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The Impact of Equine-Assisted Activities and Therapy (EAAT) on Depression

by

Annalisa Brandt

A creative component submitted to the graduate faculty in partial fulfillment of the requirements for the degree of

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Suzanne Millman, Major Professor
Wendy Ware
Steve Carlson

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis.

The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University
Ames, Iowa
2019

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Abstract

Equine-Assisted Activities and Therapy (EAAT) encompasses a variety of therapeutic techniques involving horses, and it is used by health professionals to treat physical, mental, or emotional disorders. Recently, EAAT has been utilized in cases of depression, a serious health concern that can lead to significant decreases in health and overall quality of life. It is predicted that EAAT would alleviate symptoms of depression, and the purpose of this review is to analyze research to determine if EAAT is an appropriate treatment option for depression. Four studies were found that directly measured levels of depression in association with EAAT treatment. The neurophysiology of depression is described; in addition, research involving exercise, human-animal bonding, and other forms of animal-assisted therapy are considered when evaluating EAAT and depression. Based on these studies, the author concludes that current research only shows trends that depression is alleviated with EAAT, and there is a lack of data demonstrating a significant effect of EAAT on depression. However, there is an indication that EAAT with horseback riding, and consequently higher levels of physical exercise, exerts a more significant effect on helping depressed individuals.

Keywords: Equine-Assisted Activities and Therapy, EAAT, depression, horses

Introduction

Depression is a prevalent psychiatric disorder that affects around 16.1 million adults in the United States, and it “is the leading cause of disability in the United States among people ages 15 to 44” (Anxiety and Depression Association of America, 2019). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), it is characterized by feelings of extreme hopelessness and sadness in addition to a significant lack of interest in one’s life (American Psychiatric Association, 2013). Depression increases the risk of suicide, and it can
lead to negative health consequences, like insomnia or a reliance on substances (Anxiety and Depression Association of America, 2019). Due to the severity of this disorder, it is important to consider treatment options, and the possibility to integrate multiple therapies to provide a holistic intervention. One intervention, equine therapy, is a relatively new treatment that has been touted as a therapeutic option for individuals with “depression, anxiety, attention-deficit/hyperactivity disorder, conduct disorders, dissociative disorders, Alzheimer’s disease, dementia, autism, and other chronic mental illnesses” (Malinowski et al., 2018). Thus, it is hypothesized that equine therapy is a beneficial treatment for individuals diagnosed with depression and would act to alleviate depressive symptoms.

For this review, the term Equine-Assisted Activities and Therapy (EAAT) will be adopted to define equine therapy as encompassing any form of therapeutic context where health professionals facilitate human-horse interactions for the purpose of treating an individual’s “physical, cognitive, and emotional challenges” (Professional Association of Therapeutic Horsemanship International, 2019). EAAT is growing in popularity and usage; however, the scientific literature is minimal, reflecting that EAAT is a relatively new treatment option. Many studies contain small sample sizes, possible usages are still being explored, and scientists continue to grapple with the questions of if, how, and why does EAAT work. The purpose of this review is to evaluate EAAT as a therapeutic option for treating people clinically diagnosed with depression.

The objectives of this paper will be to provide the reader: with a background on EAAT, an investigation into if EAAT alleviates depression based on studies found in the literature, and an understanding of the physiological mechanisms behind depression. Four studies will be examined that, to the author’s knowledge, are representative of the research available where the
effect on depression was a testable variable in the context of EAAT. Two of these essays involve depression in veterans with post-traumatic stress disorder (Malinowski et al., 2018; Romaniuk et al., 2018). The other two studies consider children diagnosed with a motor disability and at-risk adolescents (Hession et al., 2014; Frederick et al., 2015). Additionally, the human-animal bond and other forms of animal-assisted therapy will be discussed as topics in relation to EAAT. Exercise and involvement in nature will also be examined since these are factors associated with equine therapy in terms of stimuli present during EAAT sessions.

