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Post-traumatic stress disorder or PTSD has been a major topic of discussion within the military community over the last decade. Very little research currently examines the relationship between exercise and PTSD, however research has been able to establish a positive relationship between exercise and each of the disorders associated with PTSD, which are depression, anxiety and panic attacks. Since exercise has independently impacted the three primary disorders that often present themselves with PTSD, it seems logical that a positive relationship should exist between exercise and the symptomatology of PTSD when evaluating them together. The purpose of this study was to evaluate the relationship between exercise and the symptoms of PTSD while also evaluating the relationship between exercise and depression, anxiety and panic attacks in military populations. It was hypothesized that a relationship would exist between exercise and PTSD in military populations. This research also addressed each symptom of PTSD individually. The survey was distributed online via Qualtrics survey software program. Participants (n=122) were evaluated using regression analysis for exercise and PTSD, depression and anxiety independently. Follow up regression analysis was used to separate those diagnosed with PTSD versus those without and those with panic disorder history and those without. By using regression analysis, it was projected that there would be a relationship between exercise and PTSD, depression and anxiety. Scores on the International Physical Activity Scale were found to not be a significant predictor of PTSD symptoms, depression, or anxiety. PTSD diagnosis was a significant predictor of

PTSD symptoms, depression and anxiety with scores consistently higher for those diagnosed with PTSD as compared to those who were not diagnosed with PTSD. Finally, panic attack history was also a significant predictor of PTSD symptoms, depression and anxiety such that persons reporting a history of panic attack also reported more PTSD symptoms, greater depression and greater anxiety than persons who had never experienced a panic attack. While results indicate non-significance, it suggests that military may not benefit from exercise like non-military populations do and further research evaluating exercise more specifically in larger military populations is necessary.

THE RELATIONSHIP BETWEEN EXERCISE AND THE SYMPTOMS OF POST-TRAUMATIC STRESS DISORDER IN MILITARY POPULATIONS

by

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Approved by

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Committee Chair

Dedicated to the brave warriors who have risked their lives on behalf of the American people. Thank you for your service.

APPROVAL PAGE

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CHAPTER I

INTRODUCTION

Post-traumatic stress disorder, more commonly known as PTSD, has been a major topic of discussion over the past decade among health professionals, veterans and active duty military personnel. PTSD is classified in the Diagnostic and Statistical Manual-IV as an anxiety disorder and while a number of anxiety disorders are treated with psychotherapy, medical personnel in the military have had difficulty recognizing and effectively treating soldiers who suffer from the symptoms associated with PTSD. Amongst psychiatric disorders, PTSD has been classified as an emotional illness that develops from dangerous, terrifying, and even near death experiences. PTSD has been recognized for decades in the military community but not until the 1980's did the American Psychological Association (APA) add PTSD to the Diagnostic and Statistical Manual of Mental Disorders (DSM). During the Civil war, early references were made to a condition called Soldier's Heart. The symptoms related to Soldier's Heart were similar to PTSD. Later, references were made during World War I to combat fatigue and shell shock. Then during the Vietnam War, Post-veterans syndrome was recognized in the medical and military community as a new disorder (Wartorn, 2010).

The recent statistics for the wars in Iraq and Afghanistan show that one in six soldiers returning home suffer from PTSD. The prevalence is higher among enlisted personnel in relation to officers. More than 70% of soldiers are exposed to traumatic events in today's modern warfare; which may be reflected in the high prevalence of PTSD (Cornum et al, 2011). The suicide statistics are even more alarming; rates among military personnel in the United States surpass combat deaths and have been increasing since 2004. Of the 1.9 million troops who have deployed to Iraq and Afghanistan, 94% of troops report witnessing or experiencing traumatic events that would qualify as meeting the DSM criteria for PTSD (Hoge et al., 2004). Those who suffer from PTSD are 6 times more likely to commit suicide than those who return from deployments with no symptoms of PTSD. The statistics associated with PTSD call for urgency; military soldiers need a way to better cope with the symptoms associated with PTSD.

