

Farm Animal Assisted Therapy Intervention with Ducks
for Persons with Traumatic Brain Injury

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Dedication

This dissertation is dedicated to my husband Shannon. Thank you for being the wind beneath my wings!

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Abstract

Interaction with animals may offer numerous benefits for human health. In addition to benefits for physical health, Animal Assisted Therapies (AAT) interactions are beneficial for mental health. In particular, animal interactions may offer improvement in patients with depression and anxiety. While the majority of AAT research focuses on pets, animal assisted therapies with farm animals (AATF) also have been found to be beneficial.

AATF is a component of the Green Care therapeutic approach. Green Care is described as a cluster of nature-based therapeutic interventions to promote health in humans. AATF like AAT has undeniable benefits for people who suffer from mental health disorders. In the past, most AATF interventions utilized livestock animals like cows, pigs, sheep, and goats. Current research involved planning and creation of a duck-based AATF clinical intervention for persons with traumatic brain injury (TBI) based upon Bandura's Self-Efficacy Theory.

The intervention included participants' interaction with ducks for twelve weeks, twice a week for one hour. Participants engaged in handling, feeding, watering, herding, petting, and hand feeding the ducks. Participants completed HADS and GSE questionnaires to evaluate anxiety, depression and self-efficacy at baseline, at the conclusion of the 12-week intervention, and again four weeks later. The data analysis revealed that there was a decrease in participant's anxiety level immediately after the intervention. Meanwhile, there were no statistically significant changes in depression or self-efficacy levels. This intervention was accepted very well by the participants; the overwhelming majority of the participants shared that working with ducks made them happy.

Qualitative data were collected via interviews. PI conducted ten interviews with the participants. During these interviews the participants were asked about their experiences of

working with ducks, likes and dislikes when interacting with ducks, and how working with ducks made them feel. The interviews were transcribed and deidentified, transcripts will be analyzed for common themes. The analysis of these data will be reported separately at a later time.

The current research findings may have further implications for practice, education, research and policy development. Benefits of the current research may translate into improvement of rehabilitation activities for the persons with TBI.

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Chapter I: Introduction

Patients with Traumatic Brain Injury (TBI) may present with depression, anxiety, and a decline in self-efficacy (Belanger et al., 2020; Plourde et al., 2019; Zelencich et al., 2020).

Animal Assisted Therapy (AAT) has been shown to improve communication skills, interaction, arousal, and concentration in patients with mild to severe TBI (Gocheva et al., 2018; Hediger, Petignat, et al., 2019; Hediger, Thommen, et al., 2019). While Animal Assisted Therapy with Farm Animals (AATF) interventions have been shown to be beneficial for patients with a variety of psychiatric illnesses (Berget et al., 2011; Pedersen et al., 2012), we found no published study examining AATF in patients with TBI. One may theorize that because AAT has benefits for patients with TBI, the AATF based interventions may be beneficial for these patients.

Several studies in patients with TBI revealed the positive effect of AAT on emotional state (Hediger, Petignat, et al., 2019; Hediger, Thommen, et al., 2019; Theis et al., 2020). Hediger and colleagues (2019) suggested that AAT for patients with TBI may result in improved social skills and an increase in the number of occurrences of social behavior. These studies did not directly evaluate depression or depressive states, however negative emotional state may be related to depression (Maalouf et al., 2012). Depression is relatively common in patients with TBI. Approximately 30% - 50% of patients with TBI may develop a mental health related illness, including depression (Juengst et al., 2017). People who experienced TBI may have a significantly higher rate of being diagnosed with depression (26%) compared to the general population (8%) (Koponen et al., 2002).

While drawing parallels between AATF and AAT in patients with TBI, one may focus on improvement in emotional state and social behaviors. Several studies suggested that AATF may result in improvement in depressive symptoms, mood, and social skills (B. Berget et al., 2008; Berget et al., 2011; Mallon, 1994; Pedersen et al., 2012). Pedersen and colleagues (Pedersen et

al., 2012) came to the conclusion that AATF may lead to improvement of self-efficacy in patients with clinical depression. While the population of people who have a history of TBI has not been studied in the AATF context, because of the similarities between the outcomes of both therapeutic approaches, one may say that AATF may have benefits for patients with TBI. Please see the attached systematic review accepted for publication in “Creative Nursing” for more background details on AATF.

The Aim and Hypotheses

The aim of this study was to examine the effects of Animal Assisted Therapies with Farm Animals (AATF) with domesticated ducks on depression, anxiety, and self-efficacy.

Furthermore, the following hypotheses were tested:

Engaging in AATF with domesticated ducks will be associated with a decrease in depression.

Engaging in AATF with domesticated ducks will be associated with a decrease in anxiety.

Engaging in AATF with domesticated ducks will be associated with an increase in self-efficacy.

Approach - Theoretical Framework

Bandura’s Self-Efficacy Theory will be used to guide this research examining AATF effects on anxiety and depression in patients with TBI. Please refer to Chapter II, Chapter IV, and Chapter V of this dissertation for the details of utilization of Self-Efficacy theory in this research. Salutogenesis, Social Support, and Self-Efficacy theories were compared in order to select the best theoretical framework for this study. Below is a brief reasoning for rejection of the competing theories in favor of Self-Efficacy theory.

Salutogenesis is the opposite of Pathogenesis, the former essentially encompassing a notion of health preservation vs. disease progression (d'Alessio, 2019; Suominen & Lindstrom, 2008). The cornerstone of salutogenesis theory is the concept that life experiences govern a sense of coherence (SOC) (Bauer et al., 2020). One of the postulates of salutogenesis theory proclaims that the utilization of available salutogenic factors (resources) may lead to movement toward the health end of the continuum. For a person with TBI it may be difficult or impossible to utilize the available salutogenic factors and achieve a high SOC. Because of the limitations in cognition and the ability to utilize resources independently in people with TBI, the achievement of a high SOC state is debatable. Social Support theory also was considered as a theoretical foundation for this research. John Cassel (1974) theorized that social support may be beneficial to human health because social support may protect from stress. The concept of social support may be defined as an interpersonal process that is focused on the mutual exchange of information and is context specific (Finfgeld-Connett, 2005). The measurement of the received social support provided by animals in AATF (independent variable) may be challenging. The tools utilized for measuring social support are mostly based on self-reporting and have not been extensively validated (Peterson & Bredow, 2020). Unvalidated self-reporting-based tools may convey bias and may have low reliability (Baumeister et al., 2007). Depending on the degree of the initial injury, some people with TBI may have difficulty working with self-reporting-based tools because of the cognitive ability or physical limitations (Sunwoo et al., 2012). Because of its prior utilization in AATF research and, more importantly, its good fit with the goals of the current study, Bandura's Self-Efficacy Theory was chosen to guide the development of the study to evaluate AATF based interventions for patients with TBI.

Study Design

We utilized Time series Quasi-experimental design for this research. Because of the unique characteristics of the patient population (all patients have history of TBI) at the study site no other rehabilitation center within reasonable distance could be utilized for control and comparison. Two group comparison was also not applicable in this situation. While it was possible to split participants into two groups, control group participants may feel left out and disadvantaged because they did not have a chance to interact with the animals. We considered Switching Replications Design. In that design, the participants are randomly assigned to control and experimental groups. The experimental group is exposed to AATF, while the control group receives conventional treatments. In this design modality the control and experimental groups switch roles after the experimental group completes the AAFT activities. This design strategy was not applicable to this research because both control groups would receive unequal amounts of conventional treatment prior to the beginning of the AAFT. Participants in the first control group (second therapy group) would receive approximately double of the conventional treatments when they finish the AAFT intervention compared to the second control group (first therapy group). Time series design ensured that all of the participants were exposed to the therapeutic intervention, and the outcome was not affected by the conventional treatments the participants were receiving.

Survey and Study Measures

We utilized the Hospital Anxiety and Depression Scale (HADS) and the Generalized Self-Efficacy (GSE) scale in this study. The HADS scale was designed in 1983 for the evaluation of severity of anxiety and depression symptoms (Zigmond & Snaith, 1983). In clinical practice it is widely utilized as a screening tool, however it is not used for establishing a

final diagnosis of depression or anxiety (Wu et al., 2021). HADS is one of most commonly used tools to evaluate anxiety in persons with TBI (Osborn et al., 2016). The HADS scale has only 14 items. Seven items in HADS are focusing on anxiety related symptoms, while the remaining seven items are focusing on depressive symptoms (Zigmond & Snaith, 1983). It has been suggested that HADS depression evaluation components have high specificity and sensitivity to diagnose depressive disorders (Stern, 2014; Wu et al., 2021). While it is a single questionnaire, anxiety and depression scores are calculated separately (Abbasian et al., 2019). Multiple studies utilized the scale to evaluate symptoms of depression and anxiety over time (Craig et al., 2019; Lee et al., 2017; Poole et al., 2013). In one study, concurrent administration of HADS and DASS scales over three time points showed significant correlation between the two scales (Kumar et al., 2018). GSE scale (Schwarzer, 1993; Schwarzer & Jerusalem, 1995) has been utilized both in research focusing on TBI and AATF (Bente Berget et al., 2008; Brands et al., 2015; Hawley et al., 2022), to evaluate how AATF affected self-efficacy in persons with TBI. GSE is a 10 item Likert-type questionnaire.

We anticipated several limitations for this research endeavor when we were at the conceptualization stage. These limitations are discussed in details in Chapter IV of this dissertation.

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Chapter II: Animal-Assisted Green Care Farming for Patients with Mental and Physical Disorders: A Narrative Review

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Abstract

Green care is an umbrella term that includes numerous therapeutic interventions that immerse the patient into nature and natural environments. Animal-assisted therapy (AAT) with farm animals is a component of green care that may benefit patients with mental health disorders. While the majority of research exploring farm animal-assisted therapies originated in Europe, interest in this therapeutic intervention is emerging in the US. While there are green care farms utilizing animal therapies in the US, these therapeutic interventions have not been reported in the scientific literature. Further exploration of this topic in the US may benefit various patient populations and contribute to overall better health care. A literature review found that farm animal-assisted therapies may be beneficial for patients with mental health disorders, but did not reveal any studies addressing AAT with farm animals in the context of physical health disorders. This may be a desirable direction for future research.

Key words: Mental Health; Nursing; Green Care; Animal-Assisted Therapy; Animal-Assisted Therapy with Farm Animals; Nature-Based Therapy; Nature-Assisted Therapy

Introduction

Green Care is described as the immersion of a patient into nature and the natural environment, exposing patients to a therapeutic setting that may help recovery and healing (Berget et al., 2010). Since prehistoric times humans have associated themselves with nature, as part of a social-ecological system (Liu, 2007). Kellert and Wilson's Biophilia hypothesis (1993) suggested that the connection between humans and other life forms may be related to the inherent desire of humans to connect with nature.