**What is EAAT?**

The relationship between humans and horses has a long and rich history. First used as beasts of burden, horses played fundamental roles in early societies, functioning as transportation, war combatants, entertainment, and agricultural workers (Scott, 2005). Indeed, horses still actively participate in these roles; however, modern development has caused a paradigm shift concerning human-horse interactions. Arguably, horses remain an important factor to some subsets of the population, despite many of their original functions being superseded by machines. Current equestrians have reallocated horses into new roles to address issues specific to modern living. One new role includes a branch of animal-assisted therapy that pairs horses and humans. Equine therapy as a medical treatment option is relatively new; its modern origins are typically traced to the 1950’s (Scott, 2005). An equestrian, Liz Hartel, from Denmark suffered muscle deterioration from polio. By working with a physical therapist and horses, she was able to successfully compete in dressage at the Olympics. Since then, interest increased in the medical and equestrian communities for utilizing horses as therapeutic means, and organizations began appearing on a global scale to develop regulations and educate new practitioners for this therapy (Scott, 2005).
Equine therapy comes in several forms that are ascribed different names. One could think of equine therapy as an umbrella term encompassing subtly different disciplines and treatment methodologies. Common terms include Equine-Assisted Activities and Therapy (EAAT), Equine-Facilitated Psychotherapy (EFP), Equine-Facilitated Learning (EFL), Hippotherapy, and Therapeutic Riding (Human Equine Alliance, 2019). Additionally, miniature horses are being utilized as guide animals for the visually impaired (Burleson, 2002). Table 1 provides a summary of these types of equine therapy. The term used for this paper, EAAT, was selected due to its generalized usage to encompass a variety of equine therapy. It is also used by one of the earliest equine therapy organizations, the Professional Association of Therapeutic Horsemanship International (PATH), which began in the 1960’s and remains active today on a global scale (Scott, 2005). According to PATH, EAAT sessions may resemble each other but vary in approach depending on the patient’s level of ability and personal goals (2019). An EAAT session’s typical format involves a certified instructor leading either groundwork or riding exercises. An instructor tailors the activities to best achieve a patient’s desired result. Assistants are assigned to a patient-horse pair to help the instructor in tasks and facilitate client safety.

Patients range from persons experiencing physical disabilities to cognitive and affective disorders, like depression.

Table 1. Summary of terms used to describe equine therapy (Human Equine Alliance, 2019; Burleson, 2002).

<table>
<thead>
<tr>
<th>Equine Therapy Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equine-Assisted Psychotherapy (EFP)</td>
<td>• Primarily used for treating mental and emotional disorders.</td>
</tr>
<tr>
<td></td>
<td>• Involves interacting with the environment, herd, or an individual horse.</td>
</tr>
<tr>
<td>Equine-Facilitated Learning (EFL)</td>
<td>• Typically used for at-risk adolescents.</td>
</tr>
<tr>
<td></td>
<td>• Involves activities designed to boost positive social interaction, emotional responses, and leadership skills</td>
</tr>
<tr>
<td>Hippotherapy</td>
<td>• Focuses on motor and sensory input from the horse to develop muscle coordination and cognitive processing</td>
</tr>
</tbody>
</table>
Therapeutic Riding/
Equine-Assisted Activities
and Therapy (EAAT)  
- Associated with physical, occupational, and speech therapies  
- Generalized descriptor encompassing any form of therapeutic context where health professionals facilitate human-horse interactions  
- Used by PATH

Guide Horse for the  
Visually Impaired
- Miniature horses perform the same duties typically ascribed to seeing-eye dogs  
- Longer life-expectancy than dogs

What is depression?

The American Psychiatric Association (APA) defined and outlined the symptoms of depression in the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, where it is characterized as an affective disorder (2013). This type of disorder involves significant and detrimental alterations in mood that occur on a spectrum, ranging from mild to severely impacting one’s life. Patients would have at least five of the listed symptoms that include: depressed mood, lack of interest in previously enjoyable activities, change in weight, change in sleep patterns, increase or decrease in psychomotor ability, fatigue, feelings of worthlessness or guilt, difficulty concentrating, and recurrent thoughts of death. These symptoms would be present for a minimum of two weeks; additionally, a physician would rule out other health issues that could cause symptoms, like substance abuse or a prior medical concern. Furthermore, a depressed individual could have impaired social interaction and significant difficulty performing daily tasks necessary for successful function in life. The *DSM-5* notes that depression is persistent, and it cites one’s “inability to anticipate happiness or pleasure” (APA, 2013). The consequences of depression range from mild, where it may not be readily apparent if a person is experiencing depressive symptoms, to a severe, nearly catatonic state. Depression is often associated with other physical or mental disorders, such as cardiovascular disease or anxiety.