Among the military community, Abeysinghe (2011) evaluated prior research that showed PTSD is the most commonly occurring mental illness in combatants with about 30% suffering from the disorder. Of the 96 participants in Abeysinghe's study, 71% reported re-experiencing the trauma after returning home from deployment. Hiley-Young et al. (1990) evaluated the relationship between predictors for PTSD in military veterans and found that combat exposure was the only variable that predicted PTSD severity in military veterans. Combat exposure causes an increased risk for not adapting to high-risk situations. Increased combat

exposure causes a heightened stress response so many soldiers are unable to make a shift back into a civilian world.

Although effective treatments exist through psychotherapy and pharmacological agents, there has been very little research completed to evaluate how exercise could play a role in the treatment of PTSD in military populations. Non-military populations, who showed symptomatology of PTSD, saw a temporary reduction in their state anxiety following an acute bout of exercise (Steptoe & Cox, 1998). Research has also found that poorer physical and functional health had been associated with PTSD symptomatology (Rutter et al., 2013). Therefore, it may be beneficial for military personnel to participate in exercise to better their chances of coping with the disorder. Similar disorders of PTSD include depression, anxiety, and panic attacks. While there is limited research available on PTSD as a whole, there has been research completed on the individual with similar disorders like PTSD. Examination of evidence for the effects of exercise on depression, anxiety and panic attacks, suggest that a relationship could exist between exercise and PTSD.

Exercise has been shown to positively benefit depression among a variety of populations. De Moor (2008) showed that exercise had beneficial effects on adults suffering from depression when the exercise was offered in a therapeutic program. Further, in other research a dose-response relationship was found between exercise and reduced depression (Dunn et al., 2005). They focused on physical activities that are enjoyable and provide a sense of accomplishment. In a meta-analysis, Brown et

al. (2012) observed a small reduction in depressive symptoms amongst those who exercised. Noting further a dose-response relationship with weekly volume of aerobic exercise and larger reductions to depressive symptoms occurring when exercise was supervised. Groups participating in exercise programs have also been shown to outperform antidepressant groups during a follow-up after a 12-week intervention (Blumenthal et al., 1999). Effects of exercise on depression could show implications for the military community suffering from similar symptomatology like depression. A systematic review and meta-analysis by Bridle and colleagues (2012) looked at the impact of exercise on depression severity in older populations. In 4 trials, the degree of depression reduction was statistically significant for the exercise conditions compared to the control group. They concluded that small but significant effect sizes favored exercise. The findings of this meta-analysis suggest that individuals suffering from clinical symptoms of depression can be treated with structured exercise programs. If exercise has been shown to be beneficial for depressed patients, implications would suggest it could also be useful for those who suffer from PTSD.

Anxiety is the second disorder that compares with PTSD. State anxiety specifically has been shown to be reduced following bouts of acute exercise. In a review by Martinsen (2008), state anxiety was reduced following a single bout of exercise for those with normal and elevated levels of anxiety. Exercise has been found to benefit anxiety and those who exercise report less anxiety sensitivity and

reductions in symptoms associated with anxiety (Broman-Fulks and Storey, 2008). In a systematic review on the effects of exercise training on anxiety symptoms, researchers found that exercise training decreased anxiety scores in patients with chronic illness (Herring et al., 2010). Exercise of low intensity has also been found to be effective in lowering anxiety. The slow movements and focus on relaxation with exercises like yoga and qigong specifically have been shown to produce reductions in state anxiety (Johansson et al., 2011). Implications for exercise on anxiety may suggest that exercise could also benefit PTSD.