Green Care-based interventions may promote health in patients who suffer from a variety of mental and physical disorders (Berget et al., 2010). Green Care may include care farming, therapeutic horticulture, wilderness therapy, ecotherapy, and facilitated green exercise (Berget et al., 2010). In addition to these interventions, animal-assisted therapy (AAT) with farm animals (AATF) is considered a significant component of green care (Bokkers, 2006). Multiple studies suggested that AAT is beneficial for patients in traditional health-care or rehabilitation settings (Haubenhof et al., 2010; Pedersen, Ihlebæk, et al., 2012; Silke Scholl et al., 2008), and may benefit patients who suffer from both mental and physical health-related disorders (Beetz et al., 2012).

Even pet companionship may have benefits for the patients. In an early animal therapy-related study, 28% of patients who did not own a dog or a cat died within one year after a myocardial infarction, while only 5.7% of pet owners did not survive to the one-year mark (Friedmann et al., 1980). The use of AAT in pediatric patients was associated with improvement in wellbeing in the inpatient setting (Lindström Nilsson et al., 2020). Overall, AAT may have benefits for patients who suffer from both mental and physical health-related illnesses (Beetz et al., 2012).

At the end of the 20th century, green care farming became a widely accepted therapeutic intervention in a number of European countries to promote health and wellbeing. The United Kingdom had 170 green care farms in 2011 (Leck et al., 2014) while the Netherlands had 591 farms in 2005 (Hassink et al., 2007; Leck et al., 2014). While sporadic online sources about green care farming in the US are available, it was not possible to retrieve data regarding the exact number of green care farms in the US through either database or internet-based searches. The dearth of sources about green care farming in the US may imply that that green care farming is not as widespread as in European countries.

While the dearth of reports of green care activities is a reality in the US, hippotherapy (therapy using horses) is visible and available in most of the regions of the country where climate and terrain allow equine-related recreational activities, and is one of the most developed and researched domains of green care. The American Hippotherapy Association (AHA) was established in 1992 and has developed standards and curricula for hippotherapy (American Hippotherapy Association, 2021). Currently, 304 hippotherapists are listed on the AHA website, and they provide services in most U.S. states.

Review Question

Is farm animal-assisted green care beneficial for patients who suffer from mental or physical disorders?

Design and Literature Search

We conducted a narrative review of existing scientific literature on green care therapies involving farm animals. The topic of AATF is not well researched and there is no large body of literature that examines this arena of therapeutic interventions with animals. Because of that the authors elected to proceed with a narrative review format, preferring it to a systematic review.

The search was conducted in three electronic databases: PubMed, Cumulative Index to Nursing & Allied Health (CINAHL), and PsycINFO. The following free text search terms were utilized: “green care,” “farm animal-assisted,” “nature-based therapy,” “nature-assisted therapy,” and “working in nature.” Because green care is not a common therapeutic intervention, all articles were reviewed regardless of publication date. The search included original studies from scientific literature, English language publications, and studies that discussed use of farm animals in therapeutic interventions.

Studies exploring other domains of green care (such as horticulture, wilderness therapy, nature-based rehabilitation, care farming, and hippotherapy) were excluded. One reason for excluding hippotherapy from our search, in addition to its already strong presence in the literature, was the fact that horses have lost the status of traditional working farm animals. For many centuries horses were considered working farm animals, an integral part of land cultivation, transportation, and agricultural trade; this changed in the mid-20th century, when horses were rapidly replaced by machinery. Currently horses are used mostly for recreational activities and sporting events (Vial & Evans, 2015).

Data Analysis and Extraction

The initial search yielded 61 articles. Following the application of the above inclusion and exclusion criteria, nine articles remained. 52 articles were excluded because they were focused on AAT in general, horticulture as therapy, hippotherapy, and wilderness-based therapies. Three of the selected studies were qualitative exploratory studies, two were randomized controlled studies, one was a pretest-posttest quasi-experimental study, two were mixed-methods studies, and one was a descriptive correlational study. Eight studies were conducted in Western Europe and two in the US. All studies discussed the benefits of AATF for

patients with a primary diagnosis related to mental disorders. There were no studies focusing on AATF for patients who suffer from physical disorders.

Data Synthesis

Animal-Assisted Therapy with Farm Animals for Patients with Mental Disorders

Berget and colleagues (2007) conducted a pretest/posttest quasi-experimental study describing the activities of 90 participants at one of 15 farms (10 with dairy cows and five with dairy cows, meat cattle, sheep, or horses) for three hours twice a week for 12 weeks. Patients presented with mental health disorders including schizophrenia; substance abuse; and personality, somatoform, affective, and behavioral disorders. The intervention consisted of feeding, milking, moving, and cleaning farm animals. Sixty participants were randomly assigned to an experimental group and 30 to a control group. Both groups received traditional therapies; participants in the experimental group also worked with animals, and were videotaped interacting with the animals at weeks 1 and 12. Recordings of 35 members of the experimental group who completed both video sessions were scored for proximity to the animal, and intensity and exactness of the work, compared to the performance of an average stockperson. Those 35 participants had statistically significant increases in intensity (0.26 ± 0.05 , $p < .0001$) and exactness (0.31 ± 0.06 , $p < .0001$) from week 1 to week 12. The authors did not report findings for the control group.

In 2011, Berget and colleagues conducted a secondary analysis of data from their prior work (2007), evaluating the effect of AATF on depression and anxiety, measured by the Beck Depression Inventory (BDI) and Spielberger State Anxiety Inventory (STAI) at weeks 1, 12, and 24. Differences in means between time points in experimental and control groups were examined via matched-paired *t*-tests. Anxiety scores did not differ significantly in either those in the

experimental group or the control group from week 1 to 12. However, those in the experimental group demonstrated a significant reduction in anxiety scores at week 24 ($p = .004$) as compared with baseline ($p = .002$). There were no significant differences in depression scores between weeks 1 and 12 in the experimental group, and no significant differences in depression scores between the two groups.

Pedersen, Martinsen, and colleagues (2012) conducted a randomized control study of the effects of AATF with 29 persons suffering from clinical depression as measured by the BDI. In addition to usual care, randomly assigned experimental participants ($n = 16$) worked with dairy cows twice a week for 1.5 – 3 hours for 12 weeks, grooming, feeding, and milking the cows and caring for calves. Participants in the control group received usual care only. Both groups completed the BDI at the beginning of the intervention, at 4 and 8 weeks, at the end of the 12-week intervention period, and 3 months post-intervention. The experimental group demonstrated statistically significant decreases in mean BDI scores ($p = .003$) as well as statistically significant increases in mean General Self-Efficacy (GSE) scores ($p = .045$) between the beginning and the end of the intervention.

A phenomenological study addressed benefits of farm animal-assisted therapies for persons with clinical depression, suggesting that working with farm animals may improve coping skills in this group (Pedersen, Ihlebæk, et al., 2012). The sample consisted of eight participants with clinical depression (confirmed via Mini-International Neuropsychiatric Interview and/or the BDI) who cared for dairy cows on six dairy farms twice a week for 12 weeks. Participants were involved in grooming, feeding, and milking the cows, and caring for the calves; the authors did not mention the amount of time spent with animals at each visit. An individual thematic structured interview lasting between 16 and 51 minutes was conducted with each participant.

Malterud's (2001) systematic text condensation method was used for interview analysis, in which extracted subthemes are abstracted into new main concept themes, thus giving deeper insight into the topic. Four themes emerged: "Ordinary life," "Being sick," "Flexibility," and "Coping." The "Ordinary life" theme is especially notable: participants regarded their experiences with AATF as an opportunity to immerse themselves in the "Ordinary life" domain, something they do not experience often because of their health status. Participants also mentioned that engagement in AATF was a distraction from the notion of "Being sick."

Some may disagree and say that an ordinary life may present with routine and boredom, but for a person suffering from clinical depression a return to ordinary life may signify a path to recovery. Interacting with animals may also contribute to the creation of a safe environment. Children in one study valued the experience with farm animals because the animals will not be sharing children's conversations with others (Mallon, 1994). It was mentioned in several studies that interaction with animals may improve social skills. Animals may serve as a "social lubricant" and facilitate interaction between humans (Hunt et al., 1992).

A study conducted in the US focused on experiences of patients with autism spectrum disorders while interacting with farm animals (Barnhart, 2020). Overall, the interaction with the animals helped to improve socialization skills and self-esteem of the patients. On the other hand, the inclusion of numerous species of animals in this study makes it difficult to understand which species contributed to the improvement in socialization and self-esteem. The study may lack fidelity to generalize the findings to the farm animal assisted care arena.

This review included the only study addressing effects of AATF for persons with disabilities dwelling in a residential facility (Silke Scholl et al., 2008). In this mixed-methods study, ten disabled deaf persons with unspecified mental health diagnoses provided daily care for

goats for three months with the help of a local farmer. After 3 months the goats were relocated to a nearby farm for the winter, and participants visited them once a week for one hour for an additional three months, engaging in petting, brushing, playing, and feeding. Interactions with goats were videotaped at 11 time points over the three-month period. For comparison, participants were also videotaped at their leisure time (without goats) on the same days. Researchers established 26 behavioral parameters for quantitative analysis including attentiveness, withdrawal, tactile contact, disengagement, and expression of joy, among others. Four parameters changed over the 11 timepoints: Attentiveness, expressions of joy, and tactile contact increased significantly, while disengagement decreased significantly: attentiveness (leisure: $\chi^2 = 36.23$ $p < .001$; goats: $\chi^2 = 22.02$ $p = .009$), expression of joy (leisure: $\chi^2 = 26.53$ $p = .002$; goats: $\chi^2 = 46.44$ $p < .001$), disengagement (leisure: $\chi^2 = 36.54$ $p < .001$; goats: $\chi^2 = 26.62$ $p = .002$), and tactile contact (leisure: $\chi^2 = 7.53$ $p \leq .05$; goats: $\chi^2 = 26.88$ $p = .001$). Common themes relevant to the participants' experiences with goats were extracted from qualitative observations and staff reports, including "increase in expression of joy," "increase in initiative," and "overcoming fear."

Attitudes Toward Animal-Assisted Care Farming

Farmers play an integral role in providing green care therapies in general, and animal-assisted care farming in particular. Hassink (2005) explored attitudes of 20 Dutch farmers toward animal-assisted care farming. Instead of further industrializing farm activities and endangering animal welfare, these farmers elected to engage patients with mental health disorders through a process recognized in The Netherlands as *sheltered farming*. Data was collected in two-hour long semi-structured interviews, supplemented with field observations; the interview findings were validated by independent focus groups of farmers who had experience in AATF. The authors

reported that farmers recognized the importance of creating human-animal bonds while providing these therapies.