There is not a clear cause of depression; rather, a combination of intrinsic and extrinsic variables prompts depressive symptoms to manifest (APA, 2013). Negative or stress-inducing
experiences arise throughout life and can prompt the development of depression. It is not well understood why some people are more prone to depression; however, temperament, genetics, and environmental stimuli are useful predictors. The DSM-5 states that people who express the personality trait neuroticism, or the likelihood of experiencing negative emotions, are at a higher risk of developing depression after exposure to stress (APA, 2013). A family history of depression also increases one’s risk. This endogenous type of depression can occur without a clear environmental stressor, indicating some inheritable temperamental or physiological mechanism could precipitate major depressive disorder (Rang et al., 2012). Similarly, depression often develops concurrently with other physical or mental diseases. Obesity, personality disorder, anxiety, and cardiovascular disease potentially induce more severe or chronic depressive episodes (APA, 2013). Interestingly, significant interactions exist between corticotrophin releasing hormone (CRH), a precursor to cortisol, and deficient monoamine levels typically associated with depression; indeed, the presence of cortisol has the effect of inhibiting the immune system, which may be a compounding factor in depressed individuals with an accompanying physical disease (Rang et al., 2012). Two monoamines, 5-hydroxytryptamine (5-HT) and noradrenaline, interact with the hypothalamic-pituitary-adrenal axis, which is responsible for releasing CRH to the anterior pituitary via portal blood vessels (Rang et al., 2012; Hall et al., 2011). In response, the anterior pituitary releases adrenocorticotropic hormone (ACTH) which regulates hormone secretion in other glands, specifically cortisol secretion from the zona fasciculata of the adrenal gland (Hall et al., 2011). Cortisol is a glucocorticoid, and it normally functions during times of stress to mobilize fuel, increase appetite, and suppress inflammation. People with depression have higher levels of plasma cortisol in comparison with
non-depressed individuals, indicating that deficient monoamine levels could induce cortisol secretion (Rang et al. 2012).

Furthermore, depression can be subdivided into two categories: unipolar depression and bipolar affective disorder (Rang et al., 2012). Unipolar depression describes a depressive episode where mood changes are in one direction; in other words, unipolar depression is what typically comes to mind when people use the word depression: sadness, lethargy, and a loss of excitement towards life. It is the most common type of depression, accounting for approximately 75% of cases (Rang et al. 2012). Bipolar affective disorder is less common. It is two-pronged, in a sense, due to alteration between a depressed-lethargic state and depressed-manic state during a relatively brief time span, often a few weeks. Mania, as the name suggests, is associated with over-the-top excitement, and it is accompanied by aggression, dangerous impulsivity, and delusionary behavior. These different depressed states are explained by one of the earliest theories on depression, the monoamine hypothesis developed in 1965 (Rang et al. 2012). This hypothesis investigates the effects of two monoamines, 5-HT and noradrenaline, as neurotransmitters. At its core, the monoamine hypothesis states that lack of these neurotransmitters leads to a depressed-lethargic state whereas excessive amounts induce mania. 5-HT and noradrenaline specifically impact monoaminergic transmission, as demonstrated by the pharmacological effects of various antidepressant drugs. Common modes of action for antidepressants are to either block monoamine reuptake, as in tricyclic antidepressants, or increasing the overall stored levels of monoamines through monoamine oxidase (MAO) inhibitors. In practice, both types typically lead to mood improvement, indicating the importance of monoaminergic transmission in depressed individuals.
EAAT and Veterans

