Stress Levels in Veterans with PTSD and Equines During Therapeutic Horseback Riding

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**STRESS LEVELS IN VETERANS WITH PTSD AND EQUINES DURING THERAPEUTIC HORSEBACK RIDING**

presented by Michele L. Butkiewicz,

a candidate for the degree of Doctor of Philosophy of Nursing

and hereby certify that, in their opinion, it is worthy of acceptance.

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DEDICATION

This dissertation is dedicated to my parents, Joseph, and Virginia Butkiewicz, who instilled in me a love of learning. Their unconditional love and support encouraged me throughout this journey. Thank you for the phone calls to check up on my progress when I was burned out or otherwise unmotivated. I cannot thank them enough for their support through the personal challenges I encountered along the way. And, for all the Sunday dinners complete with to go bags, my stomach thanks you.

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LIST OF ABBREVIATIONS

AAA – Animal Assisted Activity
AAE – Animal Assisted Education
AAI – Animal Assisted Intervention
AAT – Animal Assisted Therapy
ACORP – Animal Component of Research Protocol
ACOS – Associated Chief of Staff of Research & Development
ACUC – Animal Care and Use Committee
ANOVA – Analysis of Variance
AVMA – American Veterinary Medical Association
CAT – Canine Assisted Therapy
DOD – Department of Defense
EAGALA – Equine Assisted Growth and Learning Association
EAT – Equine Assisted Therapy
EMDR – Eye Movement Desensitization and Reprocessing
EBS – Equine Behavior Scale
HAI – Human Animal Interaction
HSIRB – Health Sciences Institutional Review Board
IAHAIO - International Association of Human-Animal Interaction Organizations
MUCVM – University of Missouri College of Veterinary Medicine
OCO – Overseas Contingency Operations
OLAW – Office of Laboratory Animal Welfare
PATH, Intl – Professional Association of Therapeutic Horsemanship International
PCL-M – Posttraumatic Stress Disorder Checklist - Military
PTSD – Posttraumatic Stress Disorder
RCT – Randomized Controlled Trial
TBI – Traumatic Brain Injury
THR – Therapeutic Horseback Riding
USDA – United States Department of Agriculture
VA – Department of Veterans Administration
Military Veterans are at risk of developing posttraumatic stress disorder (PTSD) following exposure to combat while on deployment. Up to 30% of Veterans suffer from PTSD and many do not seek treatment due to the perceived stigma of seeking mental health services, distrust of the mental health profession, or perception that treatment is inadequate. Left untreated, PTSD can cause significant social, emotional, and financial hardships for the Veteran, family, and community. Animal assisted interventions (AAI) have been shown to be a successful, acceptable alternative and complementary therapy for PTSD. A literature review yielded 16 studies of AAI for Veterans with PTSD. Pinnipeds, canines, and equines were the animals used for AAI. Although the methods, lengths, and dose of therapy differed across studies, AAI were found to decrease level of PTSD, anxiety, and depression and increase in quality of life and social support.

A qualitative, thematic analysis of 116 Veteran riding diary entries following therapeutic horseback riding (THR) revealed five themes: (a) social interaction, (b) self-awareness, (c) mood, (d) relationship development and bonding, and (e) positive experience. The central theme was that THR decreases the symptoms of PTSD. As research continues to support the benefits of AAI, it is essential to also study the health and welfare of the animals used. A quantitative analysis of N = 5 Veterans with PTSD participating in THR examined the relationship between level of PTSD and physiologic and behavioral indicators of stress. No significant correlation was found between level of PTSD and
equine cortisol levels, nor level of PTSD and equine behavior scores (EBS). Level of PTSD did not significantly decrease across THR sessions; however, it did move in the expected direction. Although mean equine cortisol levels increased across sessions, levels remained within normal range. There was no significant increase in mean EBS across THR sessions. Results of this dissertation support the use of AAI in Veterans with PTSD.

*Keywords:* PTSD, equines, horses, Veterans
Stress Levels in Veterans with PTSD and Equines During Therapeutic Horseback Riding

CHAPTER 1

INTRODUCTION

Posttraumatic stress disorder (PTSD) was known as shell shock or battle neuroses in World War I, combat fatigue and post-concussion syndrome in World War II, and combat stress reaction in more recent decades (Jones, Fear, & Wessely, 2007). The American Psychiatric Association added the term PTSD to the Diagnostic and Statistical Manual of Mental Disorders III (DSM-III) in 1980 (Friedman, n.d.). The 2013 edition of the Diagnostic and Statistical Manual of Mental Disorders V (DSM-5) includes a revised definition of PTSD based on both scientific evidence and clinical experience obtained since the previous publication (American Psychiatric Association, 2013). Previously classified as an anxiety disorder, PTSD is now part of a new class, trauma and stressor-related disorders. Exposure to a trauma is the common factor of all disorders in the new class. Types of traumas include war, disaster, terrorism, motor vehicle accident, sexual assault, and violence (American Psychiatric Association, 2013).

The DSM-5 includes diagnostic criteria for PTSD. The symptoms included in the criteria must have started after exposure to the trauma. Criterion A, the stressor criterion, which must be met before looking at any other criteria, states that the individual must have been exposed to an actual or threatened death or injury, a threat to himself or others, or an indirect exposure to a violent or accidental death, or enactment of sexual violence of a loved one. Criterion B, the intrusive recollection or re-experiencing criterion, states that the traumatic experience can remain part of a person’s psyche for years and cause panic, terror, grief, or despair. Re-experiencing can mean the occurrence of spontaneous memories of the traumatic event, recurrent dreams, flashbacks or other extreme or
sustained psychological distress. The third criterion, C, is avoidance. The individual with PTSD will limit their exposure to trigger stimuli. Avoidance behaviors may include ignoring or repressing distressing memories, thoughts, feelings or staying away from places, events or objects which serve as reminders of the trauma. Criterion D is the negative mood and cognitions criterion. Hallmarks of Criterion D include persistent changes in thoughts and mood such as unrelenting and distorted sense of blame of self or others, feeling inadequate, feeling that the traumatic event was their fault, or that the world is too dangerous to interact with. Disassociation from others, significant diminished interest in activities, the inability to remember key aspects of the trauma, and difficulty experiencing positive feelings are also symptoms of changes in thought and mood. Criterion E, the fourth criterion, is alterations in arousal and activity. Hypervigilance, aggression, reckless or self-destructive behavior, sleep disturbances and being easily startled are commonly experienced symptoms of Criterion E. The final three criteria, F, G, and H state that the symptoms must be present for at least one month, cause significant distress in social and/or occupational environments, and cannot be due to alcohol, medications, or substance abuse (American Psychiatric Association, 2013).

Military Veterans are particularly at risk of developing PTSD following exposure to combat while on deployment. While the exact mechanism of PTSD is unclear, risk factors such as previous mental health issues, poor social support, and life stressors occurring after trauma exposure can predispose a Veteran to developing PTSD (Krause-Parell0, Sarenni, & Padden, 2016). It has been estimated that 5-30% of Veterans suffer from PTSD, depending upon the conflict experienced (Bourn, Sexton, Porter, & Rauch, 2016; Defrin, Schreiber, & Ginzburg, 2015; Fishbain, 2017; Irwin, Konnett, Wong, &
O’Neill, 2014; Lang, Veazey-Morris, Berlin, & Andrasik, 2016; Morasco, Lovejoy, Lu, Turk, Lewis, & Dobscha, 2013). Approximately 50% of soldiers drop out of therapy prior to completion due to the perceived stigma of receiving mental health services, distrust of the mental health profession, and perception that the treatment is inadequate (Fine, 2015). Lack of, or insufficient treatment, for PTSD can lead to significant social, emotional, financial, physical, and societal burdens (Armenta, et al., 2018; Bailey, Corbell, Sobin, & Neumeister, 2013; Forster, Simons, & Baugh, 2017; Yehuda, Vermetten, McFarlane, & Lehrner, 2014). In fact, of all adult deaths by suicide in 2001, Veterans were a striking 20% of that population, with Veterans ages 55-74 at highest risk (U.S. Department of Veterans Affairs, 2021). Perhaps even more astonishing is that in 2019, there was an average of 17.2 Veteran suicides per day for a total of 6,261 deaths (U.S. Department of Veterans Affairs, 2021).

Multiple treatment modalities are available for treating PTSD. Traditional evidence-based treatments for PTSD include brief Electric Psychotherapy, Cognitive Behavior Therapy (CBT), Cognitive Processing Therapy (CPT), Eye Movement Desensitization and Reprocessing (EMDR), Narrative Exposure Therapy (NET), Prolonged Exposure (PE), and medications such as antidepressants (American Psychological Association, 2017; Friedman, n.d.; U.S. Department of Veterans Affairs, 2020b). Frequency, dose, and timing vary by treatment type (American Psychological Association, 2017). These treatments tend to address health conditions in isolation, necessitating the need for multiple types of treatment (Kinney, 2019). Due to the large numbers of military veterans with PTSD who either do not seek traditional therapy,
drop out of therapy, or do not respond to traditional therapy, the need to identify innovative therapies to help these Veterans is critical.

Animal-Assisted Interventions (AAI), defined as goal-oriented, structured interactions between a human and an animal for therapeutic gain, has become increasingly popular in recent years as an adjunct to traditional treatment for PTSD. AAI is an umbrella term used to include Animal Assisted Therapy (AAT), Animal Assisted Education (AAE), and Animal Assisted Activity (AAA) (Beetz, A., Ormerod, E., Johnson, R., Fine, A., Yamakazi, K., Dudzik, C., Garcia, R. M., & Choi, G., 2018; Kinney, Eakman, Lassell, & Wood, 2019; O’Haire, Guérin, & Kirkham, 2015; Staudt, & Cherry, 2017; van Houtert, E. A. E., Endenburg, N., Wijnker, J. J., Rodenburn, B., & Vermetten, E., 2018). A growing subset of AAI includes Equine Assisted Interventions (EAI), which includes Equine Assisted Therapy (EAT), and Equine Assisted Activities (EAA). According to Professional Association of Therapeutic Horsemanship International (PATH, Intl) (2016), EAA are interventions facilitated by an equine professional designed to lead to therapeutic outcomes.

In general, a greater awareness of self, receipt of immediate and non-judgmental feedback, respect, trust, orientation to the present, independence, assertiveness, and empowerment are examples of the positive effects of equine-assisted therapy. In addition to these qualitative outcomes some quantitative data does exist showing significant improvements in symptoms such as depression, anxiety, trauma emotions, post-traumatic stress, quality of life, and social support. (Bergen-Cico, 2018; Earles, Vernon, & Yetz, 2015; Ferruolo, 2015; Johnson, et al., 2018; Kloep, Hunter, & Kurtz, 2017; Klontz, Bivens, Leinart, & Klontz, 2007; Lanning & Krenek, 2013; Lanning, Wilson, Krenek, &

**Specific Aims**

**Specific Aim #1:** Determine the effects of PTSD severity on equine stress levels during a therapeutic horseback riding program.

**Specific Aim #2:** Determine the effects of PTSD severity on equine stress behaviors during a therapeutic horseback riding program.

**Specific Aim #3:** Identify Veterans’ perceptions of a therapeutic horseback riding program.

**Research Questions**

**RQ#1:** What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equine cortisol levels in equines they rode?

**RQ#2:** What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equines stress behaviors in the equines they rode?

**RQ#3:** What are military Veterans’ perceptions of a therapeutic horseback riding program?

**Significance**

The proposed research study is innovative in the following ways: first, no study has looked at the association between Veteran PTSD score and equine serum cortisol nor equine behavior score. Second, the use of a riding diary for Veterans with PTSD participating in a THR program has not been widely studied.
Findings from this study may provide critical information on the health of equines during their interactions with Veterans with PTSD. Such information may inform policy on the use of equines in therapeutic horseback riding such as standardized curricula, training, and ethical utilization of animals in therapeutic milieu. In addition, the identification of a therapy for mental illness such as PTSD which does not carry the same stigma as that of traditional treatment may encourage individuals to seek and complete the recommended animal-assisted intervention.
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CHAPTER 2

ANIMAL ASSISTED INTERVENTIONS IN MILITARY PERSONNEL AND VETERANS WITH POST-TRAUMATIC STRESS DISORDER: A SYSTEMATIC REVIEW


Background

Posttraumatic stress disorder (PTSD) has been known as shell shock or battle neuroses in World War I, combat fatigue and post-concussion syndrome in World War II, and combat stress reaction in more recent decades (Jones, Fear, & Wessely, 2007). Published in 2013 by the American Psychiatric Association, the Diagnostic and Statistical Manual of Mental Disorders V (DSM V) includes a revised definition of PTSD based on both scientific evidence and clinical experience obtained since the publication of the previous version, DSM IV. Previously classified as an anxiety disorder, PTSD is now part of a new class, ‘trauma and stressor-related disorders.’ Exposure to a trauma is the common factor of all disorders in the new class. Types of traumas include war, disaster, terrorism, motor vehicle accident, sexual assault, and violence, each of which can lead to PTSD.

There are four symptom clusters emphasizing the “fight or flight” aspect of PTSD: re-experiencing, avoidance, negative cognition and mood, and arousal. Re-experiencing can mean the occurrence of spontaneous memories of traumatic events, recurrent dreams, flashbacks or other extreme or sustained psychological distress. Avoidance behaviors may include ignoring or repressing distressing memories, thoughts, feelings or staying away from places, events or objects which serve as reminders of the
trauma. Negative cognitions and mood distortion refer to unrelenting and distorted sense of blame of self or others, disassociation from others or significantly diminished interest in activities, or the inability to remember key aspects of the trauma. Arousal can be displayed as aggressive, reckless, or self-destructive behavior, sleep disturbances, hypervigilance, or related problems (American Psychiatric Association, 2013).

According to the U.S. Department of Veterans Affairs (2018), there are roughly 19.5 million Veterans in the United States. As of June 30, 2015, 865,023 Veterans were compensated for PTSD, though it is highly likely this figure is underreported due to those who are undiagnosed or untreated. People with PTSD have among the highest health care utilization and costs compared to those without PTSD. VA experts estimate that up to 30% of Vietnam Veterans, up to 20% of Operation Enduring Freedom/Operation Iraqi Freedom and up to 12% of Gulf War Veterans have PTSD in any given year, leading to increased need for healthcare services, utilization, and costs (U.S. Department of Veterans Affairs, 2018a). The number of diagnosed cases of PTSD increased by 50% from 2012 to 2013. It is estimated that 50% of those with PTSD do not seek treatment and roughly one-half of those who do seek treatment do not receive adequate treatment. Up to 40% of active-duty members drop out of therapy prior to completion due to the perceived stigma of receiving mental health services and distrust of the mental health profession (Tedeschi, Sisa, Olmert, Parish-Plass, & Yount, 2015). A 2012 report from the Congressional Budget Office states that the average cost to treat PTSD in the first year is $8,300 and if co-morbidities are present, the costs skyrocket to $18,259 (Committee on the Assessment of On-going Efforts in the Treatment of Posttraumatic Stress Disorder, 2014). If the cost to treat PTSD continues the current trajectory, by 2053 more than $1.0
trillion will be spent (Wortman, Vallone, Karnes, Walawander, Daly, & Fox-Garrity, 2018).

It is not uncommon for military personnel and Veterans with PTSD to have behavioral and medical co-morbidities, leading to difficulties in social functioning, community reintegration, participation in activities of daily living, and quality of life (Johnson, et al., 2018; Lanning, Wilson, Krenek, & Beaujean, 2017; Nevins, Finch, Hickling, & Barnett, 2013; Romaniuk, Evans, & Kidd, 2018; Wortman, Vallone, Karnes, Walawander, Daly, & Fox-Garrity, 2018). The presence of PTSD and co-morbidities complicates treatment and calls for innovative solutions that decrease or eliminate the stigma of seeking help. The use of Animal Assisted Interventions (AAI) has gained attention as an adjunct or stand-alone treatment for PTSD in Veterans, with or without co-morbidities.

Animals have played an active part in our lives for most of human history. Animal spirits were often considered to be guardians against evil and illness. Shamans were believed to take on animal forms to communicate with the spiritual world and calm the angry spirits causing physical and mental illness. Gods and goddesses of ancient Egypt and Greece were often human-animal forms and thought to possess the power to heal. During the age of Enlightenment in the 1700s, animals were seen as social agents and gained popularity as companions to treat mental illness. In the late 1800s, Florence Nightingale realized the therapeutic role of animals for the sick and chronically ill. The early 1900s saw a rise in scientific medicine, which displaced notions of animals for healing, and it was not until the 1960s when the therapeutic value of animals was once
again recognized. Despite growing interest and support, the widespread study and use of AAI remains low and underfunded by government agencies (Serpell, 2014).

AAI lacks a standardized definition and terminology. Indeed, LaJoie (2003) performed a literature search and found 20 definitions of animal assisted therapy and 12 terms all describing the same construct. Kruger and Serpell (2006) state that AAI is any intervention consciously including animals as part of the therapeutic process. In 2018, the International Association of Human-Animal Interaction Organizations (IAHAIO) developed consensus driven definitions for AAI and AAT which state the following:

“An AAI is a goal-oriented and structured intervention that intentionally includes or incorporates animals in health, education, and human service (e.g., social work) for the purpose of therapeutic gains in humans. It involves people with knowledge of the people and animals involved. AAIrs incorporate human-animal teams in formal human service such as Animal-Assisted Therapy (AAT), Animal-Assisted Education (AAE) or under certain conditions Animal-Assisted Activities. Furthermore, an AAT is a goal-oriented, planned, and structured therapeutic intervention directed and/or delivered by health, education, and human service professionals. Intervention progress is measured and included in professional documentation. AAT is delivered and/or directed by a formally trained (with active licensure, degree, or equivalent) professional with expertise within the scope of the professionals’ practice. AAT focuses on enhancing physical, cognitive, behavioral, and/or socioemotional functioning of the particular human recipient.” (p. 4)
AAI is generally used as an umbrella term to describe animal-assisted activities, animal-assisted therapy, and animal-assisted education. Within each of these terms lies a wide spectrum of interventions (Fine, Tedeschi, & Elvove, 2014). The American Veterinary Medical Association (2018) has adopted the IAHAIO definition of AAI and further states that AAI must be governed by standards, monitored regularly, and be delivered by appropriately trained personnel. It is also critical to maintain the health and welfare of the animals and humans involved in AAI.

The present review was initiated to examine the literature on the effects of animal-assisted interventions on PTSD symptoms in military personnel and Veterans. The research question to be answered in this systematic review is: What are the AAI outcomes, interventions, dose, frequency, duration, animals, and measurement instruments used in the intervention studies?

**Method**

**Search Strategy**

This study followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Moher, 2015). In March 2022, a query of scientific literature databases (CINAHL, Cochrane, DARE, Medline, ProQuest Dissertations and Theses, PsychInfo, PTSDPub, PubMed, and Scopus) was conducted. In addition, an ancestry search was conducted of bibliographies in key studies. The search was limited to articles published in English and published between 1950 and 2022. An additional filter, age 18-64, was included to further refine the literature search results. Keywords used in the search include: posttraumatic stress disorder; post traumatic stress disorder; post-traumatic stress disorder; PTSD; shell shock; shellshock; military personnel; active
military; servicemen; Veterans; military; soldiers; combat experience; animal assisted intervention; animal assisted therapy; animal assisted activities; animal facilitated intervention; animal facilitated therapy; animal facilitated activities; animal intervention; animal therapy; animal assisted; animal facilitated; therapeutic animals; human animal interaction; equine therapy; therapeutic horses; horse therapy; equine assisted; equine facilitated; therapeutic horseback riding; therapeutic riding; horseback riding; therapeutic horse; canine therapy; dog therapy; therapeutic dogs; therapeutic canines; canine facilitated; dog facilitated; canine assisted; dog assisted; feline therapy; cat therapy; therapeutic cats; therapeutic felines; feline facilitated; feline assisted; cat facilitated; cat assisted; pet therapy or therapeutic pets; pet facilitated; and pet assisted.

**Inclusion and Exclusion Criteria**

The search was limited to articles published in peer reviewed journals. Studies were eligible for review if they met the following criteria:

1. Intervention studies involving live animals and AAI to improve PTSD symptoms.
2. Active military personnel or Veterans with a diagnosis of PTSD.
3. Intervention was less than or equal to one year; and
4. Conducted in a field-based setting

Articles were excluded if they studied robotic, virtual, or other non-live animals, participants were non-military or in the military reserves, and had no diagnosis of PTSD. Additional exclusions were interventions involving service animals, emotional/psychiatric support animals, companion animals, psychotherapy using animals, and pets.