Berget et al. (2008) explored 60 health professionals' (mostly psychiatric nurses) and 15 dairy farmers' knowledge of green care therapies, experience with AATF, and attitudes toward AATF. While all the farmers and most ($n = 51$) of the health professionals were knowledgeable about green care therapies, very few ($n = 6$) had direct experience of AATF. Nevertheless, both groups recognized the benefits of AATF.

Discussion

As a group, the studies included in this review suggest that farm animal-assisted therapies may offer significant benefits for patients with a variety of mental health disorders. The benefits observed include an overall decrease in depressive symptoms and improvement in self-efficacy. In addition, farm animal-assisted therapies may bring a sense of “normalcy” to patients who suffer from depression and/or anxiety. Pedersen, Ihlebæk, et al. (2012) mentioned the emergence of the “ordinary life” theme; some people associate “ordinary life” with routine and boredom, but for a person suffering from clinical depression, a return to ordinary life may signify a path to recovery. Contact with animals may improve social interaction and communication skills in people with autism (Ávila-Álvarez et al., 2020; Hernández-Espeso et al., 2021). Animals may serve as a “social lubricant” to facilitate interaction between humans (Hunt et al., 1992).

Conclusion

These studies show that AATF is a valuable intervention that may contribute to improvement in initiative, attentiveness, and self-efficacy. At the same time, AATF may decrease severity of anxiety and depression symptoms. Several qualitative studies reflected overall positive experiences related to AATF for patients with mental disorders. The reviewed

studies also demonstrated variability of results depending on severity of initial symptoms. Future investigations should focus on increasing sample sizes, consistency of time spent in animal interactions, and robust description of qualitative data collection and analysis methods.

While there are multiple settings in the US that utilize AATF, the research in this area is still in its infancy. Whereas this literature review suggests that farm animal-assisted therapies may be beneficial for patients with mental disorder, this search did not reveal any studies addressing AATF in the context of physical disorders. This may be another desirable direction for future research.

Implications for Further Research

While an internet search may reveal the presence of Green Care farms utilizing animal-assisted therapies, the results of these offerings have not been reported in the scientific literature. This may signify a need for further exploration of this topic. Research focusing on AATF may benefit different patient populations and contribute to overall better health care.

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Chapter III: Putting the Ducks in a Row: Development of a Duck-assisted Green Care
Intervention for Persons with Traumatic Brain Injury

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Abstract

Green Care therapies are defined as the engagement of a patient with the nature, exposing patients to a nature based therapeutic setting that may facilitate their recovery. Such therapies became popular at the end of the twentieth century. This therapeutic approach may include therapeutic horticulture, nature therapies, care farming, facilitated exercise, and animal-assisted therapies with farm animals (AATF). This paper describes the processes of planning and creating an AATF-based clinical intervention wherein persons with TBI interacted with ducks (in twice weekly, one-hour groups) for 12 wk at a TBI rehabilitation facility. The discussion includes site identification, stakeholder engagement, intervention design and human and animal safety procedures. The research methods, theoretical framework, ethical consideration, and risk reduction strategies for human participants and ducks are discussed. Also, description of challenges and blueprints of possible solutions for other researchers interested in developing similar initiatives. This program will serve as a study site for examining effects of AATF-based interventions on self-efficacy, depression, and anxiety in persons with TBI. If the study suggests that AATF interventions with ducks may lead to positive changes, the proposed study will be followed with studies that include larger samples at multiple sites. Findings in this paper may contribute to the implementation science body of knowledge. Because of that, the information in this paper may benefit the researchers outside of the healthcare arena. From that perspective methods described in this paper may help to develop studies that focus on policy development, program expansion, or individual project implementation.

Keywords: Self-Efficacy, Anxiety, Depression, Traumatic Brain Injury, Animal Assisted Therapies, Animal Assisted Therapies with Farm Animals.

Putting the Ducks in A Row: Development of A Duck Assisted Green Care Intervention for Persons with Traumatic Brain Injury

Introduction

The end of twentieth century was marked by the introduction of Green Care based therapies for persons with variety of mental and physical illnesses (Berget et al., 2010). Green Care therapies are defined as the engagement of a patient with the nature, exposing patients to a nature-based therapeutic setting that may facilitate their recovery (Berget et al., 2010). Green care therapies include therapeutic horticulture (Sempik, 2010), nature therapies (Burns, 2018), care farming (Hassink et al., 2010), facilitated exercise in a nature setting (Pretty et al., 2006), and animal-assisted therapies with farm animals (AATF) such as horses, donkeys, dairy cows, sheep, goats, rabbits, and chickens (Bokkers, 2006; Hine et al. 2008; Scholl et al., 2008). In brief, AATF-based Green Care is consists of therapeutic interventions in which patients are immersed in a natural environment in order to care for domesticated farm animals (Berget et al., 2010). Several studies suggested that AATF may result in improvement in depressive symptoms, mood, and social skills in persons with substance use, schizophrenia, affective disorders, somatoform disorders, and personality disorders. (Berget et al., 2008, 2011; Mallon, 1994; Pedersen et al. 2012). AATF benefits include improvements in initiative, attentiveness, general self-efficacy, and self-esteem in persons with clinical depression, schizophrenia, substance abuse, personality, somatoform, affective, behavioral, and autism spectrum disorders (Barnhart et al., 2023; Berget et al., 2011; Pedersen et al., 2012). Pedersen and colleagues (Pedersen et al., 2012) concluded that AATF may lead to improvement of self-efficacy in patients with clinical depression. The reader is referred to Author (2023) for a detailed discussion of the history and benefits of AATF based Green Care.

Mental Health Issues Experienced by Persons with TBI

TBI results in a complex, often lifelong, recovery process secondary to the experienced structural and functional damage (Masel & DeWitt, 2010). Many individuals with TBI experience physical and neurophysiological disability including lasting neurobehavioral sequelae (Masel & DeWitt, 2010). Individuals who experience TBI are at increased risk of a number of mental health disorders, including anxiety and depression (Fleminger, 2008). Depression is relatively common in persons with TBI. Approximately 30% - 50% of persons with TBI may develop a mental health related illness (Juengst et al., 2017). Remarkably, depression is the most common mental health related diagnosis in persons with TBI (14%–77%) (Ahmed et al., 2017). People who experienced TBI have a significantly higher rate of being diagnosed with depression (26%) compared to the general population (8%) (Koponen et al., 2002). The second most common mental health related diagnosis in persons with TBI is generalized anxiety disorder (3%–28%) (Ahmed et al., 2017).

AAT in Persons with TBI

Traumatic Brain Injury (TBI) is associated with depression, anxiety, and low self-efficacy. (Belanger et al., 2020; Plourde et al., 2019; Zelencich et al., 2020). While these conditions have documented improvement after various (non-animal related) interventions (Belanger et al., 2020; Plourde et al., 2019; Zelencich et al., 2020), we found no published study examining AATF in persons with TBI. However, a small body of literature addresses the benefits of Animal Assisted Therapy (AAT) in this group. AAT is defined as interactive activities with animals leading to a therapeutic benefit for a human (Odendaal, 2000). Unlike animals involved in AATF, the animals in AAT lack the utility component: in contrast to farm animals with well-defined roles of food or other commodities production, domestic animals used in AAT

interventions are mainly pets. A few AAT animals perform utilitarian roles, for example, horses in transportation, dogs as guardians (Odendaal, 2000). Several AAT based studies produced statistically significant results in persons with TBI, suggesting improvement in communication skills, interaction, arousal, and concentration in those whose deficits ranged from mild to severe TBI (Gocheva et al., 2018; Hediger et al., 2019, 2019).

AAT may have a positive effect of on the emotional state of persons with TBI (Hediger et al., 2019; Theis et al., 2020). Hediger and colleagues (2019) suggested that AAT may result in statistically significant improvement in social behaviors (operationalized as the observed duration of verbal and non-verbal communication) in persons with TBI. Researchers also documented a statistically significant improvement in the mood using the multidimensional mood questionnaire (MDBF) after AAT with horses, donkeys, sheep, goats, miniature pigs, cats, chickens, rabbits and guinea pigs (Hediger et al., 2019).

Remarkably, Theis and the colleagues (2020) noted that positive emotions related to AAT experience may even improve episodic memory in persons with TBI. A sample of 8 persons with TBI were presented with photographs from a previous study conducted two years ago (Hediger et al., 2019). The photographs were depicting each individual participant in an AAT therapeutic session as well as the same participant in a control session with no animals present. Participants were asked which picture they remembered better. The results were statistically significant for better memory of events occurring in the photograph of the AAT session as compared to events in the non-AAT photo. Semi-structured interviews were also conducted. Qualitative thematic analysis identified the most common themes as: “Positive emotions regarding animals” and “Good memory of animals” (Theis et al. 2020, p. 5). Additionally, participants mentioned that their relationship with animals was based on trust.

Overall, the qualitative interviews revealed that participants believed that utilization of AAT resulted in positive outcomes and was beneficial for the participants themselves (Theis et al. 2020).

Taken together, these studies (all of which are non-blinded randomized trials) revealed an overall positive effect of AAT on behavioural (verbal communication) (Hediger et al., 2019) and psychological (arousal) outcomes in persons with TBI (Theis et al., 2020). The primary limitation of these studies is small sample sizes, the largest sample consisting of 19 participants (Hediger et al., 2019). While none of these studies (Hediger et al., 2019 ; Theis et al., 2020) directly evaluated depression or depressive states, increased social behaviour and enhanced positive emotions may contribute to the reduction of depressive symptoms in this group (Everaert et al., 2020; Müller et al., 2015). Although AATF differs from AAT in the ways discussed above, this small body of literature demonstrates the positive effects of animal interaction in persons with TBI.

One may hypothesize that because AAT demonstrated benefits for persons with TBI, the AATF based interventions may also be beneficial for these persons. While the effects of AATF have not been examined in people with a history of TBI, the demonstrated positive outcomes with AAT in those with TBI suggests we may expect similar improvements in persons with TBI after AATF interventions. To examine this hypothesis, our first step was the development of an AATF program initiative.

Purpose Statement

The purpose of this paper is to share the processes of planning and creating an AATF program initiative wherein persons with TBI interacted with ducks (in twice weekly, one-hour groups) for 12 weeks at a TBI rehabilitation facility. We will discuss research site identification, stakeholder

engagement, intervention design and human and animal safety procedures, providing a list of challenges and blueprints of possible solutions for other researchers interested in developing similar avian based therapeutic initiatives. At the time of writing this manuscript the design stage of this project was completed. The study site and necessary veterinary support for the ducks were secured. The approval from the respective review boards has been received.