The third disorder that is relevant to PTSD is panic attacks. The literature on exercise and panic attacks is very limited. This is mainly due to the fact that exercise can cause hyperventilation, tachycardia, palpitations, and sweating. Therefore, many people who suffer from panic attacks elect not to participate in physical activity due to these physiological responses. Nonetheless, some research completed on panic disorder has shown that therapeutic exercise is effective in improving the anxiety symptoms associated with panic disorder patients (Broocks at al., 1998). People with panic disorder can benefit from exercise and while some find exercise difficult to finish because of the physiological responses, once the exercise bout has finished reductions were shown in overall anxiety levels (Caldirola et al., 2011). While there is less literature on panic disorders compared to depression and anxiety, studies have suggested that exercise may benefit those who suffer from panic attacks.

In sum, research on the effects of exercise on depression, anxiety and panic attacks support that exercise benefits these disorders, which mechanistically are similar to PTSD. Since the literature suggests that exercise has independently impacted the three disorders, it seems logical that exercise may also positively impact PTSD.

Statement of Problem.

The primary purpose of this study was to evaluate the relationship between the symptoms of PTSD and exercise behaviors in military personnel. A secondary purpose of this study was to further evaluate each independent relationship between depression, anxiety, panic attacks and exercise in military populations post deployment.

Hypothesis.

It was hypothesized that exercise would benefit military soldiers' symptomatology of PTSD; therefore the more physically active veterans were the fewer symptoms of PTSD they would exhibit.

Sub problems:

1. Evaluate the relationship between exercise behaviors and depression in military personnel.
2. Evaluate the relationship between exercise behaviors and anxiety in military personnel.

3. Evaluate the relationship between exercise behaviors and panic attacks in military personnel.
4. Evaluate the relationship between exercise behaviors and PTSD in military personnel.

Hypothesis of Sub Problems.

1. There would be a significant relationship between exercise behaviors and depression in military personnel.
2. There would be a significant relationship between exercise behaviors and anxiety in military personnel.
3. There would be a significant relationship between exercise behaviors and panic attacks in military personnel.
4. There would be a significant relationship between exercise behaviors and PTSD in military personnel.

CHAPTER II

REVIEW OF THE LITERATURE

Post-traumatic Stress Disorder (PTSD) is defined as an ordeal that involves physical harm or the threat of physical harm (National Institute of Health). The symptoms of PTSD are "re-experiencing the trauma, symptoms of numbing the responsiveness or reduced involvement in social relations, and symptoms of hyper arousal or exaggerated startle response, survival guilt, sleep disturbances and avoidance of activities that remind the individual of the trauma" (Diagnostic and Statistical Manual of Mental Disorders, 2013, para. 5)

Some of the first studies completed on PTSD were in the 1980's after the American Psychological Association and the DSM recognized PTSD as a disorder. There are four syndromes of PTSD that are related to veterans who have combat-related stress disorders: "(1) survival guilt secondary to losing a close friend, (2) fear and anxiety secondary to life-threatening situations, (3) guilt and related conflicts secondary to participation in acts of abusive violence, and (4) mistrust secondary to the experience of betrayal of trust, especially by persons of authority" (Glover, 1988, p.58).

Early references to PTSD date back to the Civil War when it was referred to as Soldier's Heart (Wartorn, 2010). Then during World War I it was referred to as

combat fatigue or shell shock. During World War II the terms used were battle fatigue or gross stress reaction. It was not until the Vietnam War that PTSD was referred to as post-veterans syndrome (an early term for post-traumatic stress disorder). During this time the medical and military community recognized post-veterans syndrome as a disorder growing in prevalence.

Prevalence of PTSD.