**Study Selection**
A total of 176 articles were found using electronic databases, with an additional 17 articles found via ancestry search. After removing 129 articles, 64 article titles and abstracts were screened for potential inclusion in the systematic review. Following elimination of an additional 24 articles, 40 were eligible for full review. Twenty-one duplicates were found, resulting in a final full review of 19 articles. An additional three articles were excluded for the following reasons: intervention was psychotherapy and not AAI; non-interventional; participants were not Veterans; and inability to determine if participants had PTSD. Sixteen studies were selected for inclusion. See Figure 2.1.

Data Extraction

Data were extracted from each article by the author. Extracted elements included: author; year of publication; study design, purpose of study, population of interest; sample size; interventions; instrumentation; type of animal; outcome variables; measurement timeline; and results. Table 2.1 shows the characteristics of the 16 studies included in the systematic review.

Results

Of the 16 studies selected for inclusion, there was one quasi-experimental control study (Beetz, Schöfmann, Girgensohn, Braas, & Ernst, 2019), one quasi-experimental pre-post-test studies (Arnon et al., 2020), one non-experimental pre-post-test study (Scotland-Coogan, Whitworth, & Wharton, 2020), one randomized wait list control group study (Johnson, et al., 2018), one randomized controlled trial (Krause-Parello, et al., 2020), two quasi-experimental wait list control (Bergin-Cico, et al., 2018; Whitworth, Scotland-Coogan, & Wharton, 2019), three repeated measures studies (Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba,…& Neria, 2021; Lanning, Wilson, Krenek, &
Beaujean, 2017; Malinowski, et al., 2018), one case study (Nevins, Finch, Hickling, & Barnett, 2013), two quasi-experimental longitudinal studies (Romaniuk, Evans, & Kidd, 2018; Zhu, Suarez-Jimenez, Zilcha-Mano, Lazarov, Arnon, Lowell, Bergman, & Neria, 2020), one between groups questionnaire (Ferruolo, 2015), one case series study (Shelef, et al., 2019) and one secondary analysis of de-identified data from a previously conducted study (Wortman, et al., 2018). There were six pilot studies (Arnon, et al., 2020; Beetz, Schöfmann, Girgensohn, Braas, & Ernst, 2019; Ferruolo, 2015; Malinowski, et al., 2018; Shelef, et al., 2019; Whitworth, Scotland-Coogan, & Wharton, 2019). Six studies reported qualitative data (Bergin-Cico, et al., 2018; Ferruolo, 2015; Johnson, et al., 2018; Lanning, Wilson, Krenek, & Beaujean, 2017; Nevins, Finch, Hickling, & Barnett, 2013; Shelef, et al.)

Equines were used in ten of the studies (Arnon, et al., 2020; Ferruolo, 2015; Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba, & Neria, 2021; Johnson, et al., 2013; Lanning, Wilson, Krenek, & Beaujean, 2017; Malinowski, et al., 2018; Nevins, Finch, Hickling, & Barnett, 2013; Romaniuk, Evans, & Kidd, 2018; Shelef, 2019; Zhu, Suarez-Jimenez, Zilcha-Mano, Lazarov, Arnon, Lowell, Bergman, & Neria, 2020), canines in five (Beetz, Schöfmann, Girgensohn, Braas, & Ernst, 2019; Bergen-Cico, et al., 2018; Krause-Parello, et al., 2020; Scotland-Coogan, Whitworth, & Wharton, 2020; Whitworth, Scotland-Coogan, & Wharton, 2019), and one study used seals (Wortman, et al., 2018). Animal welfare was discussed in only one study (Johnson, et al., 2018).

Studies were conducted in the United States (Bergin-Cico, et al., 2018; Ferruolo, 2015; Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba, & Neria, 2021; Johnson, et al., 2018; Krause-Parello, et al., 2019; Lanning, Wilson, Krenek, & Beaujean, 2017;

A total of 560 military personnel and Veterans plus 11 spouses/partners participated in the studies, with a range of one to 71 participants per study. Publication dates of the studies ranged from 2013 to 2021. Measures to control sources of bias, such as randomization, were present in two studies and blinding to the intervention was not possible due to the nature of the intervention (Johnson, et al., 2018; Krause-Parello, 2019). Two studies utilized a theoretical framework, to guide the intervention (Johnson, et al., 2018; Scotland-Coogan, Whitworth, & Wharton, 2020).

Measurement

The studies used a wide variety of self-reported surveys and scales to measure outcomes. The primary outcome of interest, PTSD symptoms, was measured with four unique self-report instruments: PCL-M, PCL-C, PCL-5, and the Trauma Severity Index - (TSI-2). Each PCL checklist is widely accepted and used as a screening tool for PTSD as well as to measure symptom change over time in response to treatment. Two versions, the PCL-C, and PCL-M are based on the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) (American Psychiatric Association, 1994). The PCL-M and PCL-C checklists are 17-item, 5-point Likert scales, with a range of scores from 17-85, with higher scores indicating more symptoms. Wortmann, et al. (2016) state that a five-
point change is indicative of response to treatment and a ten-point change is clinically meaningful. Although often used interchangeably, each checklist has its own strengths, weaknesses, and purpose. The PCL-M measures symptoms related to an event experienced during military service and the PCL-C measures any stressful life event (McDonald & Calhoun 2010). The PCL-5 is the newest checklist and was developed to reflect changes to existing symptoms and additions of new symptoms in the Diagnostic and Statistical Manual of Mental Disorders V (DSM-V) (American Psychiatric Association, 2013). Although additional research is warranted, it has been suggested that a cut-off score of 31-33 may be indicative of PTSD. (U.S. Department of Veterans Affairs, 2018b). The PCL-5 cannot be used interchangeably with other PTSD checklists as it is a 20-item 5-point Likert scale with a range of scores from 0-80. The TSI-2 is a 136-item instrument, which evaluates acute and chronic symptomatology. The TSI-2, developed in 2011 is based on the original 1995 TSI-1 and contains only minor updates (Scotland-Coogan, Whitworth, & Wharton, 2010). Designed to evaluate PTSD symptoms as well as other non-specific psychological symptoms, it consists of four summary factors, self-disturbance, posttraumatic stress, externalizations, and somatization, 12 clinical scales and 12 subscales. Respondents are asked to rate the frequency of their symptoms, condition, or behavior within the last six months using a four-point Likert scale from zero, ‘never’ to three, ‘all the time’ (Ales & Erdodi, 2022). Brier (2011) has identified a cutoff score of >8 for the general population and ≥15 for clinical populations. The TSI-2 was validated on a sample of 628 adults whose demographics represented the population from the U. S. Census (Ales & Erdodi, 2022). The TSI-2 demonstrated high internal consistency and test re-test reliability ($\alpha = 0.76–0.94$ and $r = 0.76–0.93$,
respectively) (Briere, 2011), The Clinician Administered PTSD Scale was used in two studies and is considered the gold standard in PTSD assessment and is used to diagnose current or past month PTSD, make a lifetime diagnosis of PTSD, and to assess PTSD symptoms over the past week (Arnon, et al., 2020; Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba, & Neria, 2021; U.S. Department of Veterans Affairs, 2018c). The Short Post-traumatic Stress Rating Interview (SPRINT) is an eight-item, five-point Likert Scale, which measures the core symptoms of PTSD along with somatic malaise, stress vulnerability, and functional impairment. Scores on the SPRINT range from zero to 32, with higher scores indicating greater symptomatology. A cut-off of 11 – 13 can identify those with PTSD versus those without PTSD (Connor & Davidson, 2001; Davidson & Colket, 1997; U.S. Department of Veterans Affairs, 2018d).

An additional 27 instruments were used to measure outcomes such as psychiatric symptoms, perceived stress, work and social adjustment, self-compassion, serum cortisol, serum alpha-amylase, serum immunoglobulin A, self-efficacy, emotional regulation, loneliness, Post deployment social support, depressive symptoms, quality of life, anger reactions, disabilities, client satisfaction, social support scale, response to stressful events, anxiety, happiness, and enjoyment and satisfaction.

**Animals**

**pinnipeds.**

There was one study included in this review involving pinnipeds, or seals. It was a secondary analysis of the interventional Project Seal to Heal program (Wortman, et al., 2018). Project Seal to Heal consisted of four, one-hour sessions with direct and indirect time spent with a seal. A different seal was used for each session. Of the four seals, three
were rescued and one was raised by human hands. Much of each session was spent on indirect interactions focusing on educational topics such as anatomy and physiology, conservation, and husbandry. At least 10 minutes of direct seal interaction occurred each session. The single study participant learned about the seal and fed, touched, and observed seal behavior. The PCL-5 was completed prior to the first session, midway through the program, and after the final session, for a total of three sets of scores. It is unknown when during the session the PCL-5 was completed.

No demographic or other participant information was reported as part of this secondary analysis and outcomes of only one participant, referred to as Participant 3 were discussed. Other than mean change in score over time, no statistical analysis was completed on the data. The participant reported a decrease in overall symptoms over the length of the program; time one (T1) = 59, time two (T2) = 48, time three (T3) = 44, indicating that the intervention had a significant clinical impact on PTSD symptoms. Scores for individual questions two, three, four, five, six, seven, eight, nine, 11, 16 and 17 decreased from time one to time three. Item number one, ‘repeated, disturbing, and unwanted memories of the stressful experience’ and item number 12 ‘loss of interest in activities that you used to enjoy’ increased from T1 to T3. The participant scored these items as having little to moderate effect on symptoms, respectively, at baseline but at time three, the two symptoms affected PTSD moderately and quite a bit, respectively, possibly indicating that the intervention had a negative effect on these two symptoms. Items 10, 13, 14, 15, 18, 19, and 20 did not change from T1 to T3, possibly indicating that the intervention was not effective for these seven symptoms. Wortman and colleagues (2018) also analyzed symptom clusters of PTSD. The intrusion cluster saw a
change of 6 points between T1 and T3, the largest difference in scores of all clusters. Persistent avoidance, negative alterations in cognition and mood, and hypervigilance experienced a decrease of five, two, and two points, respectively, between T1 and T3.

canines.

Of the five studies involving canines, one was a quasi-experimental study with a wait list control group, one was a non-randomized control study, one was a randomized controlled trial. (Beetz, Schöfmann, Girgensohn, Braas, & Ernst, 2019; Bergen-Cico, et al., 2018; Krause-Parello, et al., 2020; Scotland-Coogan, Whitworth, & Wharton, 2020; Whitworth, Scotland-Coogan, & Wharton, 2019).

Frequency of AAI varied from one time to monthly with doses ranging from 20 minutes to three hours delivered over a period of once to 12 months. Other differences in the canine AAI include setting, frequency and timing of outcomes measurement, and intervention. Outcomes of interest in the canine studies varied. Beetz, Schöfmann, Girgensohn, Braas, & Ernst (2019) studied the impact of AAI on psychiatric symptoms, perceived stress, functional problems with emotions and actions, therapeutic relationships, and mental wellness. PTSD symptom severity, perceived stress and self-compassion were the outcomes studied by Bergin-Cico, et al. (2018). Krause-Parello, et al., (2019) looked at PTSD symptom severity and stress levels using the biomarkers salivary cortisol, alpha-amylase (AA) and immunoglobulin A (IgA) levels. Except for biomarkers, outcomes were measured using self-report instruments. Whitmore, Scotland-Coogan, & Wharton (2019) and Scotland-Coogan, Whitmore, & Wharton (2020) used one instrument to measure multiple outcomes such as self-disturbance, posttraumatic
stress, externalization, somatization, and other psychological impacts associated with PTSD.

Beetz, Schöfmann, Girgensohn, Braas, & Ernst (2019) designed a new intervention to be piloted in a non-randomized, controlled study. The intervention group received four 3-hour sessions of AAI delivered by an active service member using either his/her own canine or a military canine at the Bundeswehr School of Dog Handling in Germany. The AAI intervention was in addition to standard inpatient treatment received at the military hospital. Participants interacted with the dogs via walks, play, grooming, feeding, and relaxing. The control group received standard inpatient treatment only.

The AAI intervention in the Beetz, Schöfmann, Girgensohn, Braas, & Ernst (2019) study showed no statistical difference in psychiatric symptoms between groups when Page’s trend test was applied at time three and time four. Work and social adjustment significantly improved in the intervention group after time four ($p = 0.038$) when Page’s test was applied. No significant change in perceived stress was seen, although results trended in the positive direction during the intervention period. No clear trend in therapeutic relationship was seen. Mental wellness improved significantly after the intervention in weeks one ($p < 0.005$) and three ($p < 0.02$) (Beetz, Schöfmann, Girgensohn, Braas, & Ernst 2019).

The canine study by Bergen-Cico, et al. (2018) studied the effect of Dogs2Vets, a 12-month structured therapeutic dog ownership and training program, which focused on the healing aspects of the human-animal bond. Training occurred in weekly, 90-minute sessions. Dogs2Vets was used as an additional therapy in treating symptoms of PTSD in Veterans. Many of the canines in the study had also experienced significant trauma.
Veterans chose their own canine and training occurred under the guidance of a Dogs2Vets trainer. Participants in the wait list group participated in volunteer programs and Wingman, a peer support group. Participants learned basic training skills and took their canine on multiple outings to practice learned skills and encourage social interaction. At the end of the program, the Veteran adopted the dog (Bergen-Cico, et al., 2018). In a randomized, controlled trial, injured military personnel at an aeromedical staging facility (ASF) awaiting aeromedical evacuation (AE) were randomized to receive either 20 minutes of AAI or an information session about assistance dogs (Krause-Parello, et al., 2019). The intervention was delivered in the evening in a shared area of the ASF. A certified canine handler and canine demonstrated tasks such as fetch and bracing for balance following a prescriptive talk about the benefits of service and therapy dogs. Participants were also able to pet and talk to the canines under supervision of the handler.

Participants in the Dogs2Vets program experienced a decrease in PTSD symptom severity during the intervention period ($p = 0.03$) while the control group experienced a 0.5-point increase in symptoms. Linear regression significantly predicted the intervention decreased symptom severity at 12-month follow up ($p = 0.01$). A significant decrease in perceived stress was noted in the intervention group ($p = 0.02$). Linear regression significantly predicted a decrease in perceived stress at 12 months ($p \leq 0.001$). Self-compassion, self-judgement, and isolation all significantly improved during the Dogs2Vets program ($p = 0.02$, $p = 0.01$, $p = 0.02$), respectively. Linear regression also significantly predicted significant improvements at 12 months post intervention for self-compassion ($p \leq 0.001$) and self-judgement ($p = 0.002$), while isolation did not have a significant effect (Bergin-Cico, et al., 2018).
Krause-Parello, et al., (2019) performed linear mixed methods model analysis to examine PTSD symptom severity’s effect on salivary cortisol, AA, and IgA. Statistical analysis showed that the cortisol response to AAI was influenced by PTSD symptom severity, thus those with more severe symptoms had a greater response to the intervention. A significant difference in cortisol response ($p = 0.04$) was seen between groups. PTSD symptom severity did not significantly contribute to AA response. Participants with higher symptom severity had a greater increase in IgA (decreased stress) than those in the control group. In a subgroup analysis of participants with PTSD scores $\geq 40$ showed a significant difference in IgA levels than those with a PTSD score $< 40$ ($p = 0.008$).

A pilot study conducted by Whitworth, Scotland-Coogan, & Wharton (2019) tested the feasibility of a controlled trial using a waitlist control group to compare the outcomes of Veterans with PTSD participating in a 14-week service dog training program. The TSI-2 was used to measure multiple factors and psychological sequela associated with trauma. The intervention and control groups took the TSI-2 prior to beginning the program and after the program was complete. Participants also completed the WHO-DAS 2.0, which measures understanding and communicating, getting around, self-care, getting along with people, life activities and participation in society. At baseline, all participants scored similarly on all assessments apart from WHO-DAS 2.0 life activities ($p = 0.18$) and participation in society ($p = 0.27$) scores. Although the researchers were unable to determine why the scores differed, they believed the scores did not impact outcomes of the intervention. Participants in the intervention group had significant improvements in self-disturbance ($p < 0.05$), post-traumatic stress ($p < 0.05$),
and externalization ($p < 0.05$). Depression and anger significantly decreased in the intervention group as well, ($p < 0.05$). Key relationship indicators insecure attachment, relational avoidance, and rejection sensitivity were significantly decreased in the service dog training group ($p < 0.05$). Results of the WHO-DAS 2.0 in the intervention group showed significant improvements in getting along with others and participation in society ($p < 0.05$) compared to the control group. Also significantly improved was the general perception of their disability ($p < 0.05$) in the intervention group. The control group did experience significant decreases in mean scores for posttraumatic stress ($p < 0.05$) and somatization ($p < 0.05$) from pre-intervention to post-intervention but no significant changes in WHO-DAS 2.0 scores was seen.

Scotland-Coogan, Whitworth, & Wharton (2020) conducted a larger wait list control group study based on results of the feasibility study. This study only used the TSI-2 to measure outcomes. No explanation was provided for the elimination of the WHO-DAS 2.0 in the follow up study. Like the feasibility study, participants experienced significant decreases in self-disturbance ($p < 0.001$), posttraumatic stress ($p < 0.001$), and externalization ($p < 0.001$). The intervention group also reported a significant decrease in somatization ($p < 0.001$) unlike the previous study where no significant change was seen. In addition to the decrease in summary factors, participants experienced a significant decrease in a broad range of psychological symptoms ($p < 0.001$, $p < 0.01$). The authors also analyzed the participants by age groups, 18-49 years and >50 years. Similar improvements in symptoms were observed pre-to post-test. The older group, however, did not show significant improvement in dysfunctional sexual behavior, suicidality, nor
suicidal ideation. It should be noted that scores in these areas were lower in the older Veteran age group pre-test.

**equines.**

Ten studies used equines in the intervention. A wide variety of study designs were used: case study (n = 1); repeated measures (n = 2); pre-posttest (n = 2); non-controlled within groups longitudinal (n = 1); post-intervention pilot study (n = 1); prospective case study (n = 1); quasi-experimental longitudinal (n = 1); repeated measures (n = 1), and randomized wait-list control (n=1).

Six studies employed equine-assisted therapy (EAT), although actual interventions differed in each study (Arnon, et al, 2020; Ferruolo, 2015; Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba,…& Neria, 2021; Nevins, Finch, Hickling, & Barnett, 2013; Romaniuk, Evans, & Kidd, 2018; Zhu, Suarez-Jimenez, Zilcha-Mano, Lazarov, Arnon, Lowell, Bergman,…& Neria, 2020). Arnon, et al. (2020) developed a treatment manual, which was piloted using two groups of Veterans, and included eight weekly 90-minute sessions. Each session began with a grounding exercise, followed by exercises designed to acquaint the Veteran and equine, and increasing complex activities to further Veterans’ mastery and comfort with the equine. Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba,…& Neria (2021) also developed a manual for an 8-week small group session EAT for Veterans with PTSD. Session contents were similar to those in the Arnon, et al. (2020) study. Ferruolo (2015) piloted a one or two-day equine facilitated mental health intervention consisting of psychoeducation, guided equine activities, and group processing. Nevins, Finch, Hickling, & Barnett (2013) used the Connection Method (non-verbal language of the equine) in a case study of a Veteran
combat medic. The Veteran first completed four hours of education, which included safety, equine physiology and psychology, and breed being used in the study. The intervention consisted of five parts: safety, introduction to pressure halter, pressure halter exercises, observation of equine and herd dynamics, and Connection Method instruction. A five-day intensive, residential intervention which included EAT, mindfulness, grounding techniques, and Relational Gestalt Therapy was studied by Romaniuk, Evans, and Kidd (2018). Only two articles mentioned the study setting, which was an equestrian center (Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba,…& Neria, 2021; Zhu, Suarez-Jimenez, Zilcha-Mano, Lazarov, Arnon, Lowell, Bergman,…& Neria, 2020). Study settings were not discussed in any other EAT articles. The remaining four equine studies used therapeutic horseback riding although they were of different methodologies (Johnson, et al., 2018; Lanning, et al., 2017; Malinowski, et al, 2018; Shelef, et al., 2019). Frequency and dose of therapy ranged from weekly 60-minute to 2-hour sessions delivered over six weeks to six months. Additional differences between the interventions involved what was covered at each session and for how long as well as frequency of outcome measurement. In equine studies, each participant was assigned a horse with which they worked throughout the duration of the study and side-walkers were used to support the veteran and provide safety during riding. Sessions were taught by a certified Professional Association of Therapeutic Horsemanship (PATH) instructor (Ferruolo, 2015; Johnson, et al., 2018; Lanning, et al, 2017; Malinowski, et al., 2018; Nevins, 2013; Romaniuk, 2018), an Equine-Assisted Growth and Learning Association (EAGALA) instructor (Arnon, et al., 2020) or certified instructors who had passed the National Sprots Administration courses (Shelef, 2019). Study setting for the therapeutic horseback riding
interventions was described as either an indoor or outdoor riding arena in one study only (Johnson, et al., 2018).