Selection of Duck Breeds

We decided to use ducks as animals in this AATF study. There are several benefits to using ducks compared to animals traditionally used in AATF. Some persons with TBI may present with mobility limitations, however, ducks, because of their relatively small size, may not be as challenging to take care of as larger animals (cows, sheep, or goats). Even compared to other domesticated avian species, ducks may still have advantages because they are more docile and have friendlier temperaments than chicken or geese (Holderread, 2001). Compared to large livestock animals, ducks are much more affordable, and may present an economically feasible alternative for a facility when deciding on a type of AATF activities.

Several domesticated duck breeds were selected for this study. The selection of the ducks was based on temperament as well as on visually appealing characteristics. The ducks were purchased from licensed and certified commercial hatcheries at the age of 3 to 7 days old. The final selection of ducks included nine Call Ducks, one White Crested Duck, one Black Swedish , and one Rouen. Call Ducks are a bantam (miniature) breed, with a maximum weight of males at 700g and females at 550g, which makes them easy to handle. In addition to that, they are sociable, calm, and easily trainable. White Crested is a decorative breed, which is visually appealing because of the prominent crest on the head. Despite being a decorative breed, they lay sufficient number of eggs. Black Swedish and Rouen are larger duck breeds traditionally utilized

for egg production. (Holderread, 2001). All of the breeds described here have very docile temperaments and friendly dispositions. The researchers elected to utilize adult birds in this study instead of ducklings. While ducklings may be easier to handle, they are also more susceptible to illnesses, and may be subjected to an undue stress if handled excessively by humans (Cook, 2019; Holderread, 2001). In addition, the use of immature or juvenile animal species presents an additional challenge of interpreting research results, because changes related to the maturation process itself may present a variable that may affect our outcomes of interest (Baldrick, 2010; Guido et al., 2023). Before beginning the study, ducks were housed at a local farm; when they reached maturity they were transferred to the TBI rehabilitation facility.

Stakeholder Engagement

First, the PI contacted a member of the TBI rehabilitation facility board of directors to discuss the proposed project. The Board of directors member facilitated a meeting with facility staff to discuss the proposed project and answer questions. Staff were enthusiastic about adopting AATF at the facility, because “we always look for innovative ways to engage our clients” (Author, personal communication, August 12, 2022). The PI discussed potential benefits of AATF: decreased depression and anxiety, increased self-efficacy, and improvements in occupational functioning. The staff and clients sampled baked products made with duck eggs, since staff members planned to teach clients to use duck eggs in cooking and baking during occupational therapy classes. Staff members suggested that using nontraditional ingredients like duck eggs in occupational therapy classes may enhance clients rehabilitation. The proposed AATF study was met with overwhelming support from all levels of the organization. Board members, facility management, and staff members were enthusiastic about this innovative therapy program for the clients in the facility. Staff pointed out that the AATF project was well

aligned with the mission of the facility to enhance the quality of life of persons with TBI and maximize their potential.

Over the initial one-year period of gaining entrance, the PI participated in approximately three informational meetings with facility leadership and staff to discuss the project and potential benefits. In addition, the PI participated in a 5k run fundraiser organized by the facility, in which a therapy duck was carried during the race. The duck was warmly received, and the activity provided another opportunity to answer community members' questions about AATF. During the same time period the PI also participated in a Polynesian themed fundraiser for the facility, offering another chance to review AATF related benefits to financial donors and board members. Finally, the PI had six working meetings with the facility leadership and staff discussing benefits of AATF, AATF relevance to the needs of persons with TBI, as well as logistical details of having a small duck farm on the facility grounds. During these meetings the facility leadership and staff expressed their desire to support the study. In April of 2023, a formal study support letter was provided by the facility administration.

Procedural details

Theoretical Framework

The intervention was developed using concepts from Bandura's Self-Efficacy Theory. Self-efficacy theory also will guide the larger study examining AATF effects on anxiety and depression in persons with TBI. Self-efficacy may be defined as a person's belief as to whether they can successfully accomplish a task (Bandura, 1997). The theory postulates that individuals have greater motivation to engage in tasks they believe they can successfully accomplish (Bandura, 1997). Bandura's theory was successfully utilized in a number of studies with AATF that examined self-efficacy as an outcome (Berget et al., 2008b; Berget et al., 2011; Berget et al.,

2007). In one study, AATF activities with cows, sheep, horses, and poultry were introduced to persons with a variety of psychiatric disorders (n = 22 with depression) with a resultant statistically significant increase in self-efficacy as measured by the Generalized Self-Efficacy Scale (GSE) (Berget et al., 2008a).

Bandura theorized that self-efficacy may be influenced by mastery experience, vicarious experience, verbal persuasion, and somatic and emotional state (Bandura, 1997). The factors and their application to the project appear below:

- **Mastery experience.** Defined as successful performance of a task (Bandura, 1997). For this project, we designed the AATF intervention to provide didactic information, followed by supervised, hands-on practice over time, allowing participants to gradually develop their skills, and proceeding from simple tasks to complex ones. For instance, participants will begin with activities like filling feeding and watering pans, and progress to petting, holding and handfeeding the ducks, and finally, to collecting eggs.
- **Vicarious experience.** Defined as witnessing successful accomplishment of a task by others who are similar to the person observing (Bandura, 1997). The AATF intervention will be conducted in a group, to allow participants to observe other group members successfully perform various tasks. For instance, participants will observe others handfeeding the ducks, or collecting eggs .
- **Verbal persuasion.** Defined as receiving encouragement from others can increase person's self-efficacy in a specific situation and improve the ability to perform a task (Bandura, 1997). People who are verbally persuaded that they will be successful accomplishing a task, are more likely to complete it. During the duck interaction, staff will provide verbal persuasion. For example, staff will encourage participants to

handfeed the bird saying “you are holding your hand with feed just right for her (the duck), she is interested in what you have and will eat from your hand.”

- Somatic and emotional state. Defined as perceiving one’s physical and emotional reactions relative to a task performance (Bandura, 1997). Stress may lead to emotional arousal, which in turn may negatively affect perceived self-efficacy. Negative emotional states, like anxiety, may lead to reduced self-efficacy and to inability to perform the task (Bandura, 1997). Contrariwise, reduction of anxiety may foster success in the task and increase perception of self-efficacy. We designed the AATF interaction to be nonarousing and contribute to feelings of self-efficacy by providing calm and encouraging environment. Avian experts believe that simply watching ducks forage and swim reduces anxiety by fostering feelings of pleasure and relaxation (Holderread, 2001).

See figure 1 for details of specific study activities corresponding to each of the factors listed above.

Details of Group Activities

The literature review on AATF revealed that most studies were of 12-week duration; with two 1-hours sessions of animal interaction each week. (Authors, 2023). This study follows a similar timeline. Details of activities during the 12-week study period include:

Weeks 1-4.

During weeks 1-4, (total of 8 one-hour-long groups), the first 15 minutes of each group will be devoted to a discussion of duck behavior, safely handling the ducks, feeding procedures, and participant and duck safety measures. Participants will learn how to approach animals (move slowly, speak gently) and what treats ducks like (corn, peas, strawberries, watermelon, and bread products in moderation). Participants also will practice hand-washing techniques and

learn basics of protecting themselves and ducks from potential transmission of infectious diseases (do not enter duck pen if showing symptoms of illness). Handwashing will be demonstrated by study staff first; with suggestions and tips given to improve participant handwashing technique during return demonstration. Also, participants will learn about safe handling of the animals, so the ducks will not get injured and they will not accidentally be injured by the birds. It will be emphasized, that moving slowly and without making rapid movements will help the ducks to recognize participants as caregivers. Rapid and unpredictable movements may frighten the ducks because they are associated with predators in the wild.

After the above activities and discussion and having their questions answered, participants will observe the ducks for a few minutes before directly interacting with them. During the observation period, researchers will draw participant attention to **safe handling of the ducks, feeding behavior, drinking water, swimming, and movements of the ducks in the pen**. The observation period will decrease and interaction period will increase at each group according to participant comfort level. Following the initial session, each session thereafter will begin with a review to reinforce the educational content on duck and participant safety measures, including safe handling and feeding the birds, as well as handwashing techniques.

During weeks 2-4, participants will gradually increase hands on activities . For example, based on participant comfort level and physical ability, they might progress from filling the feed pans with assistance from staff during weeks 1 and 2, to more complex tasks of pan feeding, herding, and collecting eggs, (if eggs laid) independently. Researchers will provide encouragement and guidance to all participants during all sessions following self-efficacy principles (Figure 2).

Weeks 5-8.

Each session (total of 8 one-hour long groups) will begin with a review of safety information about duck and participant safety measures. While incorporating the knowledge and experience gained previously, participants will master new skills of holding, petting, and hand feeding the ducks during weeks 5-8. When carrying the ducks, participants will be encouraged to hold the duck under one arm and provide support in the breastbone area with the other hand. This technique will be demonstrated by study staff before being attempted by participants. When participants hold/ handle the ducks, study staff will provide suggestions, tips and encouragement. Participants will be instructed to hold the duck facing the same direction as themselves (with the duck's vent pointing backward). This technique will minimize the likelihood of the duck's elimination soiling the participant, since unlike mammals, ducks lack voluntary bowel control.

When handfeeding and giving treats to the ducks participants will be encouraged to hold their fingers together and let the duck pick the feed from the palm. This technique will be demonstrated by study staff first; when participants feed the ducks, study staff will provide suggestions, tips and encouragement. This technique is also safer for participants; if the participants spread the fingers, the ducks may consider a finger as a treat and try to nibble it. Researchers will demonstrate each new activity the first time, then provide suggestions and tips to improve participant technique during a return demonstration. Researchers will provide encouragement and guidance to all participants during all sessions following self-efficacy principles (Figure 2).

Weeks 9-12.

Each session (total of 8 one-hour long groups) will begin with a review of safety information about duck and participant safety measures. During weeks 9-12, participants will continue mastering the skills from previous weeks and engage in more advanced tasks if desired.

In addition to advanced skills of petting and handfeeding, participants will learn more about ducks' behaviors and lifecycle: differentiate females from males, concept of broodiness, flying and swimming abilities, molting, raising ducklings (if available), signs of stress, and signs of disease. Research staff will be available to demonstrate the advanced skills and monitor the skill performance. Research staff will continue to provide encouragement and guidance based on the training they received prior to the beginning of the study (staff training is discussed below) and following self-efficacy principles (Figure 2).

Housing and Care for Ducks

A triplex duck run was built to house the ducks. A triplex duck run is an ideal approach for housing the ducks because it provides sufficient containment of the ducks, protection from the elements, and deters predators (Holderread, 2001). The triplex run consists of an 80 square foot hardwood shed attached to a 160 square foot aviary type enclosure. An electric fence provides an external perimeter to 1600 square feet of grass covered paddock. The ducks freely move between three sections of the run during the day, and spend the night in the locked shed section. Contrary to popular belief, a large body of water is not necessary for domestic ducks to thrive. As long as there is a sufficient water depth for the ducks to rinse their bills and eyes it will meet their water requirements. A 4-6 foot diameter children play pool was installed in the pen for this purpose, as well as for swimming. While the ducks will be provided regular 16% poultry feed, they also will enjoy eating mealworms, peas, watermelon, strawberries, corn, and other fruit and berries. These are considered treats and will not be given in excessive amounts (Holderread, 2001).

