2019). Anxiety symptoms and sleep disturbance in veterans with posttraumatic stress disorder: The impact of receiving and training a service dog. *The Qualitative Report*, *24*(10), 2655–2674.

Smith, B., Browne, M., Mack, J., & Kontou, T. (2018). An exploratory study of human–dog co-sleeping using actigraphy: Do dogs disrupt their owner’s sleep?

Anthrozoös, *31*(6). https://www-tandfonline-com.ezproxy4.library.arizona.edu/doi/abs/10.1080/08927936.2018.1529355

Smith, B., Thompson, K., Clarkson, L., & Dawson, D. (2014). The prevalence and implications of human–animal co-sleeping in an Australian sample. *Anthrozoös*, *27*(4), 543–551. https://doi.org/10.2752/089279314X14072268687880

Sullivan, K. S., Park, Y., & Riviere, L. A. (2022). Military and nonmilitary stressors associated with mental health outcomes among female military spouses. *Family Relations*, *71*(1), 371–388. https://doi.org/10.1111/fare.12589

van Houtert, E. A. E., Rodenburg, T. B., Vermetten, E., & Endenburg, N. (2022). The impact of service dogs on military veterans and (Ex) first aid responders with post-traumatic stress disorder. *Frontiers in Psychiatry*, *13*. https://www.frontiersin.org/articles/10.3389/fpsyt.2022.834291

Walters, E. M., Phillips, A. J. K., Mellor, A., Hamill, K., Jenkins, M. M., Norton, P. J., Baucom, D. H., & Drummond, S. P. A. (2020). Sleep and wake are shared and transmitted between individuals with insomnia and their bed-sharing partners. *SLEEP*, *43*(1), 1r–1r. https://doi.org/10.1093/sleep/zsz206

Watson, N. F., Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., Dinges, D. F., Gangwisch, J., Grandner, M. A., Kushida, C., Malhotra, R. K., Martin, J. L., Patel, S. R., Quan, S. F., & Tasali, E. (2015). Recommended amount of sleep for a healthy adult: A joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep*, *38*(6), 843–844. https://doi.org/10.5665/sleep.4716

Yarborough, B. J. H., Stumbo, S. P., Yarborough, M. T., Owen-Smith, A., & Green, C. A. (2018). Benefits and challenges of using service dogs for veterans with posttraumatic stress disorder. *Psychiatric Rehabilitation Journal*, *41*(2), 118–124. https://doi.org/10.1037/prj0000294

Zanen, L. A., Kusters, J. G., & Overgaauw, P. A. M. (2022). Zoonotic risks of sleeping with pets. *Pathogens*, *11*(10), Article 10. https://doi.org/10.3390/pathogens11101149

Table 1. Demographic characteristics at baseline

	Group		
Characteristic	**Control (N=40)**	**Intervention (N= 48)**	***p*-value**
Age, *M* (*SD*)	37 (8.6)	36 (7.5)	0.55
Gender, n (%)			
Female	35 (88%)	43 (90%)	
Male	5 (12%)	5 (10%)	
Socioeconomic Status, n (%)			0.03
Comfortable	22 (55%)	13 (27%)	
Just enough to make ends meet	15 (38%)	30 (62%)	
Not enough to make ends meet	3 (7%)	5 (10%)	
Education, n (%)			0.60
Some High School	0 (0%)	1 (2.1%)	
High School/GED	9 (22%)	6 (12%)	
Some College	11 (28%)	17 (35%)	
2-year degree	5 (12%)	6 (12%)	
4-year degree	9 (22%)	14 (29%)	
Post-graduate degree	6 (15%)	4 (8%)	
BIPOC, n (%)			0.81
No	26 (65%)	33 (69%)	
Yes	14 (35%)	14 (29%)	
Unknown	0 (0%)	1 (2%)	
VA Caregiver, n (%)			0.56
No	5 (12%)	9 (19%)	
Yes	35 (88%)	39 (81%)	
Relationship Status, n (%)			0.85
Divorced	0 (0%)	1 (2%)	
Living with significant other	3 (7%)	5 (10%)	
Married	37 (92%)	42 (88%)	
Has Children, n (%)			0.14
None	6 (15%)	5 (10%)	
1	12 (30%)	10 (21%)	
2	9 (22%)	22 (46%)	
3+	13 (32%)	11 (23%)	
Has Pet(s), n (%)			
No	10 (25%)	14 (29%)	
Yes	30 (75%)	34 (71%)	
FAD Affective Responsiveness, *M* (*SD*)	2.09 (0.70) n = 40	2.03 (0.63) n = 47	0.62
FAD General Functioning, *M* (*SD*)	2.04 (0.59) n = 40	1.92 (0.63) n = 47	0.23

Note. p-values are the results of a *t*-test for continuous variables and Fisher's exact test for categorical variables; BIPOC = Black, Indigenous, or Person of Color; VA = Veterans' Administration; FAD = Family Assessment Device

Table 2. Group means of control and intervention groups

	Control, *M* (*SD*)		**Intervention, *M* (*SD*)**	
	Baseline	Follow Up	Baseline	Follow Up
Subjective Measures				
Pittsburgh Sleep Quality Index	7.88 (3.75)	7.90 (4.53)	7.73 (3.64)	6.45 (3.43)
PROMIS Sleep Disturbance	52.95 (8.44)	50.77 (9.48)	50.92 (9.88)	49.05 (10.18)
Objective Measures				
Sleep Efficiency	85.36 (4.10)	85.94 (4.41)	83.86 (4.95)	84.02 (5.50)
Nighttime Sleep Duration	414.58 (53.93)	407.68 (62.06)	399.53 (48.52)	404.87 (49.56)
Sleep Onset Latency	13.48 (13.7)	15.11 (14.15)	12.43 (12.08)	15.04 (12.46)
Wake After Sleep Onset	42.16 (17.57)	35.39 (13.84)	45.20 (16.27)	45.22 (18.13)

Note. PROMIS = Patient-Reported Outcomes Measurement Information System

Table 3. Regression analyses comparing control to intervention groups

Measure	***n***	β ***(SE)***	***t***	***p***	**Cohen's *d***
Subjective Measures					
Pittsburgh Sleep Quality Index (PSQI)	72	0.05 (0.69)	-1.44	0.15	0.36
Patient Reported Outcomes Measurement Information System Sleep Disturbance (PROMIS Sleep Disturbance)	72	-0.25 (1.65)	0.32	0.75	0.17
Objective Measures					
Sleep Efficiency	71	-0.21 (1.21)	-0.90	0.37	0.39
Nighttime Sleep Duration	71	0.004 (9.43)	0.03	0.98	0.05
Sleep Onset Latency	71	-0.17 (3.17)	-0.48	0.63	0.01
Wake After Sleep Onset	71	0.45 (3.94)	1.92	0.06	0.61

Note. Results presented here are from the full models. *p*-values represent values prior to a Bonferroni Correction for multiple comparisons.