The equine study outcomes included self-reported PTSD symptoms, quality life, functional and behavioral change, functional disability, depression, coping self-efficacy, emotional regulation, and social and emotional loneliness. Arnon, et al. (2020) used two clinician administered assessments: Clinician Administered PTSD Scale for DSM 5 (CAPS-V) and the Hamilton Depression Rating Scale (HAM-D). The CAPS-V and HAM-D showed significant decreases pre- to post-treatment (p < 0.001, p < 0.001), midpoint to post-treatment (p = 0.035, p = 0.037), and pre-treatment to follow up (p < 0.20, p = 0.018). Coping self-efficacy and emotional regulation changed in a positive direction but were not statistically significant (Johnson, et al., 2018). Changes in social and emotional loneliness changed in an unexpected negative direction but were not statistically significant (Johnson, et al., 2018). Lanning, Wilson, Krenek, & Beaujean (2017) examined the effects of therapeutic riding on PTSD symptom severity, quality of life and functioning. A clinically significant change in PTSD symptom severity was seen over time on both the PCL-5 and PCL-M, 13-point reduction and 25-point reduction, respectively. The calculated effect size (g = −1.15, 95% CI [−1.71, −0.59] for PCL-5; g = −1.76, 95% CI [−3.46, −0.05] for PCL-M) indicated a significant portion of the improvement was accounted for by the intervention. The mental component summary score changed in the positive direction over time, were maintained at 2 months post-intervention, and had a large effect size (g = 0.93, 95% CI [0.44, 1.41]. Changes to the physical component summary score were inconsistent with a small effect size. In the Malinowski, et al. (2017) study, no significant changes in respiratory rate or blood
pressure were seen over the five-day EAT program. Participants experienced a significant decrease in heart rate during the intervention on day two ($p<0.05$). Symptoms of psychological distress as measured with the Brief Symptom Inventory (BSI) global severity index decreased significantly overall ($p = 0.002$) and in seven out of nine subscales. PTSD symptom severity decreased significantly over time ($p = 0.0493$).

Although no statistical analysis was performed, Nevins, Finch, Hickling, & Barnett (2013) found that PTSD symptom severity, depression, and quality of life dissatisfaction all decreased from pre-test to post-test at 12 weeks. Quality of life happiness and satisfied, social support, and resilience increased over time. Romaniuk, Evans, & Kidd (2018) looked at the effects of EAT in couples and individuals on PTSD symptoms, depression, anxiety, stress, happiness, and quality of life. Three measurement points were studied in each group: pre- to post-intervention, pre-intervention to follow-up, and post-intervention to follow-up. Participants in the individual program had significant changes in the positive direction for all measures from the pre- to post-intervention period. In the post-intervention to follow-up period, all measures, apart from anxiety, changed significantly in the negative direction. No significant changes were noted in any measure in the pre-intervention to follow-up phase. In the couples' program, all measures, except for anxiety, significantly changed in the positive direction from pre- to post-intervention. Unlike the individual program, couples had significant decreases in depression, anxiety, stress, and PTSD scores in the pre-intervention to follow-up time period. And, finally, in the post-intervention to follow-up time period, quality of life significantly changed in a negative direction. In the Shelef (2019) study, overall SPRINT scores decreased significantly from baseline to six months ($p = 0.02$). Although individual symptoms on
the SPRINT decreased over time as well, only item number seven, ‘Symptoms interfered with ability to work/carry out daily activities’ was statistically significant \((p = 0.02)\).

Overall Sheehan Disability Scale (SDS) scores showed statistically significant improvement at after one month of therapy, \((p < 0.03)\) and after six months of therapy \((p < 0.02)\). Participants also reported a significant decrease in the number of days of inefficiency at home/work/school over time \((p < 0.02)\) (Shelef, 2019). One study looked at MRI imaging biomarkers rsFC and sMRI pre- and post-intervention (Zhu, et al., 2020). A significant positive correlation was found between increased rsFC and decreased PCL scores pre and post intervention \((r = 0.60, p = 0.015)\). No significant changes in sMRI and clinical outcomes were seen post intervention. At 3-month follow up, changes in rsFC were significantly correlated with PCL scores \((r = 0.58, p = 0.019)\) and BDI \((r = 0.54, p = 0.03)\). As with post-intervention, no significant changes were seen in sMRI and clinical outcomes at follow up. When the authors examined neural predictors and clinical outcomes, they found that baseline rsFC was positively correlated with baseline PCL scores \((r = 0.34, p = 0.23)\) and negatively correlated with post intervention PCL scores \((r = -0.26, p = 0.38)\). Baseline sMRI was not significantly correlated with a decrease in clinical symptoms at post-treatment. At 3-month follow up, rsFC was positively correlated with CAPS-5, HAM-D, PCL, and BDI scores \((r = 0.658, p = 0.011; r = 0.73, p = 0.003; r = 0.82, p < 0.001; r = 0.67, p = 0.008, \text{respectively})\). Baseline clinical measures were positively correlated with baseline rsFC and negatively correlated at 3-month follow-up. Baseline sMRI and clinical outcomes were not correlated at follow up. Compared to baseline, CAPS-5, PCL, and BDI scores were significantly lower at post
intervention and follow up. There were no significant changes in HAM-D scores at post intervention nor follow up when compared to baseline.

**Discussion**

Although AAIs have been utilized for hundreds of years, it is only recently, particularly in the last seven years, that the intervention has gained popularity as a complementary and stand-alone treatment intervention. Many studies of AAI look at multiple aspects of mental health. This review is the first of its kind to evaluate the effects of AAI in military personnel and Veterans with PTSD. Results support the use of short-term AAI as a potential adjunct therapy for the treatment of PTSD symptoms as well as anxiety and depression. An exhaustive search was conducted of the literature to find studies of AAI in military personnel and Veterans with PTSD. Only sixteen studies were found fitting the defined inclusion criteria. PTSD and the use of AAI is seen across the world. Studies included in this review were conducted in the United States (Bergin-Cico, et al., 2018; Ferruolo, 2015; Fisher, Lazarov, Lowell, Arnon, Turner, Bergman, Ryba,…& Neria, 2021; Johnson, et al, 2018; Krause-Parello, et al., 2019; Lanning, Wilson, Krenek, & Beaujean, 2017; Malinowski, et al., 2018; Nevins, Finch, Hickling, & Barnett, 2013; Romaniuk, Evans, & Kidd, 2018; Scotland-Coogan, Whitworth, & Wharton, 2020; Whitworth, Scotland-Coogan, & Wharton, 2019; Wortman, et al, 2018), Germany (Beetz, Schöfmann, Girgensohn, Braas, & Ernst, 2019), Israel (Shelef, et al., 2019) and Australia (Romaniuk, Evans, & Kidd, 2018).

Animals used in the included studies were pinnipeds, canines, and equines. The AAI intervention differed across studies and animals, but all included direct interaction with the animal. Although five studies looked at THR, the specific interventions differed
among the studies. Several studies included group work, psychoeducation, and journaling in addition to the AAI. A total of 33 unique instruments were used to measure outcomes, the most common of which were PTSD symptoms, quality of life, social support, and depression. AAI frequency ranged from daily to weekly, duration ranged from one day to 12 months, and of those that reported dose, anywhere from 10 minutes to 4 hours were spent on the actual AAI. Regardless of animal or intervention, PTSD symptoms decreased over time.

Despite recent efforts of groups like IAHAIO, terminology of AAI and related treatments remain confusing. AAI is an umbrella term under which animal assisted activities and animal assisted therapy fall (Fine, Tedeschi, & Elvove, 2015). Each of these terms includes subtypes. For example, animal-assisted physical therapy and animal-assisted psychotherapy are types of animal-assisted therapy. In this review, therapeutic horseback riding, equine facilitated mental health, and service dog training programs were specific subtypes of animal-assisted therapy, which is a subtype of AAI. Such complexity of terminology may be a symptom of the immature nature of studies in the field, which will hopefully resolve with time and support of national organizations such as IAHAIO, PATH, and the AVMA to name a few.

This review is limited by the paucity of quantitative interventional studies of AAI. The wide variety of measurement instruments and lack of statistical analysis in the pinniped and Connection Method studies prevents further analysis in this review. Furthermore, sample sizes remain relatively small and homogeneous, leading to lack of power and generalizability. Four studies investigated the effects of THR, but each study used a distinct set of interventions comprising the program. This inconsistency makes it
difficult to say that all therapeutic horseback riding programs are effective in decreasing PTSD symptoms. Although one study mentioned the cost to train a service dog, none of the selected studies addressed the cost of AAI for the treatment of PTSD, so it remains unknown if these types of interventions are more cost effective than traditional treatments (Kloep, Hunter, & Kertz, 2017). Interestingly, none of the selected studies discussed possible confounding variables in their results, thus making it difficult to say that it was the actual AAI and not something such as being outside in nature, which lead to the decrease in PTSD symptoms (Westlund, 2015). Another limitation is that age was limited to those between 18 and 64 years of age. This potentially eliminated studies including WWII Veterans. Finally, any study involving animals needs to be mindful of their welfare and be guided by ethical principles. Only one study in this review addressed the safety and welfare of the animals (Johnson et al., 2018).

To advance the field of AAI, future research should focus on several areas. First, standardization of interventions would provide some needed rigor in beginning to control for confounding variables. Second, the use of consistent outcomes and measurement instruments would allow for meta-analysis and study replication. Third, theoretical frameworks will help guide all aspects of a research study from the formulation of the research question to the interpretation and application of results. Fourth, researchers should consider multi-site studies to increase sample size and heterogeneity of the sample population. Fifth, researchers should consider the inclusion of program costs and cost effectiveness of the intervention. Lastly, randomized controlled trials with a sufficient sample size and a diverse sample population will assist not only in generalizability of the findings but in the acceptance of AAI.
Conclusion

Although there is support for the use of AAI in the treatment of PTSD in military personnel and Veterans, there is a paucity of well-designed randomized controlled studies. Standardization of intervention components, frequency, and duration will allow easier and more in-depth analysis of results. Further research is necessary to support the use of AAI as a stand-alone treatment and gain support for the development of national policy and insurance coverage.

Declaration of conflicting interest

None

Disclosure statement

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Figure 2.1

PRISMA flow diagram
Table 2.1
Interventional Studies of Animal-Assisted Interventions for PTSD