Risk Management

Research demonstrates that working with live animals may have gratifying effects in humans and yield potential benefits for physical and mental health (Muñoz Lasa et al., 2015). Nevertheless, contact with animals is not without risk. Furthermore, animals involved in any study are vulnerable to the effects of the environment, interventions introduced, and contact with participants. Researchers identified steps to minimize risks both to human participants and animals in this study.

Risk for Ducks

The ducks were procured from a certified hatchery and guaranteed by the hatchery to be disease free. In the unlikely event one of the birds develops signs and symptoms of a disease, such as coccidiosis (a protozoal gastrointestinal illness), lameness, or injury staff will notify the study veterinarian by phone. Precautions (handwashing, education, safe handling) will be taken to reduce or eliminate infectious disease transmission both from humans and from wildlife. Because the birds will be housed in a free-range open-air environment the risk of acquiring a zoonotic disease (salmonella) that may be transmittable to humans is very low. Usually only birds housed in congested industrial pens have high risk of acquiring such a disease (Holderread, 2001). However, there is a risk of ducks acquiring an infectious disease from humans. To minimize this possibility, all human participants and staff members will practice strict handwashing before entering the duck enclosure and handling the birds.

Risks for Human Participants

Human participants in this proposed project may receive an accidental injury from the animal, contract zoonotic disease, or experience injury from equipment, such as protective electric fencing. Accidental injuries from ducks are very rare, because ducks in general are not

aggressive (Holderread, 2001). The ducks for this project were preselected for friendliness, and if any ducks appear to be aggressive, they will be excluded from the study.

Prior to every interaction with the ducks participants will be instructed regarding appropriate handwashing, proper handling the ducks, and safe techniques for feeding and collecting the eggs. In addition, persons vulnerable to acquiring zoonotic disease will be excluded from this study (immunocompromised persons and those over 65 years). The ducks will be handled according to the CDC (2023) recommendations. In brief, the CDC emphasizes the importance of handwashing before and after handling the ducks, collecting the eggs, or handling feed and water for the ducks. In the highly unlikely event of a bite or a scratch injury, medical care will be provided by the health professionals on staff or in the emergency department if after hours. Any individuals exhibiting signs/symptoms of illness will be asked to refrain from entering the duck pen until they feel better and are cleared by their health care provider. For protection from (nocturnal) predators the duck pen will be surrounded by an electric fence. The electric fence will be disconnected during the AATF sessions to eliminate the possibility of an electric shock to the participants. Participants will be instructed to refrain from touching the fence regardless of on/off status.

Ethical Considerations

To ensure the protection of the human subjects and animals involved in this study the study protocol was reviewed and approved by both Institutional Review Board (IRB) and Institutional Animal Care and Use Committee (IACUC).

Rehabilitation Facility Staff Education

Staff members were engaged in all project preparation activities over a period of three months, by meeting with the PI, providing suggestions, and discussing recruitment strategies.

Facility staff selected the location of the duck pen, and provided input as to appropriate safety measures for persons with TBI. To mitigate risks to both ducks and humans, educational sessions were provided to the staff.

Researchers conducted a two-hour training session explain both AATF and safety strategies for working with live animals. Content covered included infection control, participant safety, duck safety, and discussion of common signs and symptoms of avian diseases. This was followed by discussion and question-and answer period. Upon the completion of the training, two staff members, who agreed to join the research team, completed a 10-item quiz on the topics of duck housing, protection from predators, and infection control discussed in the training session; both achieved 100%. Finally, both staff members engaged in this project completed Collaborative Institutional Training Initiative (CITI) to prepare to participate as staff in human subjects research. The importance of safety for participants and the ducks will be reinforced through the entire duration of the project.

Sustainability

Sustainability of a project may depend on several factors: consensus among key stakeholders, development of staff competency in sustainability strategies, and sustainability emphasis in project development. At the planning stages of the project, the roles and responsibilities of the key players were defined, in order to support organizational sustainability commitment (Aarseth et al., 2017). To ensure sustainability of this initiative, researchers gave special attention to creating a balanced environment that may benefit human participants, but at the same time will be humane and enjoyable for the birds. Paying special attention to safety of human participants and birds is one of the environmental components that may promote sustainability.

Researchers recognized that one of the factors that may hinder the sustainability of the project is cost and availability of supplies. Poultry feed is among the highest of all farm related expenses (Holderread, 2001). To reduce this expense, and ensure the sustainability of the project, the researchers negotiated a discounted pricing for the feed with local feed suppliers.

While ducks are very hardy animals and may thrive in a variety of the environments, it is still important to provide adequate shelter and care. The researchers and the staff ensured that the ducks will have a sturdy physical barrier for protection from predators, consume quality feed, and have access to clean drinking and swimming water. A local veterinarian agreed to provide care to any birds with urgent or emergent health issues at a discounted rate.

Financing and Ownership

Purchase of the ducks was made possible by a research grant from a local chapter of Sigma Theta Tau International, while the equipment to house and care for ducks was financed by a grant from a local university. Both of the grants were made to the PI, however, at the beginning of the study the ducks and the equipment will become the property of the TBI rehabilitation facility in order to support sustainability.

Conclusion

TBI is a long-term condition often without a promise of full recovery. TBI may present with significant neurobehavioral sequela. We believe that AATF based interventions may improve self-efficacy in persons with TBI and thereby improve their anxiety and depression. While the methods described in this paper may present valuable information for researchers aiming to develop AATF programs, this paper may be beneficial for the researchers outside of the healthcare arena. From that perspective this paper may be viewed as a contribution to the implementation science. Implementation science focuses the inquiry on executing the planned

intervention into effects (David et al., 2014). Interventions may focus on developing and implementation of policies, programs, or individual projects.

Our next step is to examine the effect of the intervention herein described upon these outcomes. We will measure anxiety, depression, and self-efficacy using the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) and General Self-Efficacy Scale (GSE) (Schwarzer & Jerusalem, 1995). Questionnaires will be completed before the intervention, immediately following the intervention, and again 4 week later . If the results of the study suggest positive changes related to the AATF with ducks follow-up studies will examine larger samples at multiple sites.

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Supplementary Appendix

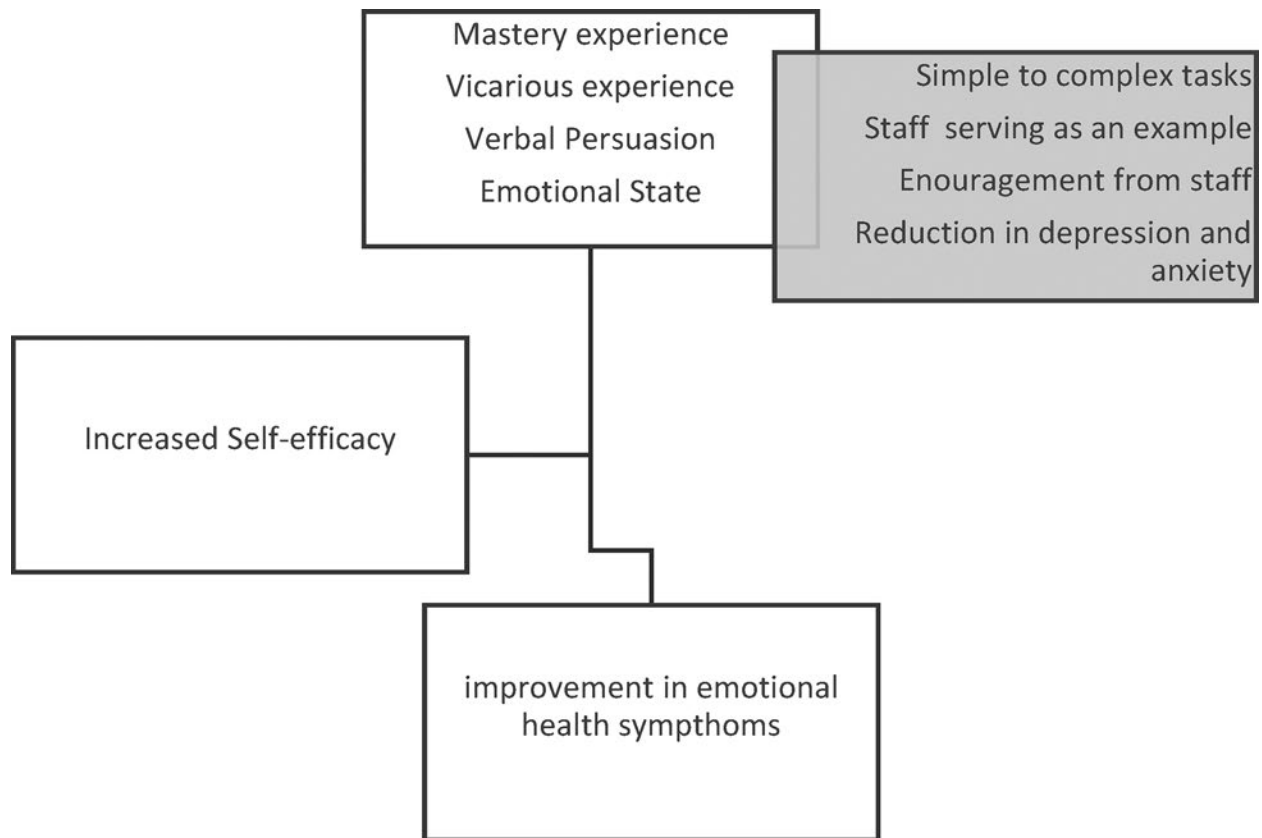


Figure 1.