EAAT has been popularized as a treatment for veterans to reduce a wide range of symptoms associated with PTSD, such as depression, anxiety, paranoia, and psychological distress (Malinowski et al. 2018). For the purpose of this review, two recent studies that specifically consider depression associated with PTSD will be considered to determine if EAAT mitigates depressive symptoms in veterans (Romaniuk et al. 2018; Malinowski et al. 2018). Romaniuk et al. (2018) investigated the efficacy of EAAT on depressive symptoms for participating veterans and their life-partners. Two programs were considered, one with individual veterans only and the other included veterans with their partners. Forty-seven participants were engaged in non-riding EAAT for a period of five days. The curriculum was largely “experiential and based around learning new skills in order to create social engagement” (Romaniuk et al., 2018, p.4). This involved ground work, grooming, and trail walks with the horses in addition to non-horse activities such as group discussions. Psychological assessments were used to measure PTSD, depression, happiness, and quality of life. Depression was measured using the Depression Anxiety Stress Scale-21 (DASS-21), a self-report questionnaire. This assessment was taken before, directly after, and three months after EAAT treatment. A t-test was run to compare the pre, post, and follow-up assessments. For the individual program, depression was considered severe pre-EAAT, then significantly dropped to mild post-EAAT. However, the follow-up assessment showed depression returned to severe. For the couples program, pre-EAAT depression was moderate and post-EAAT fell to normal. Depression rose back to mild after three months. In general, veterans with partners had less depression than veterans without partners. Romaniuk et al. (2018) determined that EAAT potentially helps veterans with depression; however, the beneficial effects are short term in duration once treatment ends, especially for
individual veterans. Similarly, another study investigated veterans undergoing EAAT; however, it was a small pilot study with only seven participants (Malinowski et al., 2018). Veterans received five days of EAAT, and depression was measured through self-reports, a Brief Symptom Inventory and PCL-5 checklist, before and after their five-day long treatment. Additionally, nurses collected data on veterans, including heart rate, respiration rate, and blood pressure, on treatment days before, during, and after EAAT to determine if EAAT physiologically impacted veterans. A t-test demonstrated that symptoms of PTSD, including depression, were reduced after EAAT. EAAT did not have a significant effect on physiological measurements, apart from heart rate which was slightly reduced during EAAT. The authors concluded that veterans psychologically benefited from EAAT based on data collected from the self-reports.

Romaniuk et al. (2018) provided a tentative conclusion, and they are correct for not overstating the trend of decreasing depressive symptoms during EAAT treatment. Participant selection, small sample size, and the presence of other therapies create difficulties when determining if EAAT alone caused the trend. Veteran participants were members of an organization that was providing therapeutic services; meaning, participants selected EAAT treatment which could affect self-reported information. This is further compounded by the fact that participants were informed of the study’s goals prior to enrollment. Possibly, participants may have been biased and reported improvements in depression to align with the study’s hypothesis. Additionally, the couples program had counseling to discuss therapy, daily life, or any issues they may be experiencing. Improvements in depression could be due to therapeutic discussions with a counselor and life-partner rather than EAAT. In comparison, Malinowski et al. (2018) based an overly strong conclusion of EAAT improving depression in veterans on little
data. It is prudent to emphasize that this study was exploratory in nature, with a very small sample size. The only significant data was through self-reported surveys, which as mentioned previously, could be subject to bias since Malinowski et al. (2018) did not state that participants were blinded. However, a strength of this study is the idea of using physiological data in association with psychological reports. As mentioned previously in this review, depression has physical impacts, like activation of the hypothalamic-pituitary-adrenal axis, that could be measured; in future studies, it may be worthwhile to consider taking blood or saliva samples to measure cortisol levels before and after an EAAT intervention as a measurement of stress and depression. For the present, Romaniuk et al. (2018) and Malinowski et al. (2018) provide interesting data that demonstrate slight trends of EAAT decreasing depression in veterans, but due to the studies’ constraints, it would be premature to decisively conclude a clear effect of EAAT on depression.

**EAAT for Children and Adolescents**

To be a successful intervention method, EAAT would bolster positive emotions which would then mitigate depression. Frederick et al. (2015) developed a study based on prior research about the negative correlation between hope and depression, meaning as hope increases, depression decreases. However, earlier research had not considered utilizing EAAT with at-risk adolescents. Frederick et al. (2015) selected a total of twenty-six participants who met a pre-selected criterion to be designated as at-risk; all participants were middle or high school aged adolescents. These individuals were randomly assigned to either a treatment group, which received EAAT, or a control group where they did not receive EAAT. The non-riding EAAT program provided a five-week curriculum that included observational and interactive activities with horses, allowing for therapeutic discussions on overcoming obstacles, safety, and goal
setting. Data was collected via two self-reports: Adolescent Domain-Specific Hope Scale (ADSHS) and Major Depression Inventory (MDI). Participants completed these reports privately during school hours; they were assigned a five-digit code and could seal response in an envelope. The reports were collected from both groups before and after the five-weeks, in addition to four points during the experiment. Based on the collected data, Frederick et al. (2015) demonstrated that depression levels trended downward, and levels of hope went up in the treatment group. A paired sample t-test indicated that the treatment group showed significant improvement in levels of hope by comparing pre-test and post-test scores; however, while depression scores decreased more in the treatment group, this change was not significant.