<table>
<thead>
<tr>
<th>Authors Year</th>
<th>Purpose</th>
<th>Population</th>
<th>Intervention</th>
<th>Measures</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arnon, et al. (2020)</td>
<td>To develop an 8-week EAP treatment program for veterans with PTSD</td>
<td>quasi-experimental pre-test/post-test pilot</td>
<td>Six weekly 90-minute sessions with paired veterans and equine. Session 1 - introduce Veterans to treatment, barn tour, meeting the equine. Sessions 2-3 - begin developing relationship with horse. Grooming activities, leading equine on rope, directing equine. Sessions 4-7 - mastery of equine activities; development of comfort with individual and team activities. Session 8 - graduation ceremony, opportunity to discuss experience.</td>
<td>Timeing - baseline, after session 4, 5 months post program</td>
<td>CAPS-2: significant decrease in symptoms pre to post-treatment (p &lt; 0.001); pre to mid-treatment (p = 0.015); pre-treatment to follow up (p = 0.020). HAM-D: significant decrease pre to post-treatment (p &lt; 0.001); pre to mid-treatment (p = 0.037); pre-treatment to follow up (p = 0.018). Self-reported measures were not significant, but did trend in a positive way. Secondary analysis of self-reported measures pre to post-treatment: PCL-5 (p = 0.009); BDI-II (p = 0.003); QLESQ (p = 0.031).</td>
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<tr>
<td>Beets, et al. (2019)</td>
<td>To determine the impact of an AAI delivered by military dog handlers on perceived stress, psychiatric symptoms, work and social life, and therapeutic relationships</td>
<td>non-randomized control trial (pilot)</td>
<td>Weekly 3-hour group sessions with military dog handler at the Bundeswehr School of Dog Handling for 4 weeks. Program included familiarization with dog, dog walking, performing exercises with dog, develop trust and relationship with dog and dog handler, and dog maintenance and care. Timing - baseline, after program, 1 month post program, 3 months post program.</td>
<td>Instruments: HSCL-25, PSS, SEASL, Fragen zur Therapeutischen Beziehung. Weekly questionnaires (intervention group only).</td>
<td>HSCL-25: no statistically significant difference between groups; intervention group improved slightly; control group worsened. PSS: no statistically significant changes; decreased after AAI in both groups and increased at follow up. SEASL: statistically significant improvement in intervention group (p = 0.038). Therapeutic relationship - no statistically significant changes nor trends.</td>
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<tr>
<td>Authors-Year</td>
<td>Purpose: Population</td>
<td>Intervention</td>
<td>Measures</td>
<td>Results</td>
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<td>Bergin-Coco, et al. (2018)</td>
<td>To measure the impact of a therapeutic dog ownership and training program for veterans with PTSD</td>
<td>Dogs2Vets program - 12 month program teaching veterans how to care for a dog that they ultimately adopt: 80-minute weekly sessions (selection of a dog at beginning of program; learn to care for dog, dog behavior management, training skills) achievement of AKC CGC and Community Canine, practice skills in real-world settings</td>
<td>Timing - baseline and 12-month follow up</td>
<td>Significant decrease in PCL-M score in intervention group (p=0.03)</td>
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<td>Instruments: PCL-M, LEC, PSS</td>
<td>No significant changes in PCL-M scores at 12-month follow up - actually saw an increase of 0.5 points</td>
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<td>Effect size for between group differences: 0.28</td>
<td>Linear regression showed that participation in Dogs2Vets program significantly predicted reductions in PCL-M scores at follow up (p=0.01)</td>
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<td>Qualitative feedback collected at 12-month follow up</td>
<td>No significant changes in linear regression for control group</td>
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<td>PSS scores significantly lower in intervention group at follow up (p=0.02); no significant changes in the control group</td>
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<td>Effect size between groups: -0.66</td>
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<td>Linear regression showed Dogs2Vets program significantly predicted decreases in PSS (p=0.001); no significant changes in the regression model for the control group</td>
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<td>Significant within group increases in self-compassion in intervention group (p=0.02)</td>
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<td>No significant changes within the control group</td>
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<td>Effect size between groups for changes in self-compassion: 0.57</td>
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<td>Linear regression showed that participation in Dogs2Vets program significantly predicted improvements in self-compassion at 12 months follow up (p&lt;0.001); no significant changes in control group</td>
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<td>Significant within group decreases in isolation subscale in Dogs2Vets participants (p=0.02); No significant change in control group</td>
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<td>Effect size between groups for isolation: -0.64</td>
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<td>Linear regression did not show any significant main effects of intervention on isolation</td>
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<td>Ferrulio (2015)</td>
<td>To determine if a pilot equine-facilitated mental health program is an effective means of addressing psychosocial issues of veterans</td>
<td>Male Veterans (unemployed, homeless but living in VA hospital)</td>
<td>One day retreat: 20 minutes of psychoeducation; 160 minutes of guided equine activity; 165 minutes of group processing and personal reflection. Two day retreat: 4 segments of psychotherapy totaling 70 minutes; 285 minutes of guided equine activity; 315 minutes of group processing and personal reflection. Equine activities consisted of using horses as a metaphor for problems and life as well as a mirror to reflect participant's interactions with the world.</td>
<td>Timing: post intervention questionnaire. Instruments: Name of questionnaire and number of items were not discussed; questionnaire was not valid, reliable, nor empirically researched.</td>
<td>Participants responded that pace of the retreat, regardless of 1 or 2 day format, was good or excellent, no significant difference between groups (p = .405). Four themes were identified through analysis of answers to open-ended questions: learning about self (p = .408) spiritual connection (p = .850), trust (p = .850), respect (p = .350) - no statistical difference between groups.</td>
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<td>Fisher, et al. (2021)</td>
<td>To test a manualized EAT-PTSD program: Assess feasibility, acceptability, and outcomes of EAT-PTSD program: Design: open trial</td>
<td>Veterans with PTSD</td>
<td>8 weekly 90-minute sessions in small groups of 3-5 veterans. Session 1 describes EAT-PTSD, includes a barn tour and ends with meeting horses in a round pen. Subsequent lessons build upon the previous lesson and include gradually more complex interactions. Each session ends with participants reviewing and discussing their experiences during the session.</td>
<td>Timing: baseline, mid-treatment, post-treatment; 3 month follow up. Instruments: clinician administered - CAPS-5, HDRS self administered - PCL-5, BDI-II.</td>
<td>N = 38 participants completed program. No adverse events or safety issues reported. Mean CAPS-5 scores decreased from 38.6 at baseline to 26.9 at post-treatment. Repeated measures ANOVA with time as within subjects factor significant (p &lt; 0.0001). Mean PCL-5 scores decreased from 50.7 at baseline to 34.6 at post-treatment. Repeated measures ANOVA with time as within subjects factor significant (p &lt; 0.0001). Baseline to post-treatment. Scores from mid-treatment to post-treatment significant (p &lt; 0.0001). Mean HDRS scores decreased from 16.2 at baseline to 12.1 at post-treatment. Repeated measures ANOVA with time as within subjects factor significant (p &lt; 0.0001). Baseline to post-treatment. No significant change in HDRS scores from mid-treatment to post-treatment nor mid-treatment to follow up. Mean BDI-II scores decreased from 27.4 at baseline to 20.8 at post-treatment. Repeated measures ANOVA with time as within subjects factor significant (p &lt; 0.0001). Baseline to post-treatment. Scores from mid-treatment to post-treatment significant (p = 0.001).</td>
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<td>Johnson, et al. (2018)</td>
<td>To test the extent to which a 6-week therapeutic horseback riding program improved outcomes of PTSD symptoms and coping self-efficacy. Secondary purpose was to see if there would be improved outcomes in emotional regulation, social and emotional loneliness.</td>
<td>Military veterans with PTSD or PTSD with TBI</td>
<td>Six weekly sessions of therapeutic horseback riding (welcome to the barn, grooming and safety, mounting and lesson, dismount and closure)</td>
<td>Timing - treatment group assessed at baseline, 3 weeks, 6 weeks. Wait list group assessed during waiting period at baseline, 3 weeks, 6 weeks, and at weeks 3 and 6 during riding period</td>
<td>Riding group - PTSD scores decreased significantly from baseline to week 3 (p=0.002) and week 3 to week 6 (p=0.00). No statistically significant changes in coping self-efficacy, emotional regulation and perceived loneliness, but the scores moved in the predicted direction. Decline in PTSD score was not uniform for all participants. Those who rode for 4-6 weeks had greater decreases than those who rode for 1-3 weeks. For both groups, scores on the social emotional loneliness scale for adults increased, but for those who rode 4-6 weeks, the increase was only temporary until the 2nd measurement when it decreased.</td>
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<td>Krause-Farello, et al. (2019)</td>
<td>To determine feasibility of providing AAI in an aeromedical staging facility; examine efficacy of 20-minute AAI at reducing stress in aeromedical evacuation (AE) patients.</td>
<td>Intervention group - 20 minute sessions with canine handler - described therapeutic uses of therapy dogs, demonstrated tasks such as fetch, participant interaction with canines (talking, petting) Control group - 20 minute session with canine handler describing therapeutic uses of therapy dogs.</td>
<td>Timing - baseline, before intervention, 2 minutes after intervention, 50 minutes after intervention, at bedtime, upon awaking next day. Instruments: PCL-M (baseline only) Cortisol, AA, IgA (salivary time<em>group, PCL-M</em>group, PCL-M*time, 3-way interaction among variables</td>
<td>PCL-M not statistically correlated with cortisol (p = 0.94), AA (p = 0.64); IgA (p = 0.70) Significant interaction group*time (p = 0.04) Cortisol responses to AAI dependent upon PTSD severity (p = 0.68) 3-way interaction did not indicate a contribution of PTSD severity to AA (p = 0.78). IgA responses dependant upon PTSD severity (p = 0.04)</td>
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<td>Lanning, et al. (2017)</td>
<td>To examine the effects of therapeutic horseback riding on PTSD scores, quality of life and functioning of combat veterans</td>
<td>Design: repeated measures</td>
<td>8 week therapeutic riding program (4 weeks learning grooming, leading, walking, working with horse, relationship building with horse; 4 weeks riding and horsemanship exercises)</td>
<td>Timing: Weeks 0, 4, 8 and 2 months post-intervention Instruments: PCL-M, PCL-5, SF-36 v. 2, WHODAS</td>
<td>No statistically significant differences between the 3 study sites on baseline PTSD scores, quality of life and functioning scores. Completers versus non-completers - no statistical difference in PCL-5 scores or mental component of SF-36. Statistically significant difference in WHODAS and physical component scores of SF-36. (p = 0.022) - Non-completers had fewer physical deficits and greater physical health at baseline than completers of the 8 week program. Clinically significant changes in PTSD symptoms across 8 weeks. PCL-5 (g = 1.13, 95% CI [-1.71, -0.59]; PCL-34 (g = 1.79, 95% CI: 3.46, 0.02); intervention accounted for significant portion of the change in PTSD symptoms. Positive change in mental components of SF-36 over time with large effect size (g = 0.92, 95% CI [0.44, 1.41]). WHODAS - none of the effect sites indicated a statistically significant intervention effect. Changes not sustained at 2 month measurement - participants did experience positive changes in understanding and communicating, getting along with people, life activities, and participating in society. Qualitative questions indicated the following themes: Q1 anxious, depressed, isolated, Q2 increase participation in life activities, Q3 horse feed back mirrors emotions, behavior, more comfortable, non-judgmental; Q4 self-acceptance, gained confidence, gratitude, hope, less anxious/angry, patience, set boundaries, trust.</td>
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<td>Malinovski, et al. (2018)</td>
<td>To determine if 5 sessions of equine assisted activities and therapy would decrease PTSD symptoms in veterans with PTSD (also included markers of stress and well-being in horses)</td>
<td>Design: repeated measures</td>
<td>5 consecutive days of equine assisted activity and therapy; 60 minutes each session (orientation to horse and safety, obstacle course and mindfulness; horse trailing and active feelings exercise, termination of program)</td>
<td>Timing: prior to first session and immediately after last session Instruments: PCL-5, BSI</td>
<td>Further therapy BSI subscales were significantly decreased with the exception of interpersonal sensitivity (p = 0.05) and phobic anxiety (p = 0.17). Composite score of PCL-5 significantly decreased (p = 0.0483); significant decrease in hyperviscous symptoms (p = 0.037). Significant reduction in heart rate on day 2 (p&lt;0.05). No significant changes in respiratory rate, systolic or diastolic blood pressure.</td>
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<td>To determine if a connection methodology had psychological and psychosocial benefits Design: case study Population: Veteran with PTSD N = 1</td>
<td>Saratoga War Horse Connection - safety instruction, pressure halter introduction, pressure halter lesson, observation of horses and hard dynamics, instruction on</td>
<td>Timing - baseline, program completion; 2, 4, 6, 12 weeks post completion Instruments: BDI-II, PCL-C, RSES, QOLi, MSSS</td>
<td>Significant improvement in PTSD symptoms (no p values reported) Improvement in depression scores pre- to 12-week post intervention Improvement in resiliency pre- to post-intervention Increased reporting of social support Improvement in quality of life at 6 and 12 weeks post-intervention</td>
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<td>Rosamzeh et al. (2018)</td>
<td>To evaluate the outcomes of equine assisted therapy on depression, stress, PTSD, happiness, and quality of life Design: non-controlled within subjects, longitudinal for veterans only and between subjects for comparison of veterans only to couples Population: Veterans with PTSD and Veteran partners N = 25 veterans with PTSD only N = 22 Veteran/Partner couples</td>
<td>Live-in, 5 day, residential therapy course consisting of hard tasks, ground work: grooming liberty work: obstacle course, trail walks, mindfulness, photo language, group discussions, couples dates (couples program only), and couples counseling (couples program only)</td>
<td>Timing - pre-intervention, post-intervention (at program conclusion), follow up (3 months post program conclusion) Instruments: PCL-5, DASS-21, OHS, Q-LES-Q-SF</td>
<td>No p values reported* No significant differences between programs at pre-intervention No significant differences at pre-intervention and follow up on those who dropped out of the program versus those that completed the program Veterans only program: significantly decreased scores on PCL-5 and DASS pre-intervention to post-intervention, significantly higher scores on OHS and Q-LES-Q-SF pre-to post-intervention, significantly higher scores post-intervention to follow up of PCL-5 and DASS scores and significantly lower scores on OHS and Q-LES-Q-SF from post-intervention to follow up, no significant differences between pre-intervention and follow up on any outcome measure Couples program: significantly lower scores on PCL-5 and DASS at post-intervention and follow up compared to pre-intervention, no significant differences in anxiety scores between pre-intervention and post-intervention, no significant differences on DASS and PCL-5 scores post-intervention to follow up, significantly higher scores on OHS and Q-LES-Q-SF at post-intervention compared to pre-intervention but no significant changes in these scores pre-intervention to follow up, significantly lower Q-LES-Q-SF at follow up compared to post-intervention Between Group Analysis: no difference in baseline scores between programs, significant differences in the depression and stress DASS-21 subscales and PCL-5 at follow up with Couples program reporting significantly fewer symptoms No significant differences in diagnosis of PTSD between groups at any measurement time. No significant differences of PTSD diagnosis between groups at pre-intervention to post-intervention, significant decrease in the number of participants in couples groups with PTSD diagnosis at follow up (p = 0.006)</td>
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<td>Coogan et al. (2020)</td>
<td>To identify changes in PTSD symptoms associated with completing a 14-week service dog training program</td>
<td>14 weekly 60 minute training sessions Conducted in small groups of 10 or fewer participants Participants were offered individual and group counseling sessions with a Master’s prepared clinical social worker</td>
<td>Timing: Before first class and after completion of final class Instrument: TSL-2</td>
<td>26/55 participants attended at least one session with the clinical social worker Significant decrease in self-disturbance (p &lt; 0.001); post-traumatic stress (p &lt; 0.001); externalization (p &lt; 0.001); somatization (p &lt; 0.001) Significant decrease in clinical scales and subscales (p &lt; 0.001 and p &lt; 0.01)</td>
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<td>Skaief et al. (2019)</td>
<td>To assess the effect of EAT on PTSD symptoms, ability to function at work and family and social interaction Design: prospective case study Population: Patients with PTSD N = 22</td>
<td>EAT once a week for 3 hours for 6 months at same time and hour each week 20 minutes - exploration of activities 25 minutes - grooming and saddling 45 minutes - riding 15 minutes - break 45 minutes - ground work with equines to develop trust and communication 45 minutes - group session</td>
<td>Timing - baseline, after 1 month (SDS only), after 6 months Instruments: SPRINT, SDS</td>
<td>SPRINT - total score: statistically significant improvement (p &lt; 0.05); ability to work and perform daily tasks significantly improved (p &lt; 0.05) SDS - total score: statistically significant improvement at 1 month (p &lt; 0.003) and 6 months (p &lt; 0.02); number of days of inefficiency decreased from baseline to end of study (p &lt; 0.02)</td>
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<td>Whitworth et al. (2015)</td>
<td>To test the feasibility of a controlled trial comparing veterans with PTSD who train service dogs to veterans with PTSD on a waitlist control Design: pre-Post-test waitlist control Population: Veterans with PTSD N = 32</td>
<td>14 weekly 60 minute training sessions Conducted in small groups of 10 or fewer participants Participants were offered individual and group counseling sessions with a Master’s prepared clinical social worker</td>
<td>Timing: Before first class and after completion of final class Instrument: TSL-2 WHO-DAS 2.0</td>
<td>N = 30 participants completed the program TSL-2: Intervention group had significant improvements in self-disturbance (p &lt; 0.005); posttraumatic stress (p &lt; 0.005); and externalization (p &lt; 0.005). Significant decrease in depression (p &lt; 0.005); anger (p &lt; 0.005); insecure attachments (p &lt; 0.05); relational avoidance (p &lt; 0.05); rejection sensitivity (p &lt; 0.05) compared to waitlist group WHO-DAS 2.0: Intervention group improved in getting along with others and participation in society (p &lt; 0.05); perceptions of own disability improved (p &lt; 0.05) TSL-2: Control group had significant decreases in posttraumatic stress (p &lt; 0.05) and somatization (p &lt; 0.05) WHO-DAS 2.0: control group had not significant changes</td>
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<td>Worman, et al. (2018)</td>
<td>To examine the impact of pinniped facilitated human-animal interaction on PTSD Design: secondary analysis of de-identified data from the Project Seal to Heal program; repeated measures N = 1 veteran with PTSD</td>
<td>4 1-hour sessions with a seal (different seal used each time) Minimum of 10 minutes direct interaction with seal - rest of time spent on education</td>
<td>Timing - prior to program (week 1), midway (week 2), and immediately after program completion (week 4) Instruments: PCL-5</td>
<td>PTSD scores were calculated in symptom clusters Questions 1-5 intrusion; Questions 6-7 re-experiencing; Questions 8-14 negative alterations in mood and cognition; Questions 15-20 hypervigilance 6 veterans unable to complete all sessions Intrusion scores decreased 6 points over time; re-experiencing scores decreased 5 points over time; mood and cognition scores decreased 2 points over time; hypervigilant scores decreased 2 points over time; overall PCL-5 scores decreased 15 points over time 7/20 items on PCL-5 showed no change over time - intervention may have had no effect on these symptoms PCL-5 item 19 (difficulty concentrating) scored 4 (extremely disruptive) at T1, T2, and T3 PCL-5 item 18 (feeling distant or cut off from others) scored 4 at T1, 2 at T2, and 4 at T3 Overall, project Seal to Heal was clinically significant</td>
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| Zha, et al. (2021) | Explore changes in rFIC in reward, executive control, default mode, salience networks, regional grey matter volume, fractional anisotropy | Equine facilitated therapy conducted in 90-minute weekly group sessions for 8 weeks. Sessions consisted of focusing on physical sensations, burnout and meeting horses. Each horse was taught based on previous crises with increasing complexity and interactions with equestrians. | Functional connectivity MRI before and after treatment program Clinical assessments: baseline, post-treatment, 3 month follow-up | N = 18 participants completed study
- Significantly lower scores from baseline to post-treatment and follow up on CAPS-5 (p = 0.002 post; p = 0.003 follow up), PCL-C (p < 0.001 post; p = 0.008 follow up), and BDI (p = 0.007 post; p < 0.001 follow up)
- No significant change in HAM-D
- Neural changes and correlation with clinical outcomes
  - Post-treatment: significant positive correlation between increased rFIC and improved PCL-C scores (r = 0.85, p = 0.015)
  - No significant correlation of changes in sMRI and clinical outcomes
  - Follow up: significant positive correlations between changes in rFIC and changes in PCL (r = 0.58, p = 0.019) and BDI (r = 0.54, p = 0.03)
- No significant correlation of changes in sMRI and clinical outcomes
- Baseline neural predictors and clinical improvements
  - Post-treatment: baseline caudate rFIC positively correlated with decreased PCL-C scores (pre-post; r = 0.69, p = 0.006); baseline caudate rFIC positively correlated with baseline PCL-C (r = 0.34, p = 0.23) and negatively correlated with post-treatment PCL-C (r = -0.35, p = 0.18)
  - No significant correlation between sMRI and clinical outcomes at post-treatment
  - Follow up: baseline rFIC positively correlated with improvement in baseline CAPS-5 (r = 0.658, p = 0.011); HAM-D (r = 0.73, p = 0.005); PCL-C (r = 0.32, p < 0.003); BDI-II (r = 0.67, p = 0.003)
- Negative correlation between rFIC at baseline and clinical outcomes at follow up
| Population: Veterans with PTSD | N = 20 |

Note. PCL-5 = posttraumatic stress disorder checklist; LEC = life events checklist; HSCL-25 = Hopkins symptom checklist; PSS = perceived stress scale; SEASL = social and emotional loneliness scale; PCL-5 = post-traumatic stress disorder checklist; PTSD = post-traumatic stress disorder; SCS-SF = self-completion scale short form; TSI-2 = trauma symptom inventory-2; AA = alpha-amylose; IgA = immunoglobin A; CSES = coping self efficacy scale; DERS = difficulties in emotion regulation; SELSA = social and emotional loneliness scale for adults; PSSS = postdeployment social support scale; QIDS = quick inventory of depressive symptomatology; QOLS = quality of life scale; DARS = dimension of anger reactions - 5; SF-36v2 = short form survey; WHODAS 2.0 = world health organization disability assessment schedule; BS1 = brief symptom inventory; PCL-C = posttraumatic stress disorder checklist civilian; CAPS-5 = clinician administered PTSD scale; HAM-D = Hamilton rating scale for depression; CSQ = client satisfaction questionnaire; BDI-II = beck depression inventory; QOLI = quality of life index; MSSS = modified social support scale; ESES = response to stressful events scale; DASS-21 = Depression anxiety stress scale; OHQ = Oxford happiness questionnaire; Q-LES-Q-SF = quality of life, enjoyment and satisfaction questionnaire short form; SPRINT = short post traumatic stress disorder rating interview; SBS = Sheehan disability scale.
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CHAPTER 3
PROPOSAL

Introduction

Over the past several decades, empirical research on the human-animal bond and animal assisted interventions (AAI) has increased. Animal assisted interventions (AAI) are slowly finding their way into medical and behavioral healthcare settings to be implemented in all age groups for a multitude of conditions. Studies have shown the beneficial effects of human animal interaction such as decreased stress, increased self-esteem, decreased symptoms of posttraumatic stress disorder (PTSD), and physiologic changes including decreased heart rate and blood pressure (Beetz, Uvnäs-Mobert, Julius, and Kotrschal, 2012; Johnson, et al., 2018; Odendall, 2000; Odendall & Meintjes, 2003; White-Lewis, Russell, Johnson, Cheng, & McClain).

AAI are of interest as a potential therapy for posttraumatic stress disorder in military Veterans. A literature review was conducted to explore the traditional treatment of PTSD in Veterans, physiology of the human-animal bond, effects of AAI on PTSD, and the use of equines for animal assisted therapy.

Post-Traumatic Stress Disorder (PTSD)

Post-Traumatic Stress Disorder (PTSD) was known as shell shock or battle neuroses in World War I, combat fatigue and post-concussion syndrome in World War II, and combat stress reaction in more recent decades (Jones, Fear, & Wessely, 2007). The 2013 edition of the Diagnostic and Statistical Manual of Mental Disorders V includes a revised definition of Post-Traumatic Stress Disorder (PTSD) based on both scientific evidence and clinical experience obtained since the previous publication (American Psychological Association, 2013). Previously classified as an anxiety disorder, PTSD is
now part of a new class, trauma and stressor-related disorders. Exposure to a trauma is the common factor of all disorders in the new class. Types of traumas include war, disaster, terrorism, motor vehicle accident, sexual assault, and violence.

There are four symptom clusters emphasizing the “fight or flight” aspect of PTSD: re-experiencing, avoidance, negative cognition and mood, and arousal. Re-experiencing can mean the occurrence of spontaneous memories of the traumatic event, recurrent dreams, flashbacks or other extreme or sustained psychological distress. Avoidance behaviors may include ignoring or repressing distressing memories, thoughts, feelings or staying away from places, events or objects which serve as reminders of the trauma. Negative cognitions and mood distortion refer to unrelenting and distorted sense of blame of self or others, disassociation from others or significantly diminished interest in activities, or the inability to remember key aspects of the trauma. Arousal can be displayed as aggressive, reckless or self-destructive behavior, sleep disturbances, hypervigilance, or related problems (American Psychiatric Association, 2013).

PTSD in Military Veterans

According to the Congressional Budget Office (2011), PTSD is the second most common diagnosis of Veterans of overseas contingency operations (OCO), which includes Operation Iraqi Freedom, Operation New Dawn, and Operation Enduring Freedom. Fifty-one percent of such Veterans have been diagnosed with PTSD. It is difficult to estimate the prevalence of PTSD in Veterans due to the variability in application of diagnostic criteria and the use of multiple assessment tools. Among OCO Veterans receiving care from the Veterans’ Health Administration, 27% were diagnosed with PTSD (Congressional Budget Office, 2011). These Veterans are known to have a
higher use of healthcare services, both mental health and non-mental health, than those without PTSD (Cohen, et al., 2010). In a two-year period between 2007 and 2009, 366,317 Vietnam-era Veterans had a diagnosis of PTSD, which represented 15.8% of all Vietnam-era Veterans seen in the VA system during that time frame (Hermes, Hoff, & Rosenheck, 2014). The number of diagnosed cases of PTSD increased by 50% from 2012 to 2013. It is estimated that 50% of those with PTSD do not seek treatment and roughly one-half of those who do seek treatment do not receive adequate treatment (Wortman, Vallone, Karnes, Walawander, Daly, & Fox-Garrity, 2018). According to Tedeschi, Sisa, Olmert, Parish-Plass, & Yount (2015), up to 40% of Veterans drop of out therapy prior to completion due to the perceived stigma of receiving mental health services and distrust of the mental health profession. A 2011 report from the Congressional Budget Office states that the average cost to treat Veterans with PTSD in the first year is $8,300 and if co-morbidities are present, the costs skyrocket to $18,259. If the cost to treat PTSD continues the current trajectory, by 2053 more than $1.0 trillion will be spent (Wortman, Vallone, Karnes, Walawander, Daly, & Fox-Garrity, 2018).

It is not uncommon for Veterans with PTSD to have behavioral and medical comorbidities, leading to difficulties in social functioning, community reintegration, participation in activities of daily living, and quality of life (Earles, Vernon, & Yetz, 2015; Johnson, et al., 2018; Lanning, Wilson, Krenek, & Beaujean, 2017; Nevins, Finch, Hickling, & Barnett, 2013; Romaniuk, Evans, & Kidd, 2018; Wortman, Vallone, Karnes, Walawander, Daly, & Fox-Garrity, 2018). The presence of PTSD and co-morbidities complicates treatment and calls for innovative solutions that decrease or eliminate the stigma of seeking help. The use of Animal Assisted Interventions (AAI) has gained
attention as an adjunct or stand-alone treatment for PTSD in Veterans, with or without comorbidities.

**Treatment of PTSD at the Department of Veterans Affairs and Department of Defense**

The Department of Veterans Affairs (VA) and Department of Defense (DOD) published a joint guideline on the management of PTSD in 2017 (VA/DOD, 2017). The guideline recommends two general types of accepted first line therapy for the treatment of PTSD: psychotherapy and medications. Psychotherapy, also referred to as ‘talk therapy’ may consist of cognitive processing therapy, prolonged exposure therapy and eye movement desensitization and reprocessing (EMDR). Medications include antidepressants, anxiolytics, and others to treat co-morbid conditions as appropriate. The VA and DOD have explored the use of canine-assisted therapy (CAT) in the treatment of PTSD but due to lack of rigorous scientific evidence, the VA and DOD eliminated their efforts to include CAT in the treatment guideline in 2012 (Owen, Finton, Gibbons, & DeLeon, 2016). The large number of troops returning home with significant physical injuries and mental disorders provides a platform for introducing CAT as part of reintegration and on-going therapy. The VA, through their Cooperative Studies Program and the U.S. National Institute of Health is recruiting subjects for a randomized trial titled, ‘Can Service Dogs Improve Activity and Quality of Life in Veterans with PTSD?’ (United States Department of Veterans Affairs, 2016; Clinical Trials.gov, 2016). Data collection ended June 2019 and results are not yet available (Clinical Trials.gov, 2019).

A meta-analysis by Haagen, Smid, Knipscheer, & Kleber (2015) assessed the impact of specific patient, treatment, and study characteristics which may be predictive
factors affecting response to PTSD psychotherapy. The authors found 57 studies testing 69 interventions in a total of 6,878 patients. It was found that Veterans respond best to individual therapy or a combination of individual and group therapy and that the number of trauma focused sessions made a difference in PTSD symptom severity. Group therapy should never be used in isolation as it does not allow for individualization of treatment. Exposure therapy was superior to stress management therapy and results did not support the use of EMDR. Veterans with severe PTSD symptoms as well as those with low level symptoms did not respond as well to therapy, indicating a need to find targeted therapies for these groups. There were no significant differences regarding type of delivery (online, face-to-face), setting (inpatient or outpatient), measurement tools, or demographic variables (Haagen, Smid, Knipscheer, & Kleber, 2015).