Week	Activities	Theoretical concepts addressed
1	Education: duck behavior, handling the ducks, feeding, and participant and duck safety measures	Vicarious experience
1,2	<i>Reinforce education.</i> Begin observation: safe handling of the ducks, feeding behavior, drinking waters, swimming, and movements of the ducks in the pen.	" and verbal persuasion
3	<i>Reinforce education and continue observation.</i> Begin simple tasks: filling the feed pans. Filling watering pools.	"
4	<i>Reinforce education and continue observation.</i> Continue simple tasks. Begin advanced simple tasks: pan feeding, herding, and collecting eggs.	"
5	<i>Reinforce education, continue observation.</i> Continue simple tasks. Begin Complex tasks: holding, petting, and handfeeding.	" and mastery experience
6	<i>Reinforce education, continue observation.</i> Continue simple tasks. Continue complex tasks.	"
7	<i>Reinforce education, continue observation.</i> Continue simple tasks. Continue complex tasks.	"
8	<i>Reinforce education, continue observation.</i> Continue simple tasks. Continue complex tasks.	" and somatic and emotional state
9	<i>Reinforce education, continue observation, continue Simple and complex tasks.</i> Putting it all together: Learn about ducks' behaviors and lifecycle: differentiate females from males, concept of broodiness, flying and swimming abilities of ducks, molting the feathers, how ducks are raising ducklings (if available), signs of stress, signs of sickness	"
10	<i>Reinforce education, continue observation, continue Simple and complex tasks.</i> Continue putting it all together.	"
11	<i>Reinforce education, continue observation, continue simple and complex tasks.</i> Continue putting it all together.	"
12	<i>Reinforce education, continue observation, continue simple and complex tasks.</i> Continue putting it all together.	"

Figure 2. Weekly activities for duck interactions groups, according to Bandura's concepts.

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Chapter IV: “Quacking for Noggin:” Farm Animal Assisted Therapy for The Traumatic Brain
Injury Survivors.

This manuscript (Scholarly Paper #3) has been prepared for submission to the *Anthrozoös: A multidisciplinary journal of the interactions between people and other animals*. The required citation format for this journal is that of American Psychological Association, 7th Edition.

Abstract

The aim of this study was to examine the effects of Animal Assisted Therapies with Farm Animals (AATF) with domesticated ducks on depression, anxiety, and self-efficacy in patients with traumatic brain injury (TBI) . Furthermore, the following hypothesis was tested: Engaging in AATF with domesticated ducks will be associated with decrease in depression, decreased anxiety, and an increase in self-efficacy.

The study examined the effects of AATF on anxiety, depression and self-efficacy among nine patients with TBI. Time series quasi-experimental design was utilized. Participants completed Hospital Anxiety and Depression Survey (HADS) and General Self Efficacy (GSE) questionnaires at baseline, followed by the AATF intervention. AATF intervention consisted of two one-hour sessions interacting with ducks, every week for 12 weeks. participants repeated baseline measures immediately following the intervention, and again four weeks post intervention to evaluate the residual effects of the intervention.

General Linear Model was employed to examine changes in anxiety, depression, and self-efficacy. Participants' anxiety scores decreased significantly from baseline to post intervention measure ($p = .009$), however, there were no statistically significant differences between anxiety levels immediately post intervention and four weeks later. There were no statistically significant differences in depression or self-efficacy levels pre, post, and retest.

Our study hypothesis was partially supported in that statistically significant decreases in anxiety were observed from baseline to immediate posttest. Mastery of skills, vicarious experiences, and verbal persuasion may be the factors that contributed to the beneficial outcomes of the interactions between persons with TBI and domesticated ducks.

Keywords: Self-Efficacy, Anxiety, Depression, Traumatic Brain Injury, Animal Assisted Therapies, Animal Assisted Therapies with Farm Animals.

“Quacking for Noggin:” Farm Animal Assisted Therapy for The Traumatic Brain Injury Survivors

Patients with Traumatic Brain Injury (TBI) may present with depression, anxiety, and a decline in self-efficacy (Belanger et al., 2020; Plourde et al., 2019; Zelencich et al., 2020).

Animal Assisted Therapy (AAT: e.g. dogs, cats) has been shown to improve communication skills, interaction, arousal, and concentration in patients with mild to severe TBI (Gocheva et al., 2018; Hediger, Petignat, et al., 2019; Hediger, Thommen, et al., 2019).

Several studies in patients with TBI revealed the positive effect of AAT on emotional state (Hediger, Petignat, et al., 2019; Hediger, Thommen, et al., 2019; Theis et al., 2020).

Hediger and colleagues (2019) suggested that AAT for patients with TBI may result in improved social skills and an increase in the number of occurrences of social behavior. These studies did not directly evaluate depression or depressive states, however negative emotional state may be related to depression (Maalouf et al., 2012). Depression is relatively common in patients with TBI. Approximately 30% - 50% of patient with TBI may develop a mental health related illness, including depression (Juengst et al., 2017). People who experienced TBI may have a significantly higher rate of being diagnosed with depression (26%) compared to the general population (8%) (Koponen et al., 2002).

While Animal Assisted Therapy with Farm Animals (AATF: e.g. cattle, chickens) interventions have been shown to be beneficial for patients with a variety of psychiatric illnesses (Berget et al., 2011; Pedersen et al., 2012), we found no published study examining AATF in patients with TBI. One may theorize that because AAT has benefits for patients with TBI, the AATF based interventions may be beneficial for these patients. AATF based interventions belong to a group of therapeutic practices under the umbrella of Green Care (Bokkers, 2006).

The concept of Green Care is defined as the engagement of a person in a nature based therapeutic setting to help the recovery from a disease (Berget et al., 2010). Humans have been part of natural social-ecological system since prehistoric times (Liu, 2007). The concept of Greencare is tightly related to Biophilia Hypothesis proposing that humans have an inherent desire to connect with other life forms and nature. (Kellert & Wilson, 1993).

While drawing parallels between AATF and AAT in patients with TBI one may focus on improvement in emotional state and social behaviors. Several studies suggested that AATF may result in improvement in depressive symptoms, mood, and social skills (B. Berget et al., 2008; Berget et al., 2011; Mallon, 1994; Pedersen et al., 2012). Pedersen and colleagues (Pedersen et al., 2012) came to the conclusion that AATF may lead to improvement of self-efficacy in patients with clinical depression. For additional background details on AATF, the reader is referred to a narrative review conducted by authors (Sargsyan & Beebe, 2023).

Theoretical Framework

Bandura's Self-Efficacy Theory was used to guide this study examining AATF effects on anxiety, depression, and self-efficacy in patients with TBI. Self-efficacy may be defined as a person's belief as to whether they can successfully accomplish a task. This belief leads to the notion that individuals will engage only in tasks they believe they can successfully accomplish (Bandura, 1997). According to Bandura self-efficacy is influenced by four factors: mastery experience, vicarious experience, verbal persuasion, and somatic/emotional state.

AATF and Self-Efficacy Theory

Bandura's theory was successfully utilized in a number of studies with AATF. These studies, among other parameters, measured changes in self-efficacy. In one study, AATF activities resulted in increased self-efficacy in patients with psychiatric disorders (Berget &

Braastad, 2011). People with TBI have a high incidence of depression compared to the general population (Koponen et al., 2002). While we have not found any studies examining AATF in people with TBI, one may contemplate that AATF may benefit patients with TBI because it was effective for patients with clinical depression: AATF activities led to a decrease in depression level and increase in self-efficacy in patients who had an established diagnosis of clinical depression (Pedersen, Martinsen, et al., 2012).

AATF based activities incorporate all four factors that influence self-efficacy. For example, for the *mastery* factor, AATF activities include different levels of complexity of tasks, which may include observation, walking, grooming, feeding, milking, and other tasks of differing difficulty levels (Pedersen, Ihlebæk, et al., 2012). In this study, differing levels of complexity included observation, petting, feeding, watering, herding, and egg collection. Patients with TBI may present with different levels of physical and cognitive impairment. To achieve mastery, tasks are introduced gradually from least complex to most complex. Having a variety of tasks of different complexity levels may allow patients with different abilities to achieve mastery, which may in turn increase self-efficacy.

Because of its prior utilization in AATF research and its good fit with the goals of the current study, Bandura's Self-Efficacy Theory was chosen to guide the development of the study to evaluate AATF based interventions for patients with TBI. For details on how the theory guided our intervention design and implementation the reader is referred to (Sargsyan & Beebe, 2024).

Study Aim

The aim of this study was to examine the effects of Animal Assisted Therapies with Farm Animals (AATF) with domesticated ducks on depression, anxiety, and self-efficacy.

Furthermore, the following hypotheses were tested:

Engaging in AATF with domesticated ducks will be associated with decrease in depression.

Engaging in AATF with domesticated ducks will be associated with a decrease in anxiety.

Engaging in AATF with domesticated ducks will be associated with an increase in self-efficacy.

Methods

Study Design

Time series quasi-experimental design structure was utilized

Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) in order to ensure the protection of the human subjects. Additionally, the study protocol was reviewed and approved by the Institutional Animal Care and Use Committee (IACUC). While no experiments were conducted on animals, nor was the environment for animals modified from conventional farm setting, we obtained IACUC approval, to ensure safety and humane treatment of animals.

Procedures

All Participants were recruited from a TBI rehabilitation center in the Southeastern United States. At the time of the study, all participants resided or attended daycare services at

this center. The center provides residential services, rehabilitation services, an adult day care program and service coordination programs serving individuals who have acquired and survived a TBI. Eligible participants were informed about the study, had the opportunity to ask questions, and signed the informed consent if they agreed to participate. Participants who lacked capacity signed assent, then PI contacted the conservator and explained the study. The conservators were given an opportunity to ask questions, and if they agreed they signed the consent.

Inclusion criteria

The participants were able to read and understand English. The participant group included individuals ranging from 18 to 65 years old. All of the potential participants had a history of acquired TBI. The participants were in stable physical condition with all physical disorders/diseases adequately managed. Only participants exhibiting functional upper extremity/hand/motor coordination were enrolled in this study.

Exclusion criteria

Potential participants with severe motor deficiencies who were unable to move independently without assistive device were excluded from this study. Individuals with severe comprehension problems who were unable to comprehend spoken/written English at 5th grade level were also excluded. Also, potential participants with history of immunodeficiency, organ transplants, undergoing immunosuppressive therapy, and unmanaged/unstable physical health disorders were excluded from this study. Individuals with animal phobias, specifically fear of birds were also excluded from this study.

Inclusion and exclusion criteria were verified by chart review conducted by the staff at the TBI rehabilitation center. Study personnel did not have access to the participant records.

Intervention

Participants completed Hospital Anxiety and Depression Scale (HADS) and General Self-Efficacy (GSE) scales at baseline, immediately after the 12-week intervention and one month after the intervention concluded. AAFI intervention included two one-hour sessions interacting with ducks every week for 12 weeks. Groups began with education on duck behavior, safely handling the ducks, and feeding procedures. Participants proceeded from simple to complex interactions with ducks over time, which included petting, watering, feeding, and herding. All groups were monitored by PI for safety of both ducks and participants. The details of designing and methodology for this AAFI intervention have been discussed elsewhere (Sargsyan & Beebe, 2024).

Measures

We utilized HADS and GSE scales in this study. The concept of Anxiety was operationalized by the anxiety subscale of HADS scale. The concept of Depression was operationalized by the depression subscale of HADS scale. The concept of self-efficacy was operationalized by GSE scale.