Since the beginning of the Iraq and Afghanistan war in 2001, over 1.9 million troops have deployed to combat in those countries. Hoge and colleagues reported that 94% of service members report witnessing or personally experiencing traumatic events that could result in potentially meeting the DSM criteria for PTSD symptomatology and 8-31% of service members experience psychological distress (symptoms of PTSD or depression) in the first 3-12 months post deployment (Hoge et al., 2004; Kim, Britt, Klock, Riviere, & Adler, 2011; Thomas et al., 2010). Of the 8-31% experiencing psychological distress, 56%-87% have not received any psychological help (Hoge et al., 2004). This failure to obtain treatment for psychological distress may be reflected in the dramatic increase in suicides by service members. Barrett (2011) reported that since 2001 suicides in the U.S. armed forces escalated rapidly with 334 suicides alone in 2009 more than any other year since records began in 1980. Barrett concluded that this was reflective of the fact that no psychological help is required following deployments. In 2009, the percentage of suicide deaths among soldiers diagnosed with PTSD grew from 4.6%

in 2005 to 14.1%(Kuehn, 2010). Specifically, 817 U.S. Army Soldiers committed suicide in 2001-2008, which was more than those who were lost in combat during that same year. Suicide statistics show that rates among military personnel in the United States surpass combat deaths and have been increasing since 2004. There were 255 soldiers who committed suicide in 2007-2008, which equates to 20 soldiers out of 10,000 (Kuehn, 2010). Between 2004 and 2007, the number of newly diagnosed cases of PTSD in the Army increased from 2,931 to 10,137 (Kuehn, 2010). This is extremely alarming because those service men and women who suffer from PTSD are 6 times more likely to commit suicide than those who return from deployment and have no history of PTSD. These statistics call for urgency; we need to train soldiers to cope better with the symptoms seen after returning from deployments. The military currently uses training fields and techniques to simulate combat, but these training practices do not train the mind to cope with the physiological and psychological responses that occur during combat. These physiological and psychological responses are important to consider in the development of training programs for soldiers who must learn to cope with warzone violence and combat situations.

Predictors/Determinants of PTSD.

PTSD is most commonly associated with survivors of traumatic events despite whether or not they have been wounded in battle. PTSD can occur after any

situation in which victims perceive that their life or safety is threatened (Shearer, 2011), and it is one of the most commonly occurring mental illnesses in combatants.

In one of the first research studies conducted on PTSD, Hiley-Young et al. (1995) explored the relationship between various predictors and the experience of PTSD. Hospitalized veterans received a psychological assessment and provided demographic information, childhood sexual history, and abuse history. Combat experience was measured by Part II of the Vietnam Era Stress Inventory (composed of 5-point Likert scale items) and the PTSD measure was a 49-item scale developed by Keane, Malloy, and Fairback (1984). Scores of 30 and above on the PTSD scale suggested PTSD symptomatology. The results showed that when combat exposure was evaluated against other abusive behaviors, combat exposure was the only variable that predicted PTSD severity (β=.18, $p < .05$). The implications from this study are that the more a soldier deploys, the less the soldier will be able to adapt to high-risk situations. Higher rates of combat exposure create a constant heightened stress response and when soldiers return from deployment, many of them cannot cope with daily tasks and life as a civilian outside a structured military world.

The statistics for military personnel returning home from deployment with symptoms of PTSD are alarming. Abeysinghe (2012) evaluated prior research that showed PTSD is the most commonly occurring mental illness in combatants. Data collected during this study consisted of pre-test self-administered scales from the Diagnostic and Statistical manual of Mental Disorders. Of the 96 participants in the

study, 40 indicated clinical diagnosis of PTSD. Abeyasinghe and colleagues found that 71% of all participants reported re-experiencing the trauma at some point after returning from deployment. These statistics warrant improved treatment to reduce the number of military personnel suffering from PTSD. If PTSD consists of 30% of all mental disorders, implications from Abeyasinghe study show that an even larger amount of soldiers are at risk for developing PTSD after re-experiencing the trauma.

Treatment of PTSD.