**Human Animal Bond - Neurophysiology of the Human-Animal Bond**

Throughout history it has been noted that love, friendship, and caring appear to aid well-being and healing. Research has shown that dogs and humans have similarities in brain structure, nerve paths, and neurotransmitters and that there is a 75% overlap of genetic code between humans and dogs (Walsh, 2009). In landmark studies by Odendaal (2000) and Odendaal and Meintjes (2003), the scientists found that positive interaction between humans and dogs produced increased levels of oxytocin, prolactin, dopamine, β-endorphins, and β-phenylethylamine in both species and decreased levels of cortisol in humans. Oxytocin promotes bonding, increases pain threshold, and has anti-stress effects. Prolactin promotes bonding by increasing oxytocin. Dopamine is responsible for emotional regulation. β-endorphins regulate blood pressure, provide analgesia, and contribute to euphoric states. β-phenylethylamine increases feelings of attraction,
exhilaration, and apprehension. These findings may help explain the close bonds humans feel with dogs. Beetz, Uvnäs-Mobert, Julius, and Kotrschal (2012) reviewed the evidence from 69 studies on human-animal interactions and concluded that most positive effects of HAI can be explained by the oxytocin system, which has effects on social interaction, stress response, anxiety, pain, the immune system, and health. A study by Handlin, Nilsson, Edjebäck, Hydbring-Sandberg, & Uvnäs-Moberg (2012) found a significant positive correlation between owners’ oxytocin levels, dog oxytocin levels, and the frequency of kissing their dogs ($p = 0.001$, $p = 0.019$, respectively). In the same study, dog oxytocin levels were higher the stronger the perceived bond with the dog ($p = 0.033$). Furthermore, the authors found that the higher the owners’ oxytocin levels were during interaction with their dog, the higher the dogs’ oxytocin level was at the conclusion of the interaction ($p = 0.013$) (Handlin, Nilsson, Edjebäck, Hydbring-Sandberg, & Uvnäs-Moberg, 2012).

**Animal-assisted intervention (AAI)**

Animal-assisted intervention (AAI) has lacked a standardized definition and terminology. Indeed, LaJoie (2003) performed a literature search and found 20 definitions of animal assisted therapy and 12 terms all describing the same construct. Kruger and Serpell (2006) state that AAI is any intervention consciously including animals as part of the therapeutic process. In 2018, the International Association of Human-Animal Interaction Organizations (IAHAIO) developed consensus driven definitions for AAI and AAT which state the following:

“An AAI is a goal-oriented and structured intervention that intentionally includes or incorporates animals in health, education, and human service (e.g.,
social work) for the purpose of therapeutic gains in humans. It involves people with knowledge of the people and animals involved. AAIs incorporate human-animal teams in formal human service such as Animal-Assisted Therapy (AAT), Animal-Assisted Education (AAE) or under certain conditions Animal-Assisted Activities. Furthermore, an AAT is a goal-oriented, planned, and structured therapeutic intervention directed and/or delivered by health, education, and human service professionals. Intervention progress is measured and included in professional documentation. AAT is delivered and/or directed by a formally trained (with active licensure, degree, or equivalent) professional with expertise within the scope of the professionals’ practice. AAT focuses on enhancing physical, cognitive, behavioral, and/or socioemotional functioning of the particular human recipient.” (p. 4)

AAI is generally used as an umbrella term to describe animal-assisted activities, animal-assisted therapy, and animal-assisted education. Within each of these terms lies a wide spectrum of interventions (Fine, Tedeschi, & Elvove, 2014).

The American Veterinary Medical Association (2018) has adopted the IAHAIO definition of AAI and further states that AAI must be governed by standards, monitored regularly, and be delivered by appropriately trained personnel. It is also critical to maintain the health and welfare of the animals and humans involved in AAI.

**Animal Assisted Therapy (AAT)**

A meta-analysis completed by Nimer & Lundahl in 2007 found 49 papers on AAT. In this meta-analysis, AAT was defined as “the deliberate inclusion of an animal in a treatment plan” (p.225). They found that dogs were used in the majority of the studies,
targeted mental health problems, and had moderately large effect sizes. The effect sizes were not seen in other animal groups (Nimer & Lundahl, 2007). Four studies comparing AAT to an exercise intervention, photographs of animals, recreational therapy, and traditional therapy groups demonstrated that AAT was superior to the other interventions (Nimer & Lundahl, 2007). Overall, the authors concluded that AAT was helpful in improving clinical well-being and behavioral outcomes and merits further research.

Maujean, Pepping, & Kendall (2015) performed a systematic review of randomized controlled trials (RCT) of AAT found in the literature from 2008-2012. The authors used the Delta Society’s definitions of Animal Assisted Activity (AAA) and AAT. Although the authors acknowledged reviews by other scientists, they were critical of them in that there were very few RCTs included. Their review consisted of seven RCTs of AAI; three with dogs, 2 with farm animals, and 2 with horses. Although the title of the paper clearly refers to AAT, all but the two horse studies involved AAA, which is significantly different than AAT and one of the horse studies was hippotherapy concentrating on posture control, balance, and strength. Despite these limitations, overall, six of the RCTs showed beneficial psychological effects of human-animal interaction (Maujean, Pepping, & Kendall, 2015).

A third systematic review by Kamioka, et al. (2014) expanded their literature search from Maujean, et al. (2015) to include RCTs from 1990-2012, which yielded 11 studies meeting inclusion criteria. Kamioka, et al. (2014) chose to use the American Veterinary Medical Association’s (AVMA) definition of AAT. Interestingly, the authors did not include the equine or farm animal RCTs which were included in the Maujean, et al. (2015) paper. Kamioka, et al. (2014) reported that the RCTs conducted were of
relatively low quality based on the 11-item Cochrane’s List (van Tulder, Furlan, Bombardier, & Bouter, 2003). A meta-analysis was unable to be performed because of the heterogeneity of the populations. Overall, the authors found that AAT may be effective in treating certain mental and behavioral disorders such as depression, schizophrenia, and alcohol and drug abuse. The authors recommend that future research include detailed descriptions of methodology, reason for participant attrition or refusal to participate, costs associated with AAT, intervention dose, and report of adverse events (Kamioka, et al., 2014).

Most recently, a systematic review by Charry-Sanchez, Pradilla, & Talero-Guitierrz (2018) found 23 articles and dissertations published after 2000, which evaluated evidence of AAT in adults. The Critical Appraisal Tools from the Joanna Briggs Institute and the Quality Assessment Checklist for Systematic Reviews and Meta-Analysis from the National Heart, Lung, and Blood institute were used to evaluate study quality (Joanna Briggs Institute, 2017; National Heart Lung and Blood Institute, n.d.). The authors found that only one article met all criteria, and the remaining studies were of poor quality. Heterogeneity of instruments, outcomes, and therapies prevented a meta-analysis. The review found that AAT was beneficial for people with dementia. Some evidence exists for the use of AAT in people with depression, stroke, and spinal cord injury, but additional research needs to be conducted to provide further support. Strong evidence exists for the use of AAT to improve quality of life and motor outcomes in people with multiple sclerosis. Finally, limited research exists for the use of AAT in people with PTSD, but the field is growing rapidly. Charry-Sanchez, Pradilla, & Talero-Guitierrz (2018) recommend that consistent interventions, definition of optimal animal
characteristics, therapy intensity, cost effectiveness, and degree of animal involvement in AAT need to be studied.

White-Lewis, Russell, Johnson, Cheng, & McClain (2017) conducted a systematic review on the use of equine assisted therapy (EAT) in adults with physical disabilities. Based on inclusion criteria, 31 studies were included in the review. The Checklist for the Assessment of the Methodological Quality of Both Randomized and Non-Randomized Studies of Health Care Interventions was used to assess reporting, internal and external validity, and power (Downs & Black, 1998). The reviewers found that 10 studies were of poor quality, six fair, eight good, and seven of excellent quality. Of the criteria assessed, reporting scored highest and external validity lowest. Overall, there was sufficient evidence to support the efficacy of EAT in adults with physical impairments. Statistically significant improvements were seen in balance, spasticity, muscle strength, gait and cadence and quality of life (White-Lewis, Russell, Johnson, Cheng, & McClain, 2017).

**Horses as Healers**

Hippocrates, long considered the father of medicine, observed that the rhythmic movement of the horse had therapeutic properties (Latella & Abrams, 2015). Until the mid-1900s, man depended upon the horse for transportation, work, and war, clearly illustrating a long and close relationship between humans and equines (Nevins, 2013). In modern times, Germany has been considered the birthplace of holistic therapeutic equine programs which focused on interactions between children with behavioral and emotional disorders and horses, rather than riding (Latella & Abrams, 2015).
It should come as no surprise that the use of multiple terms for equine therapy, like AAI, complicate understanding of and subsequent use of equine therapy. The Professional Association of Therapeutic Horsemanship International (PATH, Intl) uses the term equine-facilitated therapy while the Equine Assisted Growth and Learning Association (EAGALA) prefers equine-assisted therapy (PATH Intl, 2016; EAGALA, 2016). The two organizations even endorse different types of therapy. PATH Intl advocates horseback riding, while EAGALA supports ground activities with the horse (Masini, 2010). Therapeutic riding also lacks a standardized definition, but it is widely accepted that the use of a horse and horse-related activities improve outcomes in the physical, emotional, behavioral, and social domains in humans (Kendall, et al., 2015). In addition to terminology and methodology, variation exists in the way programs are delivered and the settings in which they take place (Kendall, et al., 2015).

In general, a greater awareness of self, receipt of immediate and non-judgmental feedback, respect, trust, orientation to the present, independence, assertiveness, and empowerment are examples of the positive effects of equine-assisted therapy. In addition to these qualitative outcomes some quantitative data does exist showing significant improvements in symptoms such as depression, anxiety, trauma emotions, post-traumatic stress, quality of life, and social support. (Bergen-Cico, 2018; Earles, Vernon, & Yetz, 2015; Ferruolo, 2015; Johnson, et al., 2018; Kloep, Hunter, & Kurtz, 2017; Klontz, Bivens, Leinart, & Klontz, 2007; Lanning & Krenek, 2013; Lanning, Wilson, Krenek, & Beaujean, 2017; Malinowski, et al., 2018; Nevins, 2013; Romaniuk, Evans, & Kidd, 2018; White-Lewis, et al., 2017; Wortman, et al., 2018).

**Horses and Stress**
While the number of therapeutic horseback riding programs has increased, consideration of the potential stress on the animal has only recently begun to be studied. The most common methods of assessing stress in horses include serum cortisol levels and behavioral observation. Kaiser (2006) studied stress related behaviors in horses ridden by recreational riders and physically or psychologically disabled individuals during a therapeutic riding program. Their results suggested that horses being ridden by disabled individuals experience no more stress than horses ridden by recreational riders without disabilities. Horse behaviors and heart rate were studied in therapeutic riding horses ridden by individuals with brain disorders (Minero, Dassi, Martelli, & Canali, 2003). Results of this study showed that the horses displayed discomfort behaviors such as chewing their bit and moving their head up and down. In 2004, Suthers-McCabe presented results of a study of 28 horses from 4 different therapeutic riding programs for children and adults. Serum cortisol was measured before and after riding sessions. Horse behaviors were videotaped and reviewed. Cortisol levels decreased in 27 horses, suggesting that therapeutic riding sessions were not stressful for the horse. In more recent research, Chen (2017) found that horses participating in university riding classes and therapeutic riding centers did not show elevated levels of serum cortisol nor increased behavior scores. Johnson, et al. (2017) found that although physiological and behavioral patterns of stress in horses varied while being ridden by Veterans with PTSD, they remained within normal range, suggesting that horses were not significantly affected by the activity. Horses used in equine assisted activities and therapies studied by Malinowski, et al. (2018) did not experience increased heart rate nor elevated serum cortisol levels while ridden by Veterans with PTSD, thus providing additional support of results of previous studies.
Roy’s Adaptation Model will be used to guide this study. Sister Callista Roy developed the Adaptation Model while in graduate school. It was first operationalized in 1968 at Mount Saint Mary’s College as the foundation of the nursing curriculum. First published in Nursing Outlook in 1970, the model has been refined over time to reflect experience and research findings (Roy, 1970; Roy & Andrews, 1999). Roy and Andrews see humans as an adaptive system, who coexist with their physical and social environments to achieve adaptation. See Figure 3.1.

Humans are continually exposed to stimuli which in turn determine the adaptation level. As an adaptive system, humans are constantly exposed to internal and external stimuli. The level of adaptation is determined by the combination of focal, contextual, and residual stimuli. Focal stimuli are those which immediately confront an individual. In Veterans with PTSD, focal stimuli may include anniversary dates, nightmares, flashbacks, and social support. Contextual stimuli are those that affect the individual but are not the center of attention. Such stimuli may include the time since the trauma, severity of the trauma, developmental level at the time of the trauma, co-morbid conditions, age, gender, and genetics. Residual stimuli are those factors whose effects are not yet known. An example of a residual stimuli could be an intervention to improve adaptation, such as THR.

Roy and Andrews (1999) define coping mechanisms as innate or acquired methods of interacting with the environment. Regulator coping mechanisms are body’s attempt to adapt to stressors and the environment via regulation of hormonal processes. Exposure to trauma can interrupt the body’s ability to regulate hormonal responses (Nayback, 2009). Cognator stimuli are the cognitive-mental coping mechanisms used to
alleviate the emotional response to the internal and external stimuli (Roy & Andrews, 1999). Veterans with PTSD may use avoidance, isolation, or hypervigilance to escape the perceived negative stimuli.

Behaviors observed in relation to regulator and cognator coping mechanisms can be grouped into one of four adaptive modes: physiological, self-concept, role function, and interdependence (Roy and Andrews, 1999). The physiological mode is those physical and chemical responses to stressors. Individuals with PTSD are known to have a disconnection between the hippocampus and amygdala resulting in a lack of sensory experience in response to harmful events. They also produce fewer endorphins leading to a decreased pain threshold. The lack of endorphins released in response to stressful stimuli inhibit the tranquilizing effects normally seen during ‘fight or flight’ situations (Nayback, 2009). The self-concept mode is comprised of the thoughts, beliefs, and feelings about the self, which are formed from internal perceptions of self and perceptions of others. Barrett et al. (2002) found a positive relationship between PTSD and self-reported lower ratings of overall health and quality of life, especially in the physical, emotional, and social realms. Role-function are those roles performed within society. Veterans with PTSD often distance themselves to avoid the uncomfortable feelings associated with giving or receiving emotional contact (Nayback, 2009). Interdependence is the ability to give and receive love, respect, and value from social support systems. Emotional numbing and avoidance of responsibilities and relationships are often observed in Veterans with PTSD (Scurfield, 2006).
The purpose of this study is to evaluate the relationships between levels of PTSD in Veterans and equine cortisol levels and equine stress behaviors and describe Veteran perception of THR.

Research question 1: What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equine cortisol levels in equines they rode?

Research question 2: What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equines stress behaviors in the equines they rode?

Research question 3: What are Veterans’ perceptions of a therapeutic horseback riding program for PTSD?

**Original Study Methods**

**Research Design**

The original study conducted by Johnson, et al. (2018), was a randomized, controlled trial with a waitlist.

**Inclusion Criteria**

Veterans were eligible for participation based on the following inclusion criteria: 18 years of age or older, no longer active military, diagnosed with PTSD and/or PTSD with TBI, willing to work with and ride a horse, able to walk at least 25 feet unassisted, and weighed 220 pounds or less. Horses were selected for the study if they met PATH criteria, had participated in THR previously, and were considered able to carry a weight of at least 220 pounds. A total of five Veterans participated in session one (intervention
group) of the study. In session two, the control group, five healthy, experienced riders participated in THR using the same five horses as in session one (Johnson, et al., 2018).

**Recruitment**

Veterans were recruited via letters and postcards following a review of the local Veterans Administration (VA) medical records for a diagnosis of PTSD or PTSD with traumatic brain injury (TBI), (Johnson, et al., 2018). Providers were able to refer potential participants and materials advertising the study were placed in clinic offices of the Harry S. Truman Veterans’ Memorial Hospital in Columbia, MO (Johnson, et al., 2018). Faculty members of the University of Missouri College of Veterinary Medicine (MUCVM) Equine Health Service served as the control group of experienced riders.

**Ethical Considerations**

The study was approved by the University of Missouri Health Sciences Institutional Review Board (HSIRB), the Animal Care and Use Committee (ACUC) of the university, and the Research & Development committee of the Harry S. Truman Memorial Veterans’ Hospital in Columbia, MO. All participants signed an informed consent form approved by the VA and the HSIRB. In addition, the VA Research and Development Animal Component of Research Protocol (ACORP) employed a VA-affiliated veterinarian to visit the riding arena to assess and verify appropriate conditions for the horses used in the study.

The use of animals in research at the University of Missouri is governed by two U.S. agencies, United States Department of Agriculture (USDA) and the Office of Laboratory Animal Welfare (OLAW) (Animal Care Quality Assurance, 2019). The University of Missouri also has an Animal Care and Use Committee (ACUC) as required
by both agencies. The ACUC is responsible for reviewing and approving all teaching and research involving vertebrate animals, ensures facilities for animals are adequate and personnel have been appropriately trained (Animal Care Quality Assurance, 2019).

**Measures**

Demographic data were collected using a demographic questionnaire developed by Johnson & Meadows (2010) and included age, gender, race, marital status, years of education and horseback riding experience. The health history questionnaire, also developed by Johnson & Meadows (2010) inquired about drug, alcohol, caffeine, and tobacco use as well as common medical conditions. Demographic and health history questionnaires were completed by Veterans and expert riders prior to the first riding session.

The PTSD checklist for DSM-4 (PCL-M) (National Center for PTSD, 2013) was used to assess participant symptoms. Participants were asked to rate “how much have you been bothered by” a particular symptom in the last month. Examples of symptoms include: “Repeated, disturbing memories, thoughts, or images of a stressful military experience?,” “Loss of interest in things that you used to enjoy?” and “Feeling jumpy or easily startled?” Checklist items are self-reported on a Likert scale where 1 is not at all and 5 is extremely, with a score range of 17-85. A cut-point score of 50 is used to diagnose PTSD. Research suggests that a change of five points in the PTSD score is a reliable indicator of response to treatment and a 10-point change is clinically meaningful (National Center for PTSD, 2013). Higher scores indicate more PTSD symptoms. The PCL-M is a well-accepted, widely used tool with internal consistency for the PCL-M of 0.94-0.97, test-retest reliability (0.97 over 3 days), concurrent validity (0.77-0.93), and
sensitivity (0.82) and specificity (0.84) (Weathers, Litz, Herman, Huska, & Keane, 1993). See Appendix A for PCL-M.

Diaries are a popular method of capturing thoughts and ideas of study participants, are of benefit to the researcher, and an acceptable method of data collection in qualitative description studies (Creswell, 2013). Diaries can be open ended to capture a free flow of ideas or guided by specific questions, such as in the current study. Diaries are particularly useful when change is expected over time, requested information is of a sensitive nature, or to track differences between and within participants (Robson, 2011). Diary entries to provide a rich, holistic analysis of the phenomenon experienced by participants. Keeping a real-time diary minimizes the time between the experience and the recording of the experience, thus reducing the chance of inaccurate depiction (Snowden, 1987). Immediately following each weekly session, Veterans were provided with a structured, solicited, paper and pencil riding diary to be completed prior to leaving the barn. The goal of the diary was to answer the research question ‘what are the Veterans’ perceptions of a six-week THR program?’ The riding diary consisted of two demographic items, date, and name of horse, and two open ended items: “describe how you felt about your ride today” and “how did you feel about your experiences/interactions with your horse today.” Confidentiality was maintained using the participant ID, which was pre-written on each diary and contained in a folder, also distinguished by participant ID. Folders were kept in a locked cabinet in the Principal Investigator’s office at the MUCVM.

Equine stress behaviors were measured using a validated instrument developed by Young, Crieghton, & Smith (2012). The Equine Behavior Score (EBS) uses heart rate
and salivary cortisol levels to help identify stress behaviors in horses (See Appendix B for the Equine Behavior Score scale). Principal component analysis of cortisol and behaviors resulted in correlation coefficients of 0.3 and higher, $p = 0.02$ (Young, Creighton, & Smith, 2012). EBSs range from 1-10, where scores from 1-2 represent no stress, 3-4 low stress, 5-7 medium stress, and 8-10 high stress (Young, Creighton, & Smith, 2012).

In the Johnson et al. (2017) study, blood was obtained via jugular venipuncture to measure cortisol. Serum cortisol levels were determined using the immunoassay analyzer, which has been validated for use in horses (Peeters, Sulon, Beckers, Ledoux, & Vandenhende, 2011).