HADS scale was designed in 1983 in for the evaluation severity of anxiety and depression symptoms (Zigmond & Snaith, 1983). HADS is one of most commonly used tools to evaluate anxiety in persons with TBI (Osborn et al., 2016). The HADS scale has 14 items, seven items focus on anxiety related symptoms, and the remaining seven are focus on depressive symptoms (Zigmond & Snaith, 1983). While it is a single questionnaire, anxiety and depression scores are calculated separately (Abbasian et al., 2019). The seven anxiety items are summed for a total anxiety score ranging from 0-21; similarly, the seven depression items are summed for a total depression score ranging from 0-21. Higher scores indicate higher anxiety and depressive

symptoms, respectively. For both scales scores below 7 signify minimal depression/anxiety symptoms. Scores 8–10 signify mild depression/anxiety symptoms, 11–14 signify moderate depression/anxiety symptoms, 15–21 severe anxiety/depression symptoms (Zigmond & Snaith, 1983). The HADS takes approximately 2-5 minutes to complete in samples of persons in general medical population (Stern, 2014), for persons with TBI, we increased the estimated time to complete this measure, to 15 minutes.

GSE scale (Schwarzer, 1993; Schwarzer & Jerusalem, 1995) has been utilized both in research focusing on TBI and AATF (Bente Berget et al., 2008; Brands et al., 2015; Hawley et al., 2022), to evaluate how AATF affected self-efficacy in persons with TBI. GSE is a 10 item Likert-type questionnaire. Item responses range from 1(not at all true) to 4 (exactly true). The final questionnaire score is the sum of item scores for the individual items. Higher GSE scores represent higher self-efficacy. The GSE takes approximately 4 minutes to complete in samples of persons in general population (Schwarzer & Jerusalem, 1995), for persons with TBI, we increased the estimated time to complete this measure, to 15 minutes.

Data Analysis

Power analysis

Power analysis was conducted based on two previous studies examining AATF effects (Berget et al., 2011; Pedersen et al., 2012). When data from these studies was processed through PASS 2023, it was determined 8 to 14 participants in a single group would provide power 0.8 to detect an effect size similar to that reported in those studies.

Data collection

Instead of using statistical methods for substituting for missing data, we included only data from nine participants who completed all surveys, because the number of the participants

was within the range suggested by our power analysis. Therefore quantitative data from nine participants was analyzed for this report.

Results

Characteristics of sample

Total 13 participants were recruited for this sample. Two of the participants dropped out of the study in the first week because of a scheduling conflict and loss of interest. Total 11 participants (two females and eight males) participated in the entire 12-week intervention period, however, only nine completed (one female and eight males) all three sets of surveys. Mean age for participants who completed all three sets of surveys was 50.3 years (range 35–64). Our study demographics for gender and age for TBI survivors are consistent with nationwide averages (Lamm et al., 2019).

Analysis

General Linear Model was employed to examine Anxiety level (HADS scale), whether there are significant differences between the score means before, immediately after, and four weeks after the intervention ended. Anxiety mean score at baseline (A_pre) was at 5.78, anxiety mean score immediately after the intervention was at (A_post) 3.67, and anxiety mean score after the intervention ended was at (A_re) was at 5.67.

Wilks' Lambda, which revealed statistically significant differences between anxiety subscale means in HADS scale at all time points ($p = .013$). This indicates that the differences between A_pre, A_post, and A_re are not likely due to random variation. As a component of Estimated Marginal Means evaluation, we conducted pairwise comparison between A_pre, A_post, and A_re. We discovered that differences between A_pre, A_post were significant ($p = .009$). No statistically significant differences were noted between A_pre and A_re, nor between

A_post, and A_re . We conducted the same analysis for Depression (HADS scale) and Self-Efficacy (GSE scale) score means before, immediately after, and four weeks after the intervention. There were no statistically significant differences observed between any variables examined.

Discussion and Conclusions

The anxiety levels in HADS scale decreased significantly from baseline to immediately after the intervention. However, anxiety levels reverted to approximately their original values during the four weeks after the intervention ended. This may be explained by several possible factors. First of all we may draw parallels between the interaction with ducks and an antianxiety medication with short half-life. Antianxiety medications with short half-life should be administered on a continuous basis to provide beneficial effect for the patient, interruption of the administration may lead to the return to the pretreatment anxiety levels (Lader & Petursson, 1983). Secondly, the final surveys were administered in early February after the holiday season ended. In general, people tend to display higher level of mental health symptoms in post-holiday season (Willis, 2019) and this may have served as a confounding factor of return to the preintervention anxiety levels. Finally, AATF based intervention is impossible to conduct in blinded environment. That in turn may contribute to participant's expectation of positive outcomes of the interventions in this study, and may be considered an example of subject bias.

The depression (HADS scale) and self-efficacy (GSE scale) did not change significantly from baseline to immediately after the intervention, nor from immediately after observation to the four-week post intervention time point. This may be explained by a variety of factors that may have affected the results. Again, one may draw parallels between the medication treatment for depression and the AATF intervention. Conventionally, it takes approximately four to six

weeks to illicit a response to the pharmaceutical treatment in patients with depression (Rothschild & Duval, 2003). The chances for a long-term benefit from a pharmaceutical treatment may increase if the patients stay at least six months on an antidepressant treatment regimen combined with cognitive behavioral therapy (Gelenberg et al., 2010). Assuming that AATF has similar treatment timetable to pharmaceutical treatment, one may contemplate that our intervention was not long enough to produce reduction in depression scores of HADS scale.

Over the course of three months of the intervention and six-month preparation phase PI has witnessed caring attitude of the staff and strict adherence to the care standards for the patients with TBI. One may speculate, that high level of care translated into the low initial values for the depression and anxiety subscales in the HADS questionnaire.

Even though HADS and GSE scales are well-validated and were utilized in the populations with TBI (Brands et al., 2015; Hawley et al., 2022; Whelan-Goodinson et al., 2009), do not necessarily give a correct assessment of the depression, and self-efficacy levels in this particular group of participants. For instance, low depression values may reflect a floor effect of HADS questionnaire in this particular group of participants. Floor effect is a characteristic of an instrument to produce low scores in the considerable number of participants (Andrade, 2021). Participant bias is another possible explanation. Participant bias may be defined as a propensity of study subjects to act in a way that may please the researcher (Gove & Geerken, 1977; McCambridge et al., 2012).

On the other hand, the high baseline self-efficacy scores observed may represent the variety of extracurricular activities and classes offered in this facility. The participants have opportunity to engage on regular basis in painting, sculpting, modeling, and computer classes. It has been suggested that engagement in art related activities may increase self-efficacy (Dickman,

2017; Hayes, 2023). The initially low levels of depression and anxiety make our finding of a statistically significant reduction in anxiety all the more compelling. Furthermore, our lack of statistically significant improvement in self-efficacy might be attributed to the initially high levels of self-efficacy observed, which in turn may represent the ceiling effect when using GSE scale in this particular group of participants (Andrade, 2021).

While HADS instrument has a certain value aiding the clinician in diagnosing the depression in persons with TBI, it has been proposed to follow up with a patient interview when the diagnosis is not clear (Whelan-Goodinson et al., 2009). In our case, the HADS scale did not reflect statistically significant changes in depression, however, the qualitative feedback received from participants and staff was overall positive. The participants shared that they felt happy when they interacted with ducks. At the same time, staff members shared that working with ducks had a positive impact on participants' mood and behavior. A future investigation will analyze qualitative data related to this intervention in the near future.

While we attempted to provide a consistent experience for the participants, AATF treatment cannot be completely standardized. This may be considered a limitation for this study. Because the treatment is based on interaction with live animals, animal behavior may be different during each visit to the duck pen. Because of that there is a possibility that the study cannot be exactly replicated. The preexisting treatments for anxiety and depression may present another limitation for this study. The participants may have different duration or complexity of treatments for anxiety and depression. This may present a confounding factor that unfortunately, was not controlled for in this investigation. Our dropout rate of 8.5%, while low, may have contributed to the nonidentification of differences owing to low statistical power.

Our study hypotheses regarding an association between time spent working with ducks and anxiety was supported. However, the hypotheses that working with ducks would decrease the depression and increase the self-efficacy levels was not supported. The results indicate that interaction with domestic ducks via observing, petting, herding, feeding, watering may lead to benefits in mental health. Mastery of experience, vicarious experiences, and verbal persuasion may be the factors that contribute to the beneficial outcomes of the interactions between persons with TBI and domesticated ducks. These findings were congruent with the previous studies suggesting that AATF has benefits for persons who experience anxiety (Sargsyan & Beebe, 2023). In the future we may consider expanding the scope of the AATF studies for persons with TBI interacting with ducks by designing studies with a larger sample of participants, control groups, and randomizations.

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Chapter V: Conclusion

Green Care is an umbrella term that includes nature based interventions utilized for the improvement of a person's health (Berget et al., 2010). Animal Assisted Therapies with Farm Animals (AATF) have been recognized as an integral part of Green Care therapeutic approach. Whereas Animal Assisted Therapies (AAT) involve animals that are traditionally utilized as pets or leisure (e. g. dogs, cats, horses), AATF involves animals that serve a utilitarian role producing dairy, meat, or eggs in a farm setting. Both AAT and AATF are utilizing human-animal bond health benefits (Ávila-Álvarez et al., 2020; García-Llorente et al., 2018; Odendaal, 2000).

The first manuscript of this dissertation provides a narrative review of the literature performed to examine the current state of the science related to AATF utilization as a therapeutic intervention for persons with mental and physical illness. The review of the literature included the qualitative and quantitative research studies that explored the AATF's role as a therapeutic intervention to improve health.

The literature review revealed that AATF contributes to the increase in initiative, attentiveness, and self-efficacy domains. At the same time, AATF may decrease severity of anxiety and depression symptoms. Several qualitative studies reflected overall positive experiences related to AATF for patients with mental disorders. Overwhelming majority of the reviewed studies drawn upon Bandura's Self-Efficacy Theory (1997). The review recognized the importance of further research to explore AATF with the focus on increased sample sizes, consistency of time spent in animal interactions, and consistent description of data collection and analysis methods in both qualitative and quantitative realms. There were several gaps in the literature because there has been no research on the effects on patients with TBI who were exposed to AATF. The literature search revealed several studies exploring effects of AAT on patients with TBI (Hediger, Petignat, et al., 2019; Hediger, Thommen, et al., 2019; Theis et al.,

2020). These studies reveal overall positive effect of AAT on patients' behavioral and psychological outcomes. Our study addressed those gaps by introducing an AATF intervention to persons with TBI. To increase the replicability of the study we attempted to meticulously document all of the steps of the study design and methodology. This may allow to have a blueprint of similar studies in the future for the researchers who are interested in AATF for persons with TBI.