Frederick et al. (2015) determined that EAAT is an effective method for alleviating symptoms of depression in at-risk youth; however, this conclusion may potentially be overstated. Frederick et al. (2015) based their findings mostly on data that, as they self-report, violated normality, leading to statistical manipulations of the t-test. In addition, an ANOVA was performed to investigate differences in levels of hope and depression at the time points during the experiment. The ANOVA results conflict with the t-test, since neither hope and depression were significantly impacted. To their benefit, Frederick et al. (2015) discussed in detail the statistical manipulations applied to the data, and it should still be valued as credible information. The issue arises from a lack of discussion about the conflicting data and using it to decidedly claim that EAAT improved symptoms of depression. Frederick et al. (2015) provided raw, mean values which indicate a definite trend of decreased depression and increased hope, especially in the treatment group. Yet based on their analyses, the differences between the control group and the treatment group were not significant. The small sample size could have affected this finding and having a larger pool of participants may have demonstrated significant trends. In addition,
participants varied in the criteria that designated them as at-risk; criteria ranged from failing classes or state assessment tests, being held back a grade, and pregnancy. Certain criteria may lead to higher stressed and depressive states than others, for example having a child could lead to postpartum depression. Frederick et al. (2015) did not discuss these differences among participants. Overall, Frederick et al. (2015) provide tentative evidence that could suggest EAAT improves positive emotions and decreases depressive symptoms. However, it can not be conclusively stated that EAAT will help depressed individuals due to the study’s limitations.

Another study by Hession et al. (2014) investigated depression in children and adolescents, and they related physical exercise to improvements in depression by considering how equine therapy would affect youth diagnosed with dyspraxia, a developmental disorder that impacts physical coordination, cognition, and mood. Individuals with this condition possess an information delay between the cerebral hemispheres, a form of communication needed for motor coordination. Additionally, patients develop cognitive impairments that affect internal processes like perception and mood, and depression is often associated with dyspraxia. In addition to measuring the physical impact of EAAT, Hession et al. (2014) also measured depressive symptoms in participants. Based on the idea “that movement and cognition are internally linked,” they predicted that EAAT would lessen depression in participants due to motor stimulation and rhythm associated with horseback riding (Hession et al., 2014, p.20). Hession et al. (2014) selected forty youths ages six to fifteen years old who were diagnosed with dyspraxia and had not previously undergone EAAT. They participated in eight weeks of EAAT that involved weekly thirty-minute sessions. A child psychologist collected data on depression using the Childhood Depression Inventories (CDI), a self-report questionnaire. Hession et al. (2014) performed statistical analysis of paired sample t-tests to compare pre-test and post-test scores of
each child. Data collected via the CDI showed a significant decrease in depressive symptoms for all children, and the four adolescents who were categorized as severely depressed were reduced to two. Furthermore, based on observations by parents, children demonstrated an improvement in confidence, attitude, and concentration in the classroom and at home. Hession et al. (2014) found that EAAT is a useful method for therapeutically treating physical and cognitive disabilities, and they present information that suggests depression is alleviated with equine therapy, citing the influence of sensory stimulation on cognition and mood.