**Intervention**

The original study took place in a PATH certified riding arena and employed a standardized curriculum, which included five components: welcome to the barn, grooming and safety, mounting, lesson, and dismount/closure. The THR session was 60 minutes once a week for six weeks (Johnson, et al., 2018). Horses were selected and matched to Veterans by a PATH certified riding instructor and horse/Veteran pairings remained consistent throughout the study. During the study period, horses were not used for any other activity.

THR occurred in weekly 50-60-minute sessions over a six-week period at a PATH Accredited Riding Center in Columbia, MO. The standardized curriculum, designed by occupational therapists and THR instructors, who served as consultants on the research team, included the following elements: Welcome to the Barn, Grooming and Safety, Mounting, Lesson and Dismount/Closure. Time allotted for each component
varied by session. For example, more time was spent on Welcome to the Barn at session one versus session six. Veterans participated in therapy at the same site each time and rode the same horse for the duration of the program. Each session was supervised by a PATH-certified riding instructor and an occupational therapist and was monitored by study staff to insure intervention fidelity. Each Veteran required a total of three volunteers: one horse leader and two side-walkers (Johnson, et al., 2018).

Data Collection and Analysis

Health history and demographic questionnaires, as well as the PCL-M were collected at baseline prior to any THR sessions and took approximately 40 minutes to complete. Subsequent PCL-M data (15-20 minutes collection time) were collected at weeks three and six for the riding group and at baseline, control week three, and control week 6. The control group then converted to a THR group, and data were collected at weeks three and six.

Immediately following each weekly session, Veterans were provided with a paper and pencil riding diary to be completed prior to leaving the barn. The goal of the diary was to understand Veterans’ perceptions of a six-week THR program. The riding diary consisted of two demographic items, date, and name of horse, and two open ended items: “describe how you felt about your ride today” and “how did you feel about your experiences/interactions with your horse today.” Confidentiality was maintained using the participant ID, which was pre-written on each diary.

Serum cortisol levels were obtained from horses via jugular venapuncture during a non-THR day to establish baseline and then at sessions one, three and six at the following times: 30 minutes prior to THR session (T1), after tacking (saddling) occurred
(T2), and after completion of the THR session (T3). Veterinary medical students in their equine rotation performed the venipunctures while supervised by MUCVM Doctors of Veterinary Medicine faculty (Johnson, et al., 2017).

Horses were also observed for behavioral indicators of stress via videotape for two minutes at baseline, T1, T2, and T3 during sessions one, three, and six prior to obtaining blood samples. Behaviors were scored by two trained raters using the Equine Behavior Score (EBS) (Johnson, et al., 2017). Observers used the EBS to rate mock videotapes of equine behavior to establish interrater reliability. A Doctor of Veterinary Medicine, who is an equine behavior expert, validated the ratings and discussed findings with the observers. The process was repeated until 90% interrater reliability was obtained.

**Proposed Study Methods**

**Research Design**

The proposed study will be a secondary analysis of existing data from a study conducted by Johnson, et al. (2015). One of the biggest advantages of using existing data is the time and expense of conducting a study are virtually eliminated, allowing more time for analysis (Cheng, 2014). Two important disadvantages include the risk that data on some variables needed to answer the research question may not have been collected and that specific nuances of the study and data are unavailable, thus potentially affecting analysis (Cheng, 2014). Quantitative data will include equine serum cortisol and PTSD scores of Veterans. Qualitative data from the Equine Behavior Scale and Veteran’s riding diaries will be used. Inductive thematic analysis approach will be used as there are no known published studies of Veterans’ experiences with therapeutic horseback riding.
Data Analysis

To address research question one, “What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equine cortisol levels in equines they rode?”, assuming assumptions of level of measurement, related pairs, absence of outliers, and linearity are met, Pearson’s correlation coefficient, $r$, will be calculated to determine the correlation. Pearson’s correlation coefficient measures the strength of a relationship between two variables. The value of $r$ should be between -1 and +1. A correlation of +1 means the two variables are perfectly positively correlated, meaning as one variable increases, the other variable increases. A correlation of zero indicates no relationship at all and a value of -1 indicates a perfectly negative relationship. Correlation does not say anything about causality, but the amount of variation in one variable that is shared by the other can be determined, which is known as the coefficient of determination, $R^2$. If assumptions are violated, Bootstrap confidence intervals and Spearman’s Rho or Kendall’s Tau will be used to determine correlation. Repeated measures ANOVA will be used to evaluate changes in levels of PTSD and equine serum cortisol levels between sessions one and three, sessions three and six, and sessions one and six. In addition to the assumptions for Pearson’s correlation coefficient, sphericity will be tested using Mauchley’s test. If the assumption of sphericity is violated, either Greenhouse-Geisser or Huynh-Feld will be used to adjust the degrees of freedom.

To address research question two, “What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program
and equines stress behaviors in the equines they rode?,” the same methods of analysis as used to address research question one will be used.

To address research question three, “What are military Veterans’ perceptions of a therapeutic horseback riding program?,” comments from the Veterans’ riding diaries will be analyzed using qualitative descriptive methodology. Information from the riding diaries was independently transcribed verbatim by two research assistants. Data will be analyzed using qualitative thematic analysis and based on Braun and Clarke’s (2006) six phase framework (see Table 5 for Qualitative Analysis Framework). It should be noted that although the process is presented in a linear fashion, the analysis will move fluidly back and forth between phases. Hard copy transcripts will be read and re-read, with notes made with pen and highlighters. The transcripts will be then reviewed by item (3 and 4) as well as by session (1 through 6) and copied into Microsoft Excel (Bree & Gallagher, 2016). In vivo coding will be applied to capture the exact words of the participants. Codes will be reviewed for pattern identification and then grouped into categories and subcategories. Resulting themes, aggregate PTSD scores, and symptom clusters will be analyzed at T1, T2, and T3, to evaluate the relationship between aggregate PTSD scores, symptom clusters, and changes in THR perception over time. Monson, et al. (2008) suggest that a five-point change in PTSD score is reliable (not due to chance) and a 10-point change in PTSD score is clinically significant. Common themes will be identified, and responses will be organized based on thematic content to facilitate analysis. Resulting themes and aggregate PTSD scores will be analyzed at T1, T2, and T3, to evaluate if PTSD scores and THR perceptions change over time. Dr. Bonnie Wakefield will assist in validation of themes.
Descriptive and inferential statistics will be completed using SPSS version 26.

The p-value for determining significance will be 0.05.

**Tables, Figures, & Appendices**

The following tables, figures, and appendices will be included:

- Demographics of horses and Veterans
- Horse serum cortisol levels
- Behavior scores of horses
- Equine behaviors associated with stress level
- Veteran PTSD scores
- Qualitative analysis framework
- Veterans’ perceptions of THR
- Roy’s Model of Adaptation
- PTSD Checklist Military Version (PCL-M)
- Equine Behavior Scale

**Funding**

The study by Johnson, et al. (2017) was supported by the USDA National Institute of Food and Agriculture, Animal Health (grant number 1003417).

The study by Johnson, et al. (2018) was supported by NIH National Institute of Nursing Research T32 grant and the Horses and Humans Research Foundation.

**Conflict of Interest**

The Author declares that there is no conflict of interest.
### Timeline

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STRESS PTSD THR


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Figure 3.1

Theoretical Framework

Therapeutic Horseback Riding for PTSD

- Combat
- PTSD
- THR
- Decreased PTSD Symptoms

Adaptive Responses

Input

Output

Intervention

Adaptation

Veteran (holistic, adaptive system)

PTSS = Post Traumatic Stress Disorder
THR = Therapeutic Horseback Riding

Adaptive Modes
Physiological, Self Concept, Role Function, Interdependence
CHAPTER 4

RELATIONSHIP OF VETERAN PTSD SEVERITY AND EQUINE CORTISOL LEVELS AND STRESS BEHAVIORS DURING THERAPEUTIC HORSEBACK RIDING


Introduction

Posttraumatic stress disorder (PTSD) is a complex trauma-related disorder often associated with physical, psychological, and behavioral comorbidities. Up to 30% of Veterans suffer from PTSD because of combat exposure (Armenta, et al., 2018). It is believed, however, that prevalence is higher due to underreporting by Veterans who fear association with a mental health diagnosis may alter their eligibility for benefits and/or disability. Untreated PTSD can have significant economic and social implications, leading to greater severity of symptoms and development of comorbid conditions. There is an urgent need to identify complimentary and alternative approaches to current treatment options, which are often reported by Veterans to be ineffective (Boss, Branson, Hagan, & Krause-Parello, 2019, Fine, Tedeschi & Elvolve, 2015).

One potential complimentary therapy for PTSD is the use of Animal Assisted Interventions (AAI), specifically, equine assisted therapy (EAT). EAT utilizes horses, volunteers, instructors, and participants in goal directed interventions, such as therapeutic horseback riding (THR), to improve health outcomes (Kinney, Eakman, Lassell, & Wood, 2019). Since 2007, the number of accredited equine centers offering programs to Veterans has increased from 89 to 335 (Professional Association of Therapeutic
Horsemanship International (PATH), (PATH, 2017). Although no standard curriculum has been agreed upon, EAT and THR are designed to increase self-esteem, confidence, communication skills, and social trust by developing a relationship with the horse (Arnon, et al., 2020; Kersten & Thomas, 2000; O’Haire, Guerin, & Kirkham, 2015; Staudt & Cherry, 2017). With the proliferation of EAT programs and lack of standard curriculum, it is essential to understand the effects of Veterans with PTSD on the horses they ride. The purpose of this study was to evaluate the relationship between level of PTSD in Veterans and equine cortisol levels and equine stress behaviors in the equines they rode during therapeutic horseback riding (THR). This study is significant because there have been no published studies on the correlation of PTSD severity and equine stress.

**Literature Review**

**PTSD**

PTSD is characterized by exposure to trauma. The trauma may be witnessed or directly experienced by an individual. Symptoms of PTSD include avoidance of situations which may trigger memories of the trauma, persistent re-experiencing of the trauma through nightmares or flashbacks, negative thoughts, and hyperarousal or reactivity (U. S. Department of Veterans Affairs, 2020). Military Veterans with PTSD are often hesitant to seek treatment for their PTSD due to the perceived stigma of mental health illness and lack of acceptable treatments (Fine, Tedeschi & Elvolve, 2015; Fragedakis & Toriello, 2014; Hoyt & Candy, 2011; O’Brien, 2015).

**Animal Assisted Interventions**
Human-animal interaction (HAI) is a rapidly growing research field. It is believed that the bi-directional effect of the relationship has a positive impact on the health of both humans and animals (Fine, Tedeschi, & Elvolve, 2015). AAI are structured interventions which intentionally include animals for the purpose of positive therapeutic outcomes in humans (International Association of Human-Animal Interaction Organization, 2018).

Therapeutic horseback riding (THR) a type of AAI, is the use of a horse and horse related activities to improve physical, psychological, behavioral, and social health in individuals with special needs (Professional Association for Therapeutic Horsemanship International, 2019). It is critical to maintain the health and welfare of the animals involved in AAI (American Veterinary Medical Association 2018).

**Horses and Stress**

While the number of THR programs has increased, consideration of the potential stress on the animal has only recently begun to be studied. Individuals with physical or mental health illnesses may lead to increased stress in the horses being ridden (McKinney, Mueller, & Frank, 2015). It has been suggested that the hippocampus, pituitary, amygdala (HPA) axis and its circulating glucocorticoids is responsible for maintaining homeostasis when a horse is exposed to a threat or stress (Ayala, et al., 2012; Fazio, Medica, Cravana, & Ferlazzo, 2013; Ille, et al., 2013). Secretion of cortisol is thought to be dependent upon type, length, and intensity of activity (Fazio, Medica, Cravana, & Ferlazzo, 2013). The most common methods of assessing stress in horses include serum cortisol levels and behavioral observation. Kaiser, Heleski, Siegford, & Smith (2006) studied stress related behaviors in horses ridden by recreational riders and physically or psychologically disabled individuals during a therapeutic riding program.
Their results suggested that horses being ridden by disabled individuals experience no more stress than horses ridden by recreational riders without disabilities. Horse behaviors and heart rate were studied in therapeutic riding horses ridden by individuals with brain disorders (Minero, Dassi, Martelli, & Canali, 2003). Results of this study showed that the horses displayed discomfort behaviors such as chewing their bit and moving their head up and down. In 2004, Suthers-McCabe presented results of a study of 28 horses from 4 different therapeutic riding programs for children and adults. Serum cortisol was measured before and after riding sessions. Horse behaviors were videotaped and reviewed. Cortisol levels decreased in 27 horses, suggesting that therapeutic riding sessions were not stressful for the horse. In more recent research, Chen (2017) found that horses participating in university riding classes and therapeutic riding centers did not show elevated levels of serum cortisol nor increased behavior scores. Hovey, Davis, Chen, Godwin, & Shea Porr (2021) also found that horses participating in THR had cortisol levels with range throughout the study and displayed few negative or abnormal behaviors. McKinney, Mueller, & Frank (2015) also found that cortisol levels and behaviors were not affected by participation in THR. Similarly, Merkies, McKechnie, & Zakrajsek (2018) did not find any differences in equine behaviors nor cortisol levels in riders with PTSD versus those without. Johnson, et al. (2017) found that although physiological and behavioral patterns of stress in horses varied while being ridden by Veterans with PTSD, they remained within normal range, suggesting that horses were not significantly affected by the activity. Horses used in equine assisted activities and therapies studied by Malinowski, et al. (2018) did not experience increased heart rate nor
elevated serum cortisol levels while ridden by Veterans with PTSD, thus providing additional support of results of previous studies.

Methods

Inclusion Criteria

To be eligible for the study, Veterans must have been 18 years of age or older, no longer active military, have a diagnosis of PTSD and/or PTSD with traumatic brain injury (TBI), willingness to work with and ride a horse, ability to walk at least 25 feet unassisted, and weighed 220 pounds or less. Horses were selected for the study if they met criteria established by the Professional Association for Therapeutic Horsemanship International, had participated in THR previously, and were considered able to carry a weight of at least 220 pounds (Johnson, et al., 2018).

Recruitment

Veterans were recruited via letters and postcards following a review of the local Veterans Administration (VA) medical records for a diagnosis of PTSD or PTSD with TBI (Johnson, et al., 2018). Providers were able to refer potential participants and materials advertising the study were placed in clinic offices of the Veterans Hospital (Johnson, et al., 2018).

Ethical Considerations

The study was approved by the University of Missouri Health Sciences Institutional Review Board (HSIRB), the Animal Care and Use Committee (ACUC) of the university, and the Research & Development committee of the Harry S. Truman Memorial Veterans’ Hospital in Columbia, MO. See Appendices 1-4. All participants signed an informed consent form approved by the VA and the HSIRB. In addition, the
VA Research and Development Animal Component of Research Protocol (ACORP) employed a VA-affiliated veterinarian to visit the riding arena to assess and verify appropriate conditions for the horses used in the study.

**Measures**

Demographic data were collected using a demographic questionnaire developed by Johnson & Meadows (2010) and included age, gender, race, marital status, years of education and horseback riding experience. The health history questionnaire, also developed by Johnson & Meadows (2010) inquired about drug, alcohol, caffeine, and tobacco use as well as common medical conditions. Demographic and health history questionnaires were completed by Veterans prior to the first riding session.

The PTSD checklist for DSM-4 (PCL-M) was used to assess participant symptoms (National Center for PTSD, 2013). Participants were asked to rate “how much have you been bothered by” a particular symptom in the last month. Examples of symptoms include: “Repeated, disturbing memories, thoughts, or images of a stressful military experience” “Loss of interest in things that you used to enjoy?” and “Feeling jumpy or easily startled?” Checklist items are self-reported on a Likert scale where 1 is not at all and 5 is extremely likely, with a score range of 17-85. Higher scores indicate more PTSD symptoms. A cut-point score of 50 and higher is used to diagnose PTSD. Research suggests that a change of five points in the PTSD score is a reliable indicator of response to treatment and a 10-point change is clinically meaningful (National Center for PTSD, 2013). The PCL-M is a well-accepted, widely used tool with internal consistency for the PCL-M of 0.94-0.97, test-retest reliability (0.97 over 3 days), concurrent validity
(0.77-0.93), and sensitivity (0.82) and specificity (0.84) (Weathers, Litz, Herman, Huska, & Keane, 1993).

Equine stress behaviors were measured using a validated instrument developed by Young, Crieghton, Smith, & Hosey (2012). The Equine Behavior Score (EBS) uses heart rate and salivary cortisol levels to help identify stress behaviors in horses. In a validation study principal component analysis of cortisol and behaviors resulted in correlation coefficients of 0.3 and higher, \( p = 0.02 \) (Young, Crieghton, Smith, & Hosey, 2012). EBSs range from 1-10, where scores from 1-2 represent no stress, 3-4 low stress, 5-7 medium stress, and 8-10 high stress (Young, Crieghton, Smith, & Hosey, 2012). The EBS was designed using both behavioral and physiological data. Salivary cortisol was collected at 60 and 30 minutes prior to normally occurring husbandry procedures. Samples were obtained again after the 10-minute procedure and then at 10-minute intervals for 40 minutes. A significant correlation between behavior score and salivary cortisol levels was found \( (p = 0.02) \). Additional analysis showed that salivary cortisol was a sensitive and reliable measure of stress and EBS was an indicator of physiologic stress in equines. (Young, Crieghton, Smith, and Hosie, 2012).

Blood samples were obtained via jugular venipuncture to measure cortisol (Johnson, et al., 2017). Serum cortisol levels were determined using the immunoassay analyzer, which has been validated for use in horses (Peeters, Sulon, Beckers, Ledoux, & Vandenheede, 2011).

**Intervention**

The original study took place in a PATH certified riding arena and employed a standardized curriculum, which included five components: welcome to the barn,
grooming and safety, mounting, lesson, and dismount/closure. The THR session was 60 minutes once a week for six weeks (Johnson, et al., 2018). Horses were selected and matched to Veterans by a PATH certified riding instructor and horse/Veteran pairings remained consistent throughout the study. During the study period, horses were not used for any other activity.

THR occurred in weekly 50-60-minute sessions over a six-week period at a PATH Accredited Riding Center in Columbia, MO. The standardized curriculum, designed by occupational therapists and THR instructors, who served as consultants on the research team, included the following elements: Welcome to the Barn, Grooming and Safety, Mounting, Lesson and Dismount/Closure. Time allotted for each component varied by session. For example, more time was spent on Welcome to the Barn at session one versus session six. Veterans participated in therapy at the same site each time and rode the same horse for the duration of the program. Each session was supervised by a PATH-certified riding instructor and an occupational therapist and was monitored by study staff to insure intervention fidelity. Each Veteran required a total of three volunteers: one horse leader and two side-walkers (Johnson, et al., 2018).

**Data Collection and Analysis**

Veteran health history and demographic questionnaires, as well as the PCL-M were collected at baseline prior to any THR sessions and took approximately 40 minutes to complete. Subsequent PCL-M data (15-20 minutes collection time) were collected at sessions three and six.

Serum cortisol levels were obtained from horses via jugular venipuncture during a non-THR day to establish baseline and then at sessions one, three and six at the following
times: 30 minutes prior to THR session (T1), after tacking (saddling) occurred (T2), and after completion of the THR session (T3). Veterinary medical students in their equine rotation performed the venipunctures while supervised by veterinarians from University of Missouri College of Veterinary Medicine (Johnson, et al., 2017). Sampling occurred at the same time of day during sessions 1, 3, and 6 to control for potential variation in cortisol due to circadian rhythm.

Horses were also observed for behavioral indicators of stress using videotape for two minutes at baseline, T1, T2, and T3 during sessions one, three, and six prior to obtaining blood samples. Behaviors were scored by two trained raters using the Equine Behavior Score (EBS) (Johnson, et al., 2017). Observers used the EBS to rate mock videotapes of equine behavior to establish interrater reliability. A Doctor of Veterinary Medicine, who is an equine behavior expert, validated the ratings and discussed findings with the observers. The process was repeated until 80% interrater reliability was obtained.

**Research Design**

The current study was a secondary analysis of existing data from a study conducted by Johnson, et al. (2017). Quantitative data included equine serum cortisol, EBS, and PSTD scores of Veterans.

**Data Analysis**

Statistics were analyzed using SPSS version 27. Kendall’s tau-b was used to examine the correlation between level of PTSD and equine serum cortisol and level of PTSD and EBS across sessions. Mean equine cortisol levels by session were determined by using the three values taken across the session. Mean EBS by session were determined
by using the two values recorded at each session. Friedman’s Test was used to analyze change in PTSD, mean cortisol levels and mean EBS across sessions. The p-value for determining significance was 0.05. A post-hoc Wilcoxon sign rank test with a Bonferroni adjustment was used to identify change in mean cortisol level between sessions 1 and 3, sessions 3 and 6, and sessions 1 and 6.