The second manuscript of this dissertation was devoted to the description of the methodology and the design of the AATF study with ducks for persons with Traumatic Brain Injury (TBI). The manuscript included site identification, stakeholder engagement, and AATF intervention design. Also, risk reduction strategies for human participants and ducks are discussed. The manuscript gave a description of encountered problems and an outline of possible solutions that may be useful for other researchers interested in AATF. This manuscript is a contribution to implementation science, and because of that it may be of interest to researchers who work outside of the healthcare field. The manuscript may be helpful for policy development, program expansion, or individual project implementation initiatives.

The third manuscript focused on exploring the results of the AATF study conducted at a TBI rehabilitation facility. Our narrative review identified that all of the available AATF research was exploring the effect of AATF on patients with mental illness. While our study was focusing on mental health (e. g. anxiety and depression), we also examined the effect of AATF on self-efficacy.

This research was performed to examine the effects of AATF on anxiety, depression and self-efficacy among the patients with TBI. We utilized time series quasi-experimental design. Participants completed Hospital Anxiety and Depression Survey (HADS) and General Self

Efficacy (GSE) questionnaires at baseline, followed by the AAFIT intervention. Immediately after the intervention the participants' anxiety scores significantly decreased. However, when the intervention stopped, the anxiety levels returned to baseline levels. Intervention did not have a statistically significant effect on depression or self-efficacy levels. These results partially supported our study hypothesis. We have discussed that factors in Bandura's self-efficacy theory contributed to the beneficial outcomes of the AATF intervention with ducks for persons with TBI.

Theoretical Foundations

This research endeavor is rooted in Bandura's self-efficacy theory (Bandura, 1977). In the third and final manuscript for this research, the factors of Bandura's theory corresponded to the experiences of the participants. Bandura's theory was used as a theoretical foundation in several AATF studies. These studies, measured changes in self-efficacy, anxiety, and depression. (Berget & Braastad, 2011; Pedersen et al., 2011). Overall, it was suggested that AATF activities may lead a decrease in depression and anxiety levels and increase in self-efficacy (Berget et al., 2008; Pedersen et al., 2012; Pedersen et al., 2015).

Bandura theorized that self-efficacy may be influenced by mastery experience, vicarious experience, verbal persuasion, and somatic and emotional state (Bandura, 1997). Somatic and emotional state is one of the factors that came into play in this study. Bandura defined the somatic and emotional state factor as a perception of one's physical and emotional reactions in relation to an implementation of a certain task (Bandura, 1997). Stress may lead to emotional arousal, which in turn may negatively affect perceived self-efficacy. Negative emotional states, like anxiety, may lead to reduced self-efficacy and to inability to perform the task (Bandura,

1997). Contrariwise, reduction of anxiety may foster success in the task and increase perception of self-efficacy.

The AATF interaction in our study had comforting character and contributed to the reduction of the anxiety level. This finding was congruent with the avian experts opinion, who believe that simple observation of ducks' daily activities may contribute to the reduction of anxiety by promoting feelings of calm and pleasure (Holderread, 2001).

Results

We examined Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) and General Self-Efficacy (GSE) (Schwarzer, 1993; Schwarzer & Jerusalem, 1995) survey results from nine participants in the final manuscript for this research.

General Linear Model was employed to examine Anxiety (HADS scale), whether there are significant differences between the score means before, immediately after, and four weeks after the intervention ended. Anxiety mean score at baseline was at 5.78, anxiety mean score immediately after the intervention was at 3.67, and anxiety mean score after the intervention ended was at 5.67. Wilks' Lambda revealed statistically significant differences between anxiety subscale means in HADS scale at all time points ($p = .013$). Furthermore, we conducted pairwise comparison between the score means before, immediately after, and four weeks after the intervention ended. This comparison showed that the differences between the score means before and immediately after were significant ($p = .009$). No statistically significant differences were noted between the score means before and four weeks after the intervention ended, nor between the score means immediately after and four weeks after the intervention ended.

In similar fashion we analyzed the score means before, immediately after, and four weeks after the intervention for Depression (HADS scale) and Self-Efficacy (GSE scale). No statistically significant differences were observed between these variables.

This study supported the hypotheses regarding an association between time spent working with ducks and anxiety. Nonetheless, the hypotheses that interaction with ducks may benefit the domains of depression and self-efficacy levels was not supported. These results suggest that that AATF intervention of working with domestic ducks may have benefits in reduction of anxiety symptoms in persons with TBI.

All of study participants shared how the physical contact felt with the ducks when they had the opportunity to touch, pet, or simply hold the ducks. They described the sensation of feeling very soft feathers. They also mentioned the docile character of the ducks, and that the ducks were not resisting being held, touched, or pet. Participants shared that they felt that both humans and ducks were looking forward to their biweekly interactions: "...they all come out excited. It made me feel good." "And they (ducks) like it when we go out there and talk to them. I think it's good for us and also good for them." One of the participants shared that this was novel but very positive experience for them, and they would never think about working with farm animals in the past: "I didn't think I would move out into the country like this, but I did and I'm glad I did. Definitely." All the participants expressed that they felt happy while interacting with the ducks: "They're just cute and fun. And I enjoyed just about everything actually." This is only a small sample of qualitative data from our study, the qualitative data from this this AATF intervention will be analyzed and reported separately.

The participants presented with relatively low questionnaire scores for depression and anxiety at the beginning of the study. This may be a result of participant's bias. Participant bias

may be defined as a propensity of study subjects to act in a way that may please the researcher (Gove & Geerken, 1977; McCambridge et al., 2012). Nevertheless, the scores immediately after the end of 12-week period of interaction with ducks reflected further decrease, significant for reduction in anxiety levels.

Implications for Research

Further research is needed to evaluate the effectiveness of AATF based interventions in persons with TBI. While AATF interventions with domesticated ducks have not been conducted in the past, the current study defined the foundational methodology for designing and implementing such studies. This study outlined mechanisms to provide a stress-free environment both for the participants and ducks thereby facilitating an intervention to reduce anxiety symptoms. While the methodological foundation laid in this research is solid (Sargsyan & Beebe, 2024), in the future we may consider strengthening the AATF research for persons with TBI by recruiting larger samples of participants, introduction of control groups, and randomization.

Self-efficacy as a mechanism for improved outcomes for depression and anxiety was not supported by our data. This may be because self-efficacy measure (GSE scale) were not ideal to use in persons with TBI, particularly in the participants in current research. Further research may include use of different measures of self-efficacy, or exportation and revisiting other theories. For instance, social-support or attachment theories may serve as a possible theoretical background for the further research involving AATF.

Qualitative research is another direction for studies exploring AATF effects on persons with TBI, interviews conducted with the participants in the current research study revealed

intricate cluster of information related to the lived experiences of persons with TBI engaging in AATF.

Implications for Policy and Practice

Agriculture is the number one industry in the state of Tennessee (TNDA, 2024). Agriculture in general, and raising of poultry in particular, are well established in Tennessee. It is a centuries long tradition in the region. According to the Tennessee Poultry Association (2024), today, the poultry industry offers more than 27,000 poultry related jobs in the state. Also, many people have a backyard flock in this state. Because people in the state are familiar with raising poultry, it is expected that AATF with ducks may be accepted by the patients, advance care providers, and policy makers in the state. AATF may be introduced as a valid alternative to traditional treatments in mental health disease management, rehabilitation, and long-term care. Besides the acceptance and familiarity with farming activities in the state, fiscal modalities may make AATF a lucrative alternative or an addition to traditional pharmaceutical or cognitive-behavioral treatments.

Current research supports policy development for wide implementation of Green Care approaches in general and AATF based activities in particular. The abundance of poultry related activities in this state supports the notion that AATF with poultry may be a feasible therapy approach to implement in this state or any other locale where agriculture and poultry businesses have been developed.

Implications for Education

The nursing curriculum has grown tremendously over the last few decades. Among many other reasons for that, innovations in patient care and the emergence of new diseases played a role in the increase of the volume of material presented to future nurses. At the same time, the

nursing curriculum still includes approaches that are outdated and irrelevant to clinical practice (Jordal & Heggen, 2015; Pere et al., 2023). It is imperative to introduce methodology and interventions that are efficient and result in better patient outcomes. Current research presents a therapeutic modality that is beneficial for persons with TBI. Exposing future nurses to AATF may help them to learn more about rehabilitation strategies, chronic disease progression, and increase their knowledge about TBI. Because of AATF's focused and streamlined character, its relatively short duration, and its acceptance by patients, future nurses may find it easy to understand this intervention. At the same time, with the shortage of clinical sites for entry level nursing education (Shajani et al.), rehabilitation facilities that employ AATF may present a valid alternative to acute settings. Dedicated educational unit (DEU) is a novel clinical education approach that provides a robust clinical education for nursing students (Goslee et al., 2020). Because of a potential to provide an effective learning milieu for students, utilizing a TBI rehabilitation facility with AATF program as a DEU may present an opportunity to create a nurturing environment both for students and patients.

Conclusion

While we were preparing and conducting this research study, we witnessed the caring attitude of the staff and strict adherence to the care standards for the residents in the TBI rehabilitation facility. We are confident to say that the level of care received by the residents played a role in the successful completion of this study. The results of this research suggest that working with domesticated ducks may lead to benefits in mental health. Mastery of experience, vicarious experiences, and verbal persuasion may be the factors that contribute to the positive outcomes of the AATF intervention for persons with TBI. Our research findings were similar to previous studies suggesting that AATF has benefits for persons who experience anxiety

(Sargsyan & Beebe, 2023). This study suggests that AATF based intervention may become a supplemental instrument in post TBI rehabilitation addressing mental health issues. Moreover, Green Care in general and AATF in particular may be valuable tools aiding to mental health rehabilitation in general.

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Vita

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Alex Sargsyan is a graduate of Summer Genetics Institute, National Institute of Nursing Research National Institutes of Health. He utilized the knowledge and expertise (gained) in NIH to develop, manage, and coordinate the Healthcare Genetics Certificate Program at ETSU College of Nursing. He serves as a reviewer for professional journals and organizations, which include among others Health Resources and Services Administration, American Nurse, and Issues in Mental Health Nursing. He presented his work on national and international health and education related forums including invited presentations in Greece and Russian Federation. He is the author of several publications focusing on animal assisted therapies and men's health issues.

Alex Sargsyan is one of the managing partners at Dashing Duckling Farm, LLC. It is a no-kill, free-range poultry farm sitting on 12+ acres. While embracing traditional agricultural values the farm established a cost-effective production that is humane, sustainable, and self-reliant. His keen interest in human-animal bonds fueled his research endeavors at the University of Tennessee in Knoxville where he is enrolled in the PhD program. His dissertation explores the effects of Farm Animal Assisted Therapies with ducks on persons with Traumatic Brain Injury.

His scholarly endeavors outline the importance of human-animal bonds and focus on the further exploration of the role of animals in improving human health and wellbeing.