Current treatment methods for PTSD focus on therapeutic interventions of psychotherapy or pharmacology or a combination of both. In a review of literature by Wisco et al. (2012), pharmacological agents were found to be effective in the treatment of PTSD. These agents are serotonin reuptake inhibitors (SRRIs) and serotonin-norepinephrine reuptake inhibitors (SNRIs) and they have been found to be effective in both civilian and veteran populations. A large disadvantage to these types of treatment is that maintenance doses are required in order to prevent relapse. Therefore, this form of treatment requires long-term care. The second form of treatment is psychotherapy and two forms of cognitive behavioral therapy have been found effective in the treatment of PTSD. Cognitive Processing Therapy (CPT) was originally developed for the treatment of sexual assault victims (Resick and Schnicke, 1992). CPT involves cognitive restructuring and exposure processing elements (Wisco et al., 2012). This type of restructuring is designed to teach patients how to challenge their thoughts about the trauma (Resick and Schnicke,

1992). In a study by Resick and Schnicke, 19 women were selected to participate in CPT over a 12 sessions. The results indicated that CPT was effective in improving symptoms in a large portion of participants. These improvements were maintained over a 6-month time period following the treatment. Research has found that those receiving CPT improve significantly and 40% of veterans no longer meet criteria for PTSD upon completion of the CPT treatment (Monson et al., 2006). The positive effects of CPT on PTSD symptoms also helped co-symptoms of depression and general anxiety, guilt distress and social adjustment. Prolonged exposure therapy (PE) is the second therapy that has been used as a successful treatment for combat-related PTSD. Significant reductions in PTSD have been seen as a result of PE (Powers et al., 2010; Rauch et al., 2009). In Powers et al. (2010), a meta-analysis of 13 RCT PE trials showed that PE performed significantly better than control conditions on measures of PTSD. In military veterans receiving PE therapy, reductions in symptoms were seen across all veterans (Operation Enduring Freedom/Operation Iraqi Freedom, Vietnam, and Military sexual trauma), which were comparable to nonveteran populations (Rauch et al., 2009). While effective pharmacological and psychotherapy treatments have been found, it is still important to look at the relationship of exercise and PTSD in order to help people who may not benefit from these current treatments.

Another study demonstrating an effective treatment for PTSD focused on Internet interventions using interactive workshops (Ruzek, 2011). Ruzek addresses

the issue that military personnel have barriers and concerns about the potential stigmatization associated with seeking face-to face care and its interpretation as a sign of weakness. Ruzek offered Internet workshops in place of face-to-face care and gave military personnel suffering from PTSD the ability to come forward with their disorders. The Internet workshops helped to educate them and allow them to interact online in hopes that this would contribute to decreases in their symptoms of PTSD. While the website has not formally been evaluated, it has received 153,697 visitors from 2008-2011. However, clearly there is still a lot we must learn about PTSD and specifically about military personnel who suffer from PTSD in order to help them further.

We know the symptoms of PTSD include reliving the event, avoiding situations that remind you of the event, nightmares, flashbacks, having troubles sleeping, concentrating, and hyper arousal. We know that mechanistically, disorders like depression, anxiety and panic attacks have very similar neurological make-up and symptomatology to PTSD. Studies looking at the role of exercise in the treatment and prevention of PTSD are limited since the disorder has not been focused on until recently. However, by looking at how exercise has directly impacted these similar disorders, insights regarding a potential relationship between exercise and PTSD may be possible.

Exercise and PTSD in Non-military Populations.

Despite the lack of research examining the effects of exercise on PTSD symptoms, there is research showing that non-military populations suffering from non-clinical levels of PTSD (not receiving treatment, but displaying symptomatology) have received benefits from exercise. Thirty-two female medical students completed 2- 8-minute high intensity exercise trials and 2- 8-minute low intensity exercise trials. They showed a temporary reduction in their state-anxiety for as little as 5 minutes and as long as several hours post exercise after completing low intensity acute bouts of exercise (Steptoe & Cox, 1998). Rutter and colleagues (2013) tested relationships between physical and functional health and PTSD. The Veterans Affairs Boston Healthcare researchers surveyed 200 undergraduate students on traumatic events, anxiety, depression, health background and physical activity (Rutter et al, 2013). The Traumatic Life Events Questionnaire (TLEQ) was used to report trauma history on 22 types of traumatic events. The PTSD Checklist-Civilian (PCL) and Beck Depression Inventory II (BDI-II) were used to assess PTSD and depression levels while physical activity was assessed on a health risk appraisal scale (HRA) of 50 items self-reporting health related behaviors. Rutter and colleagues found that poorer physical and functional health were associated with PTSD symptoms and depressive symptoms.