Hession et al. (2014) provide convincing research on the benefits of physical exertion on mood, specifically improving depressive symptoms in children and adolescents. They included a larger sample size of participants, although there were twice as many boys as girls and the authors neglected to provide a complete breakdown on participants’ backgrounds. This background information would be beneficial since it could include factors that affect depressive symptoms outside of the experiment; for example, Hession et al. (2014) do not mention if participants are receiving other forms of treatment, like medication or counseling. If participants were receiving other treatments, it may be difficult to entirely ascribe the significant decreases in depression to EAAT intervention. However, a strength of the study was the duration of EAAT, a full eight weeks, so it is still likely that EAAT impacted participants. Furthermore, the measurement of depression was a self-report questionnaire given by a psychologist, and while this provided the raw data, Hession et al. (2014) also included the input of the participants’ parents which bolstered claims that depression decreased. There could potentially be an issue with the parents’ reports since the authors did not mention if parents were blinded to the aims of the study. However, these reports allow for a multi-dimensional perspective on changes in participants’ mood and behavior in everyday life that a self-report questionnaire may not
illustrate. While a few questions remain, the study demonstrates how increasing motor coordination has a positive effect on mood; in other words, Hession et al. (2014) show how EAAT can alleviate depression through the physical demands of horseback riding.

**Exercise, EAAT, and the Neurophysiology of Depression**

EAAT may help individuals with depression partially because of the exercise participants engage in during sessions. Horseback riding requires development of endurance and muscle coordination, and EAAT is used for physical therapy to strengthen motor coordination, balance, strength, and other motor functions. Previous research on the biological effects of exercise on the human body addresses the connection between depression and exercise (Balchin et al. 2016; Sturm et al. 2012). Exercise produces analgesic effects due to β-endorphins, and these β-endorphins have been implicated in improving depressive symptoms (Balchin et al., 2016). Moderate to high intensity exercise produces a significant amount of β-endorphins, and individuals participating in an exercise regimen reported an improvement in well-being and decreased depressive symptoms (Balchin et al., 2016). Furthermore, being outside in nature could provide health benefits and this combination of exercise and nature could contribute to EAAT’s function in treating depression. Sturm et al. (2012) devised a study to examine the connection between nature, exercise, and depression. Participants had been clinically diagnosed with depression and had attempted suicide. Sturm et al (2012) assigned each person to mountain hiking session for a nine-week period, with approximately two to three hour hikes occurring twice a week. Depression was evaluated through self-reported surveys: Beck Hopelessness Scale (BHS), Beck Depression Inventory (BDI), and Beck Scale of Suicide Ideation (BSI). Participants also received their usual therapeutic treatments. Sturm et al. (2012) determined a significant decrease in hopelessness, depression, and suicide ideation when people participated in regular
hiking sessions, and they suggested that an activity for physical endurance may be a helpful inclusion when treating depression.

As demonstrated, physical exertion and β-endorphin release may mitigate stress, and consequently depression, which could indicate a mechanism through which EAAT could help depressed individuals. Physical or emotional chronic stress leads to increased amounts of circulating cortisol, and there is a correlation between stress and depression. Indeed, one of cortisol’s precursors, CRH, alters brain function, and studies in animal models demonstrate excess CRH potentiates depressive symptoms (Rang et al. 2012). One theory associates depression with the rate of neurogenesis and neurodegeneration, or the brain’s ability to develop and degrade neurons, respectively (Rang et al. 2012). Studies indicate that neurogenesis is inhibited in clinically depressed patients, especially in the hippocampal and prefrontal cortex brain regions. Research utilizing brain imaging technology reveals neurodegeneration of these regions since they are reduced in size when compared to non-depressed persons. Additionally, experiments using animal models suggest neurodegeneration is also caused by excessive glucocorticoid presence in the circulation. This provides evidence that excess cortisol may stimulate deterioration of the hippocampus and prefrontal cortex, thereby indicating another link between chronic stress and depression. In addition various treatments for depression induce neurogenesis, including exercise and antidepressant drugs.

Furthermore, there are two prodepressive and three antidepressive neurobiological pathways (Rang et al. 2012). The main prodepressive pathways involve stress which activates the hypothalamus-pituitary-adrenal axis as described earlier in this review. This pathway, via cortisol release, affects gene transcription and interacts with glutamate action to upregulate apoptosis of neurons, consequently causing neurodegeneration in the hippocampus and
prefrontal cortex. Glutamate action is the second prodepressive pathway. Depression has been associated with excess glutamate, which in turn, increases stimulation of NMDA receptors that directly turn on genes responsible for neural apoptosis. Conversely, the three antidepressive pathways contain noradrenaline, 5-HT, and brain-derived neurotrophic factor (BDNF). The two monoamines work on their respective G-protein coupled receptors α2 and 5HT1A while BDNF acts on the kinase-linked TrkB receptors. These receptors enhance the expression of beneficial genes, or genes that inhibit apoptosis of neurons and increase neurogenesis.