**Results**

Demographic data for the Veterans and Equines are shown in Tables 4.1 and 4.2, respectively. Five Veterans and five equines participated in the THR program. All Veterans were married, Caucasian males with a mean age of 61.8 years. The equines were all used for THR and had experience with riders with multiple disabilities. Veteran health history data are displayed Table 4.3.

**Table 4.1**

*Veteran Demographics*

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*Note.* SD = standard deviation; THR = therapeutic horseback riding.
Veteran PTSD scores, mean cortisol levels, and mean equine behavior scores by
THR session can be found in Table 4.4. All Veterans had a formal diagnosis of PTSD or
PTSD with TBI as a requirement of participation. At the time of THR, however, two
veterans scored <50 on the PCL-M at lesson 1. Mean EBS ranged from 1.0 - 1.92, which
are within normal range indicating no stress. All serum cortisol levels were within normal
range for horses.
Data met the assumptions for level of measurement, random sample, and independence of observations (Pallant, J., 2020). The assumption of normality was violated by PTSD scores and EBS. See Figures 4.1 and 4.2, respectively. Equine serum cortisol levels were normally distributed. See Figure 4.3.
Research Question 1

‘What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equine cortisol levels in equine they rode?’ There was a weak, negative correlation between the two variables
which was not significant, $t_b = -0.09, p = 0.54$. Additional analysis was performed at the individual participant level. For Veteran one, there was a small, non-significant, negative correlation between level of PTSD and equine cortisol levels, $t_b = -0.160, p = 0.518$.

Veteran two had a small, non-significant, negative correlation between the two variables, $t_b = -0.289, p = 0.35$. Veteran three had a small, non-significant, negative correlation between level of PTSD and equine cortisol, $t_b = -0.032, p = 0.91$. Veteran four had a large, non-significant, negative correlation between the two variables, $t_b = -0.507, p = 0.14$. Veteran five had a small, non-significant, negative correlation between level of PTSD and equine cortisol, $t_b = -0.282, p = 0.4$.

Research Question 2

‘What is the relationship between level of PTSD among military Veterans participating in a therapeutic horseback riding program and equine behavior scores in equine they rode?’ There was no correlation between level of PTSD and EBS, $t_b = -0.00, p = 1.00$. Additional analysis was performed at the individual participant level. In Veteran one there was a large, positive correlation between level of PTSD and equine behavior score, although the result was non-significant, $t_b = 0.503, p = 0.09$. In Veteran two, three was a small, non-significant, positive correlation between the two variables, $t_b = 0.236, p = 0.50$. In Veteran three, there was a medium, non-significant, positive correlation between level of PTSD and equine behavior score, $t_b = 0.298, p = 0.43$. The large, positive correlation between variables in Veteran four was non-significant, $t_b = 0.536, p = 0.08$. In Veteran five, there was no correlation, $t_b = 0.00, p = 1.00$.

Change Over Time
As the assumption of normality was violated, a Friedman Test was conducted on each of the dependent variables; PTSD score, equine cortisol level, and EBS to assess changes over sessions 1, 3, and 6. See Table 4.5. The results of the Friedman test indicated that there was not a statistically significant difference in PTSD scores across the three THR sessions $\chi^2 (2, n = 5) = 3.6, p = 0.16$. Inspection of the mean values showed a decrease in PTSD scores from session 1 ($M = 57$) to session 3 ($M = 50.8$) to session 6 ($M = 50.2$), though this was not statistically significant. For equine cortisol levels, the Friedman Test indicated that there was statistically significant difference in cortisol levels across the three THR sessions $\chi^2 (2, n = 5) = 6.4, p = 0.04$. Mean values showed an increase in cortisol levels from session 1 ($M = 2.85$) to session 3 ($M = 3.32$) to session 6 ($M = 3.64$), indicating that the equines did experience increased stress levels across sessions 1, 3, and 6. There was no statistically significant change in EBS across the three THR sessions $\chi^2 (2, n = 5) = 4.11, p = 0.13$. Mean EBS values increased from session 1 ($M = 1.39$) to session 3 ($M = 1.48$) and decreased from session 3 to session 6 ($M = 1.30$).

The Friedman Test tells us if there is a change over time, but it does not tell us which times are significantly different from each other. A post hoc Wilcoxon Sign was run for equine cortisol level. A Bonferroni adjustment was made to decrease the likelihood of a Type 1 error. Examination of the post-hoc analysis of cortisol levels indicated that the change in mean cortisol levels between session 1 and session 6 were no longer significant, $p = 0.04$.

**Discussion**
For research question one, there was a weak negative non-significant relationship between level of PTSD and equine cortisol levels. For research question two, no correlation was found between level of PTSD and EBS. These findings may be due to the small number of participants in the study and number of data points. Additional analyses found no changes over time for any of the three study variables.

According to the National Center for PTSD (2013) a change of five points in the PTSD score is a reliable indicator of response to treatment and a 10-point change is clinically meaningful. Mean PTSD scores decreased from 57 at session 1 to 50.2 at session 6, a 6.8-point change in scores. Although the change between sessions was not significant, the PTSD scores moved in the expected direction. It is not possible to attribute this change in scores solely to THR. Veterans may have been participating in other treatments for their PTSD, which could confound the results of this study. In addition, we do not know if the change in PTSD scores would have continued the positive downward trend if more sessions of THR were conducted nor if the improvement in scores would have been maintained longitudinally. To date, the ideal
length and number of sessions has not been agreed upon. Despite these unknowns, the military Veterans participating in this study did respond to THR indicating that it may be successful in decreasing levels of PTSD.

Mean cortisol levels increased significantly over time according to Friedman’s Test. The post hoc Bonferroni adjustment, however, did not support a statistically significant increase in cortisol levels between session 1 and session 6, indicating that the equines being ridden by military Veterans with PTSD did not experience a significant increase in stress over the duration of the program. Although mean cortisol levels increased over time, they remained within the normal range of 2 and 6 µg/dL. One possible explanation of this could be that the horse was reacting to the inexperience of the Veteran. Each lesson built upon the information from the previous lesson and activities became more challenging (Johnson, et al., 2018). None of the Veterans had ridden horses before, nor participated in THR.

No statistically significant difference in mean EBS over time was identified. The low incidence of equine stress behaviors during THR provides support of previous findings that military Veterans with PTSD do not significantly increase stress levels in the horses they ride (Johnson, et al., 2017).

**Limitations**

This study was not without limitations. All Veterans were married, Caucasian males. All but one Veteran was of the Vietnam War era. The small sample size was also an important limitation. The study findings only apply to a small subpopulation of Veterans and cannot be generalized to other Veterans. It is unknown how much, if at all, Veteran co-morbidities affected equine stress responses. A study by Peeters, M., Sulon,
J., Beckers, J. F., Ledoux, D., & Vandenheede (2011) found that serum and salivary cortisol levels had a strong correlation and that salivary sampling methods may be a good non-invasive sampling technique, thereby causing less stress for the equine. Finally, the horses used in the current study were used exclusively for THR and may be used to the activities and therefore may not show any changes in cortisol or behavior (Merkies, McKechnie, & Zakrajsek 2018).

**Future Research**

Future research should include a larger sample size of horses and Veterans with greater representation of race, age, and service branch. Longitudinal, multi-site studies could enhance generalizability of results. Collaborative efforts could potentially lead to the identification of the optimum program length and interaction time with the animal. Consideration should be given to collecting physiological measures on the human participants in addition to self-report measures. It may also be worthwhile to measure positive indicators on human-animal interaction during THR such as oxytocin.

**Conclusion**

As prey animals, horses are sensitive to social and emotional cues. To survive in the wild, horses live in herds, where they can read the behaviors of others to find food, escape predators, and maintain social relationships (Baba, Kawai, & Takimoto-Inose, 2019). Studies have shown that horses can read the social and emotional cues of humans as well (Maros, Gacsi, & Miklosi, 2008; Nakamura, Takimoto-Inose, & Hasegawa, 2018; Proops, Grounds, Smith, & McComb, 2018; Proops, & McComb, 2010; Smith, Proops, Grounds, & Wathan, 2016; Smith, Proops, Grounds, & Wathan, 2018; Takimoto, Hori, & Fujita, 2016). The horse is said to be a mirror of human emotions with the ability to
provide immediate feedback, through behaviors, to the rider, thus increasing self-awareness (Bivens, Leinhart, Klontz, & Klontz, 2007). Thus, THR can be especially helpful for Veterans with PTSD who suffer from re-experiencing, avoidance, negative mood, and hyperarousal.

The health and welfare of animals used in AAI is crucial for the continuation and development of future programs. It is essential to understand the amount of stress the animal may or may not experience due to the intervention or characteristics of participants. Although studies have looked at the effects of different populations riding equines, there are very few studies on the effects of PTSD in military Veterans on the equines they ride. Johnson, et al. (2017) found that serum cortisol, plasma ACTH, and glucose levels in equines did not indicate that equines were experiencing stress during therapeutic horseback riding.

In the current study, no relationship was found between level of PTSD in military Veterans and equine cortisol levels nor equine behavior scores. The results demonstrate that horses are not significantly stressed when used for THR and support findings in other research studies (Johnson, et al., 2017; Kaiser, Heleski, Siegford, & Smith 2006; McKinney, Mueller, & Frank, 2015; Malinowski, et al., 2018; Merkies, McKechnie, & Zakrajsek 2018).

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Conflict of Interest

The Author declares that there is no conflict of interest.
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Proops, L., Grounds, K., Smith, A. V. & McComb, K. Animals remember previous facial expressions that specific humans have exhibited. *Current Biology, 28*, 1428-1432. doi: 10.1016/j.cub.2018.03.035


CHAPTER IV

STRESS REDUCTION IN VETERANS THROUGH THERAPEUTIC HORSEBACK RIDING: “THE HORSE MADE ALL THE DIFFERENCE”


Introduction

According to VetPop2018, there are over 18 million Veterans in the United States (U. S. Departments of Veterans Affairs, 2021). PTSD is a significant problem in Veterans, affecting up to 30% of those that have served (Bourn, Sexton, Porter, & Rauch, 2016; Defrin, Schreiber, & Ginzburg, 2015; Fishbain, 2017; Irwin, Konnett, Wong, & O’Neill, 2014; Lang, Veazey-Morris, Berlin, & Andrasik, 2016; Morasco, Lovejoy, Lu, Turk, Lewis, & Dobscha, 2013). Although evidence-based treatments such as cognitive processing therapy (CPT) and prolonged exposure therapy (PET) are successful in treating PTSD, Veterans must be willing to participate in the entire course of treatment (Scotland-Coogan, Whitworth, & Wharton, 2020). It has been reported that up to 50% of Veterans do not seek treatment and that 50% of those who do, drop out prior to completion due to time commitments, perceived stigma of seeking help, hesitancy to talk about experiences, and lack of connection with the therapist (Fine, 2015; Fragedakis & Toriello, 2014; Hoyt & Candy, 2011; O’Brien, 2015). Therapeutic horseback riding (THR) may be a viable option as a standalone or complimentary therapy for Veterans with PTSD.

PTSD

First introduced as a formal diagnosis in 1980 in the Diagnostic and Statistical Manual of Mental Disorders III (DSM-III), PTSD was considered controversial as it was
dependent upon external versus intrinsic factors (American Psychiatric Association, 1980; Friedman, n.d.). The diagnostic criteria for posttraumatic stress disorder (PTSD) were revised in 1987, 1994, 2000 and 2013. In 2013, the American Psychiatric Association updated the classification of PTSD, which is now part of ‘trauma and stressor-related disorders’, with exposure to a trauma being the common factor of all disorders in the new class. Symptoms that accompany PTSD are categorized into four clusters: intrusion, avoidance, negative cognitions and mood, and arousal (American Psychiatric Association, 2013). The American Psychological Association (2021) defines PTSD as

a psychiatric disorder that may occur in people who have experienced or witnessed a traumatic event such as a natural disaster, a serious accident, a terrorist act, war/combat, or rape or who have been threatened with death, sexual violence or serious injury. (p. 1)

**Therapeutic Horseback Riding**

Over the past several decades, empirical research on the human-animal bond and animal assisted interventions (AAI) has increased. Animal assisted interventions (AAI) are slowly finding their way into medical and behavioral healthcare settings to be implemented in all age groups for a multitude of conditions. Studies have shown the beneficial effects of human animal interaction such as decreased stress, increased self-esteem, decreased symptoms of posttraumatic stress disorder (PTSD), and physiologic changes including decreased heart rate and blood pressure (Beetz, Uvnäs-Mobert, Julius, and Kotrschal, 2012; Johnson, et al., 2018; Odendall, 2000; Odendall & Meintjes, 2003; White-Lewis, Russell, Johnson, Cheng, & McClain).
The International Association for Human Animal Interaction Organizations (IAHAIO) (2018) have defined AAI as
a goal oriented and structured intervention that intentionally includes or incorporates animals in health, education and human services (e.g., social work) for the purpose of therapeutic gains in humans. It involves people with knowledge of the people and animals involved. Animal assisted interventions incorporate human-animal teams in formal human services such as Animal Assisted Therapy (AAT), Animal Assisted Education (AAE) or under certain conditions Animal Assisted Activity (AAA). Such interventions should be developed and implemented using an interdisciplinary approach. (p. 5)

Therapeutic Horseback Riding is an AAI and is defined as the use of a horse and horse-related activities to improve outcomes in the physical, emotional, behavioral, and social domains in individuals with special needs (PATH, 2019).

**Psychological Benefits of Horses**

Animals in general have been recognized as social agents as early as the seventeenth century (Fine, 2015). Animals can assist humans in times of stress, facilitate coping, offer unconditional affection, and provide feelings of security (Walsh, 2009). Animals can also serve as a social catalyst to enhance communications skills in humans due to their unscripted behavior and serving as a neutral subject on which to focus efforts (Fine, 2015). In the late eighteenth century, animals began being integrated into mental health treatment in England and physicians found that the interaction between patients and animals led to social awakening. Socialization is so important to health that isolation has been likened to physical torture and, indeed, isolation has been used as a method of
punishment for centuries (Fine, 2015). Social isolation is the most severe type of stress individuals can experience (Beck, 2014). Prolonged social isolation can lead to apathy, despair, and even catatonic withdrawal (Serpell, 2015).

The history of the human-horse relationship dates back nearly 4 million years (Olsen, 2019). The first relationships between humans and horses were related to the need for food, work, and transportation, but their ability to carry a human has perhaps had the greatest impact on the human-horse relationship (Robinson, 1999). The need to use horses for work and transportation has markedly decreased and modern human-horse relationships are valued more for their companionship (Olsen, 2019).

Research has shown that horses are social animals who can perceive, respond to, and learn from their environment (Voelpel, Escallier, Fullerton, & Abitbol, 2018). Horse’s perceptions are influenced by internal and external stimuli, which can include changes in the environment, relationships with other horses, and human body language and chemistry (Fine, 2015). THR builds upon these traits of the horse to strengthen the human-equine interaction and relationship to achieve outcomes. As prey animals, horses are attuned to the minutest details, even those that go unnoticed by humans. They continuously scan their environment and can communicate situations to each other, thereby building trust (Voelpel, Escallier, Fullerton, & Abitbol, 2018). Building a trusting relationship can be difficult for Veterans, thus interaction with horses has the potential to be therapeutic. Horses are often referred to as mirrors as their sensitivities to non-verbal communication enable them to respond to an individual’s mood in a non-threatening, non-judgmental manner, thereby creating self-awareness. (Fine, 2015; Brandt, 2013). Becker (2002) stated that the horse acts as a metaphor during therapy for overcoming
large obstacles and perceived negative internal and external stimuli. Interactions with horses require a balance of strength and control, that when mastered, can be applied to everyday life situations. Horses are also large animals, often weighing around 1200 pounds, making them an ideal candidate for therapy with Veterans who have experienced combat (Masini, 2010). Therapeutic horseback riding has been shown to increase self-efficacy, confidence, quality of life, and social interaction and decrease depression, anxiety, and heart rate (Boss, Branson, Hagan, & Krause-Parello, 2019; Johnson, et al., 2018; Johnson, et al., 2021; Lanning, Wilson, Krenek, & Beaujean, 2017; Nevins, Finch, Hickling, & Barnett, 2013; Shelef, et al., 2019).

The purpose of this study was to examine Veterans’ perceptions of a THR program using riding diaries from a prior study.

**Method**

The original study by Johnson et al. (2018) was approved by the VA Research and Development Committee at Harry S. Truman Memorial Veterans’ Hospital and the University of Missouri Health Sciences Institutional Review Board. The use of equines in the original study was approved by the Animal Care and Use Committee of the University. All participants signed a research consent form.

**Description of the THR intervention**

The THR sessions took place at two Professional Association of Therapeutic Horsemanship International (PATH) certified riding facilities, one of which was an indoor arena and the other a covered outdoor arena. Veterans participated in one-hour weekly sessions for six consecutive weeks. The curriculum consisted of five elements,
Welcome to the Barn, Grooming and Safety, Mounting, Lesson, and Dismount/Closure, each of which was covered at every encounter (Johnson, et al., 2018).

Sample

Purposive sampling was used to find participants who were military Veterans with a confirmed diagnosis of PTSD or PTSD with traumatic brain injury (TBI). A medical record review was conducted to identify individuals who met inclusion criteria. Veterans were recruited for the study via letters and postcards, referral by VA clinicians, and advertising throughout the VA hospital (Johnson, et al., 2018).

Data Collection

Immediately following each weekly session, participants were provided with a structured, solicited, paper and pencil riding diary to be completed prior to leaving the barn. The goal of the diary was to answer the research question ‘what are the Veterans’ perceptions of a six-week THR program?.’ The riding diary consisted of two demographic items, date, and name of horse, and two open ended items: describe how you felt about your ride today and how did you feel about your experiences/interactions with your horse today. Confidentiality was maintained using the participant ID, which was pre-written on each diary and contained in a folder, also distinguished by participant ID. Folders were kept in a locked cabinet in the Principal Investigator’s office.

Data Analysis

Inductive thematic analysis approach was used as there are no known published studies of Veterans’ experiences with therapeutic horseback riding. Entries from the riding diaries was independently transcribed verbatim by two research assistants from the Research Center for Human Animal Interaction (ReCHAI) at the University of Missouri.
Data were analyzed using qualitative thematic analysis and based on Braun and Clarke’s (2006) six phase framework. It should be noted that although the process is presented in a linear fashion, the analysis moved fluidly back and forth between phases. Hard copy transcripts were read and re-read, with notes made with pen and highlighters. The transcripts were then reviewed by item as well as by session and copied into a Microsoft Excel spreadsheet (Bree & Gallagher, 2016). In vivo coding was applied to capture the exact words of the participants. Codes were reviewed for pattern identification and then grouped into categories and subcategories. Categories were reviewed and revised two additional times to ensure all codes were accurately categorized. Common themes were identified, and responses were organized based on thematic content to facilitate interpretation. The process and data were reviewed by a second investigator experienced in qualitative analysis. Joint discussions were held to refine the themes. A second reviewer, BW, reviewed the coding conducted by this author and was in 73% agreement.

**Findings**

Riding diaries from twenty-eight participants were analyzed. Mean age of participants was 51 years (range 29-68 years) and 13 of the participants were male. Participants primarily self-identified as Caucasian and served in the Navy, Marine Corp, Army, and National Guard. See Table 3. Veterans had diagnoses such as can be found in Table 4. One hundred sixteen riding diaries were analyzed, resulting in 713 codes and 11 final categories. One overarching theme emerged from the analysis: THR promotes mental health. Five subthemes were identified: (a) social interaction, (b) self-awareness, (c) emotions, (d) relationship development and bonding, and (e) experience.

**Social interaction**
The subtheme of social interaction refers to an exchange between two or more individuals and the way they talk and interact with each other. For purposes of this study, social interaction includes exchanges between a participant and an equine, between participants, or between a participant and barn staff.

Social interaction comments were predominantly positive, indicating that the rider felt a social connection either to the horse or barn staff. Other comments indicated a progression of comfort with social interaction.

“I came early just to spend more time interacting with him so we can get to know each other.”

“Getting more comfortable each time also with the people that are around the arena. It was difficult the first time and I wasn’t sure I would come back. But I’m glad I did!”

“I am a little low at interaction with anyone or anything, but I think I will really begin to enjoy this as I get to know people here.”