In a 2010 study by Oeland and colleagues, participants were recruited for a 20-week physical activity group exercise program based on meeting criteria for

panic disorder, generalized anxiety disorder, and mild to moderate depression. Those eligible had to have a body mass index (BMI) <35, be above the age of 18, and could not be abusing substances. The participants completed both aerobic and anaerobic exercise. The aerobic exercise was 30 minutes of exercise on an ergometer bike, jumping, stepping and walking on a treadmill. The anaerobic exercise was weight lifting with basic exercises of all major muscle groups progressing from machines to free weights. In both groups, patients suffering from anxiety and mild to moderate depression were able to participate in the exercise programs and showed resultant improvements in their overall quality of life (Oeland et al., 2010).

Exercise and Depression.

Depression has a known association with PTSD and while the literature is sparse for exercise related to the treatment of PTSD, we do know that exercise has been shown to improve depression.

In a study by De Moor et al. (2006), participants were recruited through a national database in the Netherlands and were asked if they participated in exercise regularly. Participants self-reported the type, frequency, and duration of their regular exercise and were classified as an exerciser if they exercised for at least 60 minutes per week with a MET score of 4 or more. Depression was measured on a modified Beck's Depression Inventory (BDI) of 13 items. Findings showed that people who exercise tend to be less depressed compared to non-exercisers. These

findings are a part of an ongoing study on lifestyle and health of adolescent adult twins and their families. In 2008, De Moor et al, published a follow up to the cross-sectional research by using data collected in 1991, 1993, 1995 and 2002. Leisure-time exercise was measured be self-report questionnaires and again, all exercise was quantified using METs. To evaluate anxiety and depressive symptoms they used a somatic anxiety scale and neuroticism scale. The results showed that the antidepressant effects of exercise may only occur if exercise is monitored and a part of a therapeutic program. Thus, the results of these studies indicate that significant cross-sectional and prospective associations exist between regular exercise and reduced anxious and depressive symptoms. Lower levels of regular exercise are associated with more depressive symptoms (De Moor et al., 2008). If exercise can be used as a therapy to help patients suffering from depression, then it may become important to implement exercise for all soldiers returning home from deployments. From the two De Moor et al. studies, symptoms of depression were lowered when participants exercised in a monitored or therapeutic program.

In a study exploring the combined effects of exercise and antidepressant medications on depressive symptoms, Blumenthal and colleagues (1999) randomly assigned 156 men and women with major depression to either exercise 3 times per week, receive antidepressant medication, or receive a combination of the two. All three groups significantly improved in their depressive symptoms. At baseline, groups did not differ in level of depression but at the 4-month mark, all three groups

no longer met DSM-IV criteria for major depressive disorder. Importantly, the authors found that those who received the antidepressants improved faster initially, but at the 12-week mark, those who exercised had kept their gains longer and to a larger extent when compared to the non-exercise medication group. Implications for this study show that long-term exercise interventions with patients with depression can be beneficial and may even be more beneficial than regular medication routes. The implication for the military community is that those who suffer from symptomatology similar to depression might be able to return to duty and cope better over the long term if they participate in regular exercise.

In another study examining the relationship between exercise and depression, Dunn and colleagues (2005) studied the dose-response relationship of exercise and reduced depression. Focusing on regular physical activity of any type that is enjoyable and provides a sense of accomplishment, they found that those who exercised according to ACSM recommendations (three to five times a week) had significantly larger reductions in depression compared to those who exercised at a lower intensity and lower energy expenditure during the 12 week intervention. The results of these studies suggest that an exercise program can be effective for patients suffering from depression.