There are several mechanisms that connect stress and depression and alleviation of stress often corresponds with decreasing depressive symptoms. Exercise has been documented to release to β-endorphins, induce neurogenesis, and decrease cortisol levels, ultimately leading to less reported depression in patients (Rang et al., 2012; Balchin et al., 2016; Sturm et al. 2012). As indicated through Hession et al. (2014), the motor coordination necessary for horseback riding during EAAT may mitigate depression through these mechanisms. However, further research would need to be performed to quantitatively validate this claim, and future study could include physical measurements, like blood or saliva samples to measure cortisol levels.

**Table 2.** Major studies reviewed that involved the effect of EAAT on depression in people.

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample size (n)</th>
<th>Assessment Methods</th>
<th>Major Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frederick et al. (2015)</td>
<td>n=26</td>
<td>• Adolescent Domain-Specific Hope Scale (ADSHS)</td>
<td>• EAAT caused an increase in feelings of hope and a decrease in depression in at-risk adolescents, although statistical tests did not show significance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Major Depression Inventory (MDI)</td>
<td>• Improvements in depressive symptoms were more pronounced in adolescents receiving EAAT.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Measures</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hession et al. (2014)</td>
<td>n=40</td>
<td>• Ravens test</td>
<td>• Levels of depression were significantly reduced in children diagnosed with dyspraxia.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Childhood Depression Inventory (CDI)</td>
<td>• Motor and cognitive functions significantly improved.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• GAITRite Pressure Mapping System</td>
<td></td>
</tr>
<tr>
<td>Romaniuk et al. (2018)</td>
<td></td>
<td>• Individual, n=25 • Couples, n=22</td>
<td>• Significant improvements found in depressive symptoms as associated with PTSD in veterans.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Depression Anxiety Stress Scale-21 • PCL-5 • Oxford Happiness Questionnaire • Quality-of-Life Enjoyment and Satisfaction Questionnaire-Short Form</td>
<td>• Improvements were better maintained three months after treatment ended in veterans who had life partners.</td>
</tr>
<tr>
<td>Malinowski et al. (2018)</td>
<td>n=7</td>
<td>• Brief Symptom Inventory (BSI) • PCL-5 checklist • Heart rate • Respiration rate • Blood pressure</td>
<td>• Significant improvements found in depressive symptoms as associated with PTSD in veterans.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No significant indication of stress or well-being in horses participating in EAAT.</td>
</tr>
</tbody>
</table>

**Further Consideration**

Another factor of EAAT that may exert an effect on depression is the bonding experience between human and horse. The human-animal bond has been subject to research, with various species of companion animals under consideration. Dogs and cats may primarily come to mind when thinking of companion animals, but that group is broadening to include horses and farm animals, as well. One study (Yorke et al. 2008) discussed the benefits of forming bonds with horses and investigated if they can alleviate health problems in humans. Yorke et al. (2008) examined how people bonding with equine companions impacted their recovery from trauma.
While they were not measuring depression directly, this study demonstrates how horses beneficially affected their primary caretakers, and it may reveal another aspect of equine therapy that contributes to patient improvement. Yorke et al. (2008) described their study as “a qualitative phenomenological research approach sensitive to an emotionalist perspective” (Yorke et al., 2008, p.19). The human-animal bond is difficult to measure, so they relied on qualitative measurement of how participating individuals perceived their interactions with horses.