“Communicated with helpers more”

**Self-awareness**

The subtheme of self-awareness refers to having a clear perception of one’s thoughts, emotions, and motivation. Self-awareness is important as it allows for the control and appropriate expression of emotions, behaviors, and personality, which may be difficult for those with PTSD.

“It feels as though when I’m around the horse my stress level goes down and I’m more relaxed when I leave.”
“I arrived today with probably a bit more stress than last riding session, which I’m sure made me more tense while riding.”

“While on Huey I tend to forget what is going on in the world.”

“Riding today helped put things in perspective”

**Emotions**

The subtheme of emotions refers to the expression of emotional experiences. The emotions may be positive or negative and expressed verbally or in actions.

“Feel completely elated.”

“I’ve been mad if not angry at times and those feels were replaced with calm and happiness. Great time!”

“Came in a bad mood left in stable one.”

“It felt totally AWESOME. I loved it and am sad that it’s over.”

**Relationship development and bonding**

The subtheme of relationship development and bonding refers to a physical or emotional connection to or engagement with a person(s) or equine. In response to the question, “how did you feel about your experiences/interactions with your horse today?,” the responses of one participant are used to illustrate the progression of relationship development and bonding of one participant and his horse over the course of the program.

Session one: “Relaxed. Almost one with the horse. I wanted to reassure Rock that I wanted to be his buddy.”

Session two: “Much more relaxed. He seemed to have wanted to go faster. I hope it was because he was happy. His ears seemed perkier than before.”
Session three: “Uplifting, and just totally got me into a fantastic mood. Mood changing.

Session four: Good. “Rock was cranky. [I felt] nervous, painful.”

Session five: “I felt great as always when with Rock.”

Session six: “Sad since it was my last day. I think Rock felt some of my emotions cause he was a little crabby.”

**Experience**

The subtheme of experience refers to the general assessment of the THR experience by the veteran.

“A great experience, and the helpers were very attentive & reassuring to me!!!

A+”

“Had a wonderful time learning about horses and their care.”

“I really enjoyed the ride and wasn’t ready to stop. A very pleasurable experience.”

“I think it’s a very fine program.”

**Discussion**

Several themes emerged from analysis of the riding diaries: social interaction, self-awareness, emotions, relationship development and bonding, and experience. Riding diary comments were overwhelmingly positive, which supports findings from a previous study by Johnson, et al. (2021). Negative comments were predominantly seen in the riding diaries from the last THR session.

As prey animals, horses are in a constant state of high alert to their environment. Their keen senses make them very perceptive to the emotional state of the horses in their
herd as well as the humans with whom they (Maros, Gacsi, & Miklosi, 2008; Nakamura, Takimoto-Inose, & Hasegawa, 2018; Proops, Grounds, Smith, & McComb, 2018; Proops, & McComb, 2010; Smith, Proops, Grounds, & Wathan, 2016; Smith, Proops, Grounds, & Wathan, 2018; Takimoto, Hori, & Fujita, 2016). Horses will mirror the personality, actions, and intentions of whomever is working with them. (Bivens, Leinhart, Klontz, & Klontz, 2007). One Veteran wrote that their horse was skittish during the session, which could indicate that the Veteran was feeling anxious or nervous. Another Veteran wrote that he felt his horse could feel exactly what he was feeling. Others wrote that their horse felt cranky, which could reflect the Veteran’s mood.

Developing a relationship with a horse is not easy. It requires constant effort and self-evaluation because horses are naturally hardwired to fear predators. The only way to develop a relationship with a horse is to use respect, trust, understanding, and compassion (Yorke, Adams, & Cody, 2015). These same qualities can be used to successfully develop relationships with humans. Veterans spoke of being one with their horse, being completely focused on the activity, and becoming more comfortable and confident over time, indicating that the strength and quality of the relationship was growing with each session.

By virtue of participating in this study, the Veterans interacted with horses, barn staff, and other participants, which could be interpreted as a decrease in the avoidance symptom of PTSD. Diary entries were overwhelmingly positive for social interaction. Very few negative entries were made, and those decreased over time until the last session when the Veterans were sad to see the program end. To potentially mitigate these feelings, Veterans were provided with the opportunity to be a volunteer for others.
participating in THR. The findings of this study are consistent with those of Johnson, et al. (2021), who looked at the benefits and drawbacks of THR, as well as overall perception of a THR program.

**Limitations**

This study has several limitations. Despite active measures to prevent participant attrition, the number of participants decreased from 28 at session one to 19 at session six, a 38% attrition rate. In addition to losing participants over time, not every participant completed a diary after each session. These issues affected the amount of raw data and potentially missed critical codes and categories, ultimately affecting identified themes. As the riding diary was completed by the participant, there were no opportunities to ask probing questions or to ask for clarification of answers. At times, it was difficult to determine if a written statement should be attributed to the participant or the horse. The sample was homogeneous and consisted of primarily Caucasian males, which could limit generalizability to other populations of Veterans. Data were collected following each of the six THR sessions only. The lack of longitudinal follow-up prevents the analysis of any longer-term impact of THR. Demographic data were not received from all participants, which may have affected sample representativeness, including age, gender, race, and military branch.

**Future Research**

Future research should include heterogeneous samples, e.g., female Veterans and diverse race and ethnicity, to aid generalization of findings. Longitudinal follow up at intervals such as three and six months would provide information on the long-lasting
effects of THR. Consideration should be given to using an interview for data collection so that probing questions can be asked, which would enhance the analysis.

**Conclusion**

This study was conducted to identify the perceptions of a six-week THR program in military Veterans with PTSD. One overarching theory emerged from the data: THR improves mental health. Five subthemes were identified: social interaction, self-awareness, mood, bonding, and experience. These subthemes lend credibility to using a structured THR program as an innovative, complimentary therapy for military Veterans with PTSD. The results of this study suggest that THR can help Veterans overcome the challenges of PTSD. There is no magic treatment or therapy for PTSD. To date, there is insufficient evidence to support THR as a standalone treatment for PTSD. Studies show, however, that there is scientific, psychological, and biological evidence to support the use of horses, thus, it can be used successfully as an adjunct therapy.

**Funding**

The original study by Johnson, et al (2018) was funded by the Horses and Humans Research Foundation (HHRF). This secondary analysis received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Support**

Support was provided by the Harry S. Truman Veterans’ Memorial Hospital in Columbia, MO.

**Conflict of Interest**

The Author declares that there is no conflict of interest.
References


O’Brien, B. (July 31, 2015). *Seeking and studying alternative PTSD treatments* [Radio broadcast transcript]. Retrieved from Seeking And Studying Alternative PTSD Treatments | WLRN


Proops, L., Grounds, K., Smith, A. V. & McComb, K. Animals remember previous facial expressions that specific humans have exhibited. *Current Biology, 28*, 1428-1432. doi: 10.1016/j.cub.2018.03.035


CHAPTER V

DISCUSSION AND CONCLUSION

The systematic review is the first one to examine the effects of Animal Assisted Interventions (AAI) on Veterans with posttraumatic stress disorder (PTSD). The review, which focused on 16 interventional studies, provides support for the use of AAI as a therapy for Veterans with PTSD. Six unique instruments were used to measure PTSD and an additional 27 instruments measured multiple aspects of mental health such as depression, anxiety, quality of life, social support, and loneliness. Pinnipeds, canines, and equines were used for AAI in the reviewed studies. Studies varied in the amount of time interacting with the animals, frequency, and program length. Despite the differences in approach to AAI, the level of PTSD decreased in all studies. Additional outcomes reported include decreased depression, anxiety, and loneliness and improved quality of life and social support.

A weak, negative, non-significant correlation was found between level of PTSD and equine cortisol levels. A stronger, statistically significant correlation may be found in future research with a larger sample size. There was no correlation found between the level of PTSD and EBS. This is an interesting finding because the authors of the EBS found a significant correlation between salivary cortisol and equine behaviors, and that cortisol was a sensitive and reliable measure of stress leading to the conclusion that the EBS measures stress. If this is true, one would expect a similar type of correlation between the level of PTSD and equine cortisol and level of PTSD and EBS. This could potentially be explained by the number and length of the video recordings upon which two research assistants determined the EBS at the defined sessions and points in time.
There was no significant change in PTSD scores over time, however, the scores moved in the expected direction. One Veteran had a 15-point decrease, and another had a 7-point decrease in level of PTSD between sessions 1 and 6, indicating a positive response to therapy on an individual level.

Following a Wilcoxon sign rank with an adjusted Bonferroni, there was non-significant increase in mean cortisol levels across sessions 1, 3, and 6 of THR. Although non-significant, the cortisol levels did increase between session 1 and session 6. Session 6 was the last session of THR in the program and it is possible that the equines were reacting to the behaviors and emotions of the Veterans. As the THR sessions progress, more time is spent riding the horse. Session 1 starts with 10 minutes of riding and 30 minutes are spent riding in lesson 6 (Johnson, et al., 2017). In addition to being the last session, the increased amount of time spent riding the horse may have contributed to higher levels of stress and anxiety in the Veteran. Veterans may have also felt sad or disappointed that the program was ending, and the equine was reacting to those feelings. The THR program took place in the spring at a covered, outdoor arena, and it is possible that the theoretical increase in environmental temperature over six weeks created a stress response in the equines.

There was no significant difference in mean EBS between sessions. As mentioned previously, one would expect to see a similar increase in EBS as was seen in serum cortisol. A possible explanation for the difference could be that the video segments were filmed prior to obtaining the serum cortisol sample and stress behaviors may not have been captured. There is also the potential that the EBS instrument is not as sensitive in detecting stress as the serum cortisol. Additional studies using both methods to identify
stress are called for. Alternatively, salivary cortisol samples could be used in place of serum cortisol samples.

The analysis of riding diaries, the first to describe the perceptions of Veterans with PTSD after weekly sessions of therapeutic horseback riding (THR), also supports the use of AAI. Themes identified included social interaction, self-awareness, emotions, relationship development and bonding, and experience. Comments expressed by Veterans after their riding sessions indicate that they may have had decreased symptoms of PTSD such as re-experiencing, avoidance, negative cognition and mood, and arousal.

“All of my friends were here”

“All felt comfortable and confident”

“All more and more stress free”

“All trust, trust, trust”

Negative comments were only expressed after the final THR session and included statements such as “I am sad that it is over.” These findings are consistent with results from a study by Johnson, et al. (2021), which described Veteran’s perceptions of THR following program completion. Analysis of a THR program exit questionnaire resulted in four themes. The themes were ‘connected to horse,’ ‘relaxing,’ ‘180-degree change’, and ‘meeting new people’. Veterans also expressed that the program was ‘too short’ (Johnson, et al., 2021).

Developing a relationship with an equine is not easy. It requires forming a partnership with constant communication, trust, and mutual understanding (Yorke, Adams, & Cody, 2015). Such a relationship offers an opportunity for closeness, safe touch, physical contact, proficiency, and accomplishment and focuses on ability rather
than disability (Yorke, Adams, & Cody, 2008). These same qualities can be used to successfully develop relationships with humans. Veterans spoke of being one with their horse, being completely focused on the activity, and becoming more comfortable and confident over time, indicating that the strength and quality of the relationship was growing with each session.

**Future Research**

Future research should include heterogeneous samples, e.g., female Veterans and diverse race and ethnicity, to aid generalization of findings. Researchers should consider multi-site studies to increase sample size and heterogeneity of the sample population. Longitudinal follow up at intervals such as three and six months would provide information on the long-lasting effects of THR. Standardization of interventions across studies would provide some needed rigor in beginning to control confounding variables. Use of consistent outcomes and measurement instruments would allow for meta-analysis and study replication. Very few studies have used a theoretical framework to guide the interventions. Theories can guide every aspect of both qualitative and quantitative studies and assist in understanding relationships between variables. Brazil, Ozer, Cloutier, Levine, & Stryer (2005) propose that the use of theory in research can encourage interdisciplinary collaboration and adoption of results into practice. Johnson, et al. (2017) utilized Bandura’s social cognitive theory to guide interventions. Beetz (2017) proposes that psychological theories such as biophilia, anthropomorphism, and motivation support AAI. The activation of oxytocin, a neurobiological theory, can be used to support the mutual positive effects of AAI. Bowlby’s attachment theory can be used to explain the human animal relationship and the need for a safe haven and a secure base, which helps
individuals explore their environment (Beetz, 2017). Consideration should be given to using an interview for data collection so that probing questions could be asked, which could add to the richness of the data. Detailed descriptions of methods, reason for participant attrition or refusal to participate, optimal animal characteristics, report of adverse events, definition of optimal animal characteristics, therapy intensity, and degree of animal involvement in AAT need to be studied. Inclusion of program costs for AAT as well as cost effectiveness of the intervention could help contribute to policy development. Finally, the health and welfare of the animals used for AAT need to be considered and included in all research proposals.

**Conclusion**

Findings of this dissertation support the use of AAI for Veterans with PTSD. AAI can be a viable alternative to traditional treatments such as Cognitive Behavior Therapy (CBT), Eye Movement Desensitization and Reprocessing (EMDR), and Prolonged Exposure (PE), which Veterans may find intimidating, difficult to access, or too clinical. Using animals such as pinnipeds, canines, and equines in a more natural, safe setting may encourage more Veterans to seek and complete therapy for their PTSD. Additional research on AAI for Veterans with PTSD will only continue to strengthen the support for such therapies and hopefully lead to policy development and reform.
References


Proops, L., Grounds, K., Smith, A. V. & McComb, K. Animals remember previous facial expressions that specific humans have exhibited. *Current Biology, 28*, 1428-1432. doi: 10.1016/j.cub.2018.03.035


## Appendix A

### MU IRB Approval

**IRB #2039567 MU**

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<td>Wakefield, Bonnie Jean</td>
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<tr>
<td>Project title</td>
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November 17, 2020

To [email]

Subject: IRB Determination Notice Project #2039567 Review #287789

Project #2039567
Project Title: Stress Levels in Veterans with PTSD and Equines during Therapeutic Horseback Riding
Principal Investigator: Bonnie Jean Wakefield
Primary Contact: Michele Butkiewicz (MU-Student)

Dear Investigator,

The MU Institutional Review Board reviewed your application and supportive documents. It has been determined that this project does not constitute human subjects research according to the Department of Health and Human Services regulatory definitions. As such, there are no further IRB requirements.

If you have questions, please feel free to contact the MU IRB office at 573-882-3181 or email at muresearchirb@missouri.edu.

Sincerely,

MU Institutional Review Board
Appendix B

ACOS IRB Approval

DEPARTMENT OF VETERANS AFFAIRS
Harry S. Truman Memorial VA Hospital Research and Development Committee
Harry S. Truman Memorial VA Hospital

Date: March 2, 2022
From: ACOS/R&D and R&D Committee
TO: Bonnie Wakefield, PhD
Protocol Title: [1601737-1] Stress Levels in Veterans with PTSD and Equines During Therapeutic Horseback Riding
Submission Type: New Project
Review Type: Full Committee Review
Action: APPROVED
Effective Date: February 16, 2022
Subject: Combined Associate Chief of Staff for Research and Development (ACOS/R&D) and R&D Committee Study Approval Notice

1. This research project was reviewed and found to be aligned with the mission of the VHA, scientifically valid, and reviewed by all appropriate subcommittees to ensure the safety of the study subjects and VHA staff. Approval was granted by Convened Board Review of the Harry S. Truman Memorial VA Hospital Research and Development Committee on February 16, 2022.

2. This research project has obtained the following additional approvals
   a. Subcommittee on Research Safety and Security Approval: 02/10/2022
   b. Institutional Review Board Approval: 11/9/2021
      i. Exempt Determination with Limited IRB Review conducted on: 11/09/2021

3. If applicable, the Privacy Officer reviewed this research project on 03/01/2022 and found that the proposed research complies with VA Privacy Requirements.

4. The Information Security and Safety Officer reviewed this research project on 02/11/2022 and found that the research project complies with information safety and security requirements for VA.

5. A waiver of HIPAA authorization was approved on 01/24/2022.

6. You are responsible to your overseeing committee for any requests for information, continuing review (if required), or other project status updates. No changes may be made to your project without the permission of the reviewing subcommittee unless there is a circumstance where harm could come to a research subject. Immediate reporting to the responsible committee is then required.
   a. The period of approval for this project is from the date of this letter until the date of expiration set by the applicable R&D subcommittee or oversight committee(s). Please refer to the
Appendix B, continued.

subcommittee/oversight committee letter(s) for continuing review requirements and the date(s) of expiration. Please be reminded that Continuing Review (if applicable) is required by the appropriate oversight committee(s) prior to the expiration of approval.

7. If any of your personal or financial situations change that may reasonably put you in conflict with this study, you must submit a revised OGE 450 Alt to your local conflict of interest administrator.

8. Acknowledgment of the VA's contribution is required in any publications and presentations that may result from this research.

9. If at some point in the study the PI needs to expand the study population to include non-Veterans, the PI must inform the R&D Committee.

10. As all applicable approvals have been obtained, you may now begin your research project.

Chandrasekar Bysani
Digitally signed by Chandrasekar

Date: 2022.04.06 07:38:38 -05'00'

Associated Chief of Staff for Research and Development (ACOS/R&D)
Appendix C

ACOS Study Initiation Notice

DEPARTMENT OF VETERANS AFFAIRS
Harry S. Truman Memorial VA Hospital Research and Development Committee
Harry S. Truman Memorial VA Hospital

Date: March 2, 2022
From: ACOS/R&D
TO: Bonnie Wakefield, PhD
Protocol Title: [1601737-1] Stress Levels in Veterans with PTSD and Equines During Therapeutic Horseback Riding
Action: Associate Chief of Staff for Research and Development (ACOS/R&D) Study Initiation Notice

1. This research project was reviewed and found to be aligned with the mission of the VHA, scientifically valid, and reviewed by all appropriate subcommittees to ensure the safety of the study subjects and VHA staff. Approval was granted by Convened Board Review of the Harry S. Truman Memorial VA Hospital Research and Development Committee on February 16, 2022.

2. You are responsible to your overseeing committee for any requests for information, continuing review (if required), or other project status updates. No changes may be made to your project without the permission of the reviewing subcommittee or committee unless there is a circumstance where harm could come to a research subject. Immediate reporting to the responsible committee is then required. Reportable events involving risks to subjects and others, noncompliance, suspensions and terminations, or other incidents requiring reporting must be reported to responsible oversight committee in accordance with VHA Handbook 1085.01, Research Compliance Reporting Requirements.

3. If any of your personal or financial situations change that may reasonably put you in conflict with this study, you must submit a revised OGE 450 Alt to your local conflict of interest administrator.

4. Acknowledgment of the VA’s contribution is required in any publications and presentations that may result from this research.

5. If at some point in the study the PI needs to expand the study population to include non-Veterans, the PI must inform the R&D Committee.

6. As all applicable approvals have been obtained, you may now begin your research project.

Chandrasekar Bysani
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Associated Chief of Staff for Research and Development (ACOS/R&D)
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Michele L. Butkiewicz

Michele L. Butkiewicz was born in St. Louis, MO. During her childhood, she lived in New York, Pennsylvania, Minnesota, and Arizona before returning to St. Louis in 1975. Michele graduated from Pattonville High School in Maryland Heights, MO, where she enjoyed being a member of the band, jazz band, and drill team. A BSN was obtained in 1992 from Saint Louis University, after which she worked at Cardinal Glennon Children’s Hospital in the NICU as a staff nurse and transport nurse. In 1997, she earned her MSN from Saint Louis University with a focus on Clinical Nurse Specialist, Perinatal Nursing. Michele has practiced nursing in Missouri, Idaho, and Wisconsin. She resides in St. Louis, MO.

Michele is a member of the Association for Nursing Professional Development, Human Animal Bond Research Institute, International Society for Anthrozoology, Midwest Nursing Research Society, and Sigma Nursing Honor Society

Presentations and Publications


*Animal assisted interventions in military personnel with post-traumatic stress disorder: A systematic review* [manuscript in preparation]. Sinclair School of Nursing, University of Missouri, Columbia.


*Relationship of Veteran PTSD Severity and equine cortisol levels and stress*
behaviors during therapeutic horseback riding [manuscript in preparation].

Sinclair School of Nursing, University of Missouri, Columbia.


MNRS 2020 Poster Session (accepted) – Stress Reduction in Veterans with PTSD – ‘The Horse Made All the Difference’

MNRS 2019 Poster Session – Animal Assisted Intervention for Posttraumatic Stress Disorder: A Systematic Review

Sigma 2019 Poster Session – Theoretical Frameworks for Human Animal Interaction Studies

Awards and Recognitions

Mercy Hero Award for work on prevention of ventilator associated pneumonia

March of Dimes Nurse of the Year, Quality (nominated)