In a review looking at treating postpartum depression, Daley and colleagues (2007) looked at published English language reports of randomized control trials (RCT), uncontrolled studies, and observational reports that assessed physical

activity as a treatment of postpartum depression. They found two published RCT's, three observational studies, and several studies comparing postpartum populations against general populations of women. Significant evidence was found for exercise benefiting people with general depressive symptomatology and furthermore benefiting women who suffer from postpartum depression.

In 2008, Daley followed up with a review on exercise and depression. Four RCT's were examined for the effects of exercise on depression. When evaluating exercise against standard forms of treatment, exercise was found to not be significantly different from psychotherapy or other types of behavioral and pharmalogical interventions. Since exercise has minimal side effects and many potential health gains, the author concluded that clinicians and health professionals should promote exercise as an effective treatment method for depression (Daley, 2008). Daley recommends exercise in combination with other treatment methods to be the most beneficial for treatment.

Young adult women with postpartum depression and women with clinical depression have been shown to benefit from decreased depression after exercising. Looking at an older aged population, Laske and colleagues (2010) studied exercise-induced normalization of decreased BDNF serum concentration in elderly women with major depression. Thirty-five elderly women with depressive, unipolar depression according to DSM-IV criteria and 20 healthy women without any disease participated in a modified incremental exercise testing on a motorized treadmill.

Walking speed and incline increased simultaneously every 3 minutes. At every 3-minute marker, perceived exertion was recorded using a 15-point Borg scale. Major depressive disorder has been shown to decrease BDNF levels and anti-depressants have been shown to normalize BDNF levels in the brain. After a single bout of short-term exercise, major depressive patients showed a significant increase and normalization of BDNF serum levels. They concluded that a single exercise session leads to significant up-regulation and normalization of BDNF serum levels with major depression and by normalizing BDNF levels from exercise it is similar to antidepressant drugs. This is a beneficial effect of physical activity on acute treatment and relapse prevention in major depression patients. Repetitive physical activity may be the key to reduced symptoms of depression. BDNF levels were shown to normalize for only 1 hour after a single bout of exercise. Repetitive physical activity has been shown to create a dose-response relationship with depression. The evidence provides a physiological mechanism by which exercise can be used as a treatment method of depressive symptomatology.

Recently, Bridle and colleagues (2012) completed a systematic review and meta-analysis of exercise on depression severity in older people. Studies were included if they were RCT's of exercise interventions among older populations. The minimum age requirement was greater than 60 years of age. Of all the studies looked at, nine studies were included in the meta-analysis. In four of the nine trials the degree of depression was statistically significant in exercise conditions(P= 0.02)

compared to the control groups and the review concluded that a small but statistically significant effect size favored exercise as having a positive effect on the severity of depression. These findings are consistent with the suggestion that individuals with clinical symptoms of depression can be prescribed structured exercise (both cardiovascular and strength) and they will experience a reduction in severity depression severity (Bridle et al., 2012).

Exercise has not only shown to benefit people with depressive symptoms, it is also has been found to be enjoyable. Mata and colleagues (2013) recruited 81 women with depression. Depression, affect, and physical activity were self-reported measures. During the first session, the women were administered the Structured Clinical Interview for the Diagnostic (SCID) and the Statistical Manual for Mental Disorders Beck Depression Inventory-II (BDI-II). Of the 41 women recruited, 22 were randomly assigned to an exercise group while the remaining 19 were assigned to a non-exercise control group. During the second visit, participants in the exercise group were asked to exercise for 15 minutes on a stationary bike at a speed and resistance they were most comfortable with. Mata and colleagues found that participants who exercise compared to the control group exhibited lower levels of negative ratings on the BDI-II and SCID. Lower negative ratings showed that the women who participated in the exercise treatment, enjoyed working out while lowering their depressive symptoms. Mata and colleagues concluded a dose-response relationship of exercise and reductions in depressive symptoms, showing

that exercise may be an alternative or adjunct treatment to traditional treatment methods for adults suffering from depression.