Participants had experienced either physical trauma that rendered them with a severe injury or psychological trauma. Researchers interviewed and audio-taped each participant twice. The first interview was based on what trauma the rider had experienced and his/her relationship with their horse. The second interview involved how the horse had affected the participants recovery from trauma. Upon review of these interviews, researchers identified four main bonds that developed between horse and rider: intimacy/nurturing, identity, partnership, and utility. In addition, Yorke et al. (2008) noted language used in the second interview about the therapeutic affect horses had on people involved “feelings, proximity, and behaviors relevant to healing and recovery” (Yorke et al., 2008, p.23). They concluded that the bonding experience riders share with equine companions significantly impacted healing and recovery for the better. These bonds provided “acceptance, nurturance, intimacy, safe touch and physical affection, collaboration, development of a sense of mastery and empowerment, and a natural setting that is safe and soothing” (Yorke et al., 2008, p.27). Admittedly, it is difficult to extrapolate these results and definitively apply them to all forms of equine therapy. Only six participants were involved, and they had all been involved with their respective horses from a young age, leading to potential bias. However, this should not negate the fact that participants derived some benefit from interacting and bonding with horses in a similar manner to EAAT.
In addition to bonding with horses, EAAT sessions provide an active, outdoors-type environment where clients would be presented with nature-like stimuli, and this combination of exercise and nature could further contribute to EAAT’s function in treating depression. Farm-animal assisted intervention is another example of animal assisted therapy with large animals. The context, barns and outdoor areas, is similar to where EAAT is typically conducted. Farm-animal assisted therapy falls under therapeutic interventions known as “Green Care” where providing an environment close to nature is supposed to increase feelings of well-being and good health (Pedersen et al. 2012). Pedersen et al. (2012) investigated the effect of twelve weeks of farm-animal assisted therapy on depression for twenty-nine people. Sixteen people received the therapy while thirteen others received treatment as usual without animal interaction. Individuals in the treatment group worked with dairy cattle twice a week. The Beck Depression Inventory (BDI) was used to self-report symptoms of depression, and participants submitted their assessment before treatment, at four weeks and eight weeks, at the end of treatment, and after a three-month follow-up. Pedersen et al. (2012) found that depression was significantly reduced in the treatment group by the end of treatment, and this was maintained for the three-month follow-up. The control group also showed decreases in depression, but not the same degree as the treatment group. Pedersen et al. (2012) concluded that farm animal assisted intervention is helpful when treating depression in combination with other therapies. This finding is well-supported by previous studies, as cited by Pedersen et al. (2012), and Green Care is becoming a prominent therapy, particularly in Europe. As described by Pedersen et al. (2012), interactions with farm animals include basic care and maintenance, but also close contact through grooming, petting, and talking to animals. These behaviors and activities are present in EAAT, and it is
possible that EAAT participants could derive the same anti-depressive benefits as people involved with Green Care.

**Conclusion:**

Four studies specifically connected EAAT with depression: Romaniuk et al. (2018) and Malinowski et al. (2018) investigated depressive symptoms of veterans diagnosed with PTSD, Frederick et al. (2015) considered at-risk youth, and Hession et al. (2014) described children diagnosed with dyspraxia. In each study, depression was measured through self-report questionnaires. Three studies (Frederick et al. 2015; Romaniuk et al. 2018; Malinowski et al. 2018) provided data that demonstrated trends of depression lessening after EAAT; however, these decreases in questionnaire scores were not always significant, or a study’s design was flawed to prevent entirely conclusive findings that indicated EAAT alleviated depressive symptoms. Hession et al. (2014) gave a more robust experimental design, larger sample size, and longer treatment period in comparison to the other three. Additionally, participants engaged in more physical activities since motor coordination was another factor Hession et al. (2014) assessed; indeed, this study was the only one where participants rode horses during EAAT. The addition of physical exercise may have contributed to more conclusive results that EAAT exerted a positive effect on depression. Previous research (Balchin et al. 2016; Sturm et al. 2012) demonstrates that moderate to high-intensity exercise leads to decreased levels of self-reported depression, primarily through the action of endorphin release. Endorphins reduce stress, potentially acting on the hypothalamic-pituitary-adrenal axis to reduce cortisol levels. Based on these four major studies, it is difficult to entirely accept the hypothesis that EAAT mitigates depressive symptoms. Potentially, EAAT is more effective when riding is involved to increase physical exertion. EAAT as a treatment option for depression should not be completely ignored;
EAAT fosters human-animal bonds that invigorate the healing process in recovery from trauma, and EAAT provides a similar context as Green Care farms which have been shown to significantly help depressed individuals (Yorke et al. 2008; Pedersen et al. 2015). In conclusion, EAAT should be considered further for treatment of depression, potentially with a focus on implementing more physically strenuous tasks like riding based formats in EAAT sessions.
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