Brown and colleagues (2012) conducted a meta-analysis on the efficacy of exercise in reducing depressive symptoms among cancer survivors. The review found that there was a small overall reduction in depressive symptoms among cancer survivors who exercise. There was a greater significance noticed among ages 47-62 years than those who were younger than 47 years and older than 62 years. The review confirmed that exercise provided a small effect in reducing depressive symptoms among cancer survivors. Brown and colleagues also observed a dose-response relationship with the weekly volume of aerobic exercise. Larger reductions in depressive symptoms also occurred in studies where the exercise was supervised.

In a meta-analysis conducted by Rethorst and colleagues (2009), they examined the effects of exercise on depression, specifically the effectiveness of moderate to vigorous exercise as a treatment condition. Only randomized control trials were included as long as the control trial was not light exercise. Of the 149 articles examined, 75 studies met the inclusion criteria. They found that participants in the exercise treatment condition had significantly lower depression scores than those in the control treatments. Participants with non-clinical depression that participated in combined aerobic and resistance exercises showed significantly larger effects than aerobic exercise or resistance exercise alone. Those who were clinically depressed showed no difference in the type of physical activity performed

or combination, all saw a decrease in depression scores. It was concluded from the meta-analysis that exercise improved depression scores and clinically depressed patients showed a significant improvement in their depression scores as well.

From the amount of research found on the effects of exercise and depression, exercise has been shown to reduce depressive symptoms and to produce effects comparable to those seen in response to formal treatments like antidepressants and psychotherapy. Since depression is so closely associated with PTSD, the literature would suggest that those suffering from PTSD might also see reductions in their depressive symptoms similarly to what has been seen from depression only research.

Exercise and Anxiety.

Anxiety is a second disorder associated with PTSD and over the last decade research has similarly shown that exercise benefits anxiety symptoms. In a review, Martinsen (2008) reported that state anxiety is significantly reduced following acute bouts of exercise for both those with normal and elevated levels of anxiety. These reductions are significant from 5-15 minutes post-exercise and remain decreased for the following 2-4 hours before returning to pre-exercise levels. Martinsen (2008) noted that while few studies have been published on children and adults with anxiety disorders, there seems to be a small effect size favoring exercise as a way to reduce anxiety in general populations.

Subsequent to this review, Broman-Fulks and Storey (2008) reported the effects of a brief aerobic exercise intervention on high anxiety sensitivity. Thirty-five undergraduate students were administered the PAR-Q (physical activity readiness questionnaire) to ensure they were healthy enough to participate in activity. They were then assigned to either a high-intensity aerobic exercise group or a non-exercise control condition. All participants reported high anxiety sensitivity according to a revised Anxiety Sensitivity Index. Participants in the exercise group performed aerobic exercise that was designed to expose them to bodily sensations associated with anxiety. The participants were asked to exercise based on American College of Sports Medicine recommendations of 60-90% of their predicted maximum heart rate. All participants wore a heart rate monitor and adjusted the speed of the treadmill if necessary. To evaluate anxiety a revised version of the Anxiety Sensitivity Index was used with a rated 5-point Likert Scale. Factors that were analyzed were fear of respiratory symptoms, fear of publicly observable anxiety reactions, fear of cardiovascular symptoms, and fear of cognitive dyscontrol. The results showed that exercise-induced anxiety exposure was associated with significant declines in self-reported anxiety levels post exercise. Broman-Fulks and Storey found that exercisers reported less anxiety sensitivity while anxiety sensitivity scores did not change for the control group. Elevated anxiety sensitivity has been associated with an increased risk for anxiety disorders. The decrease in anxiety sensitivity is related to exercise providing reductions in cardiovascular and

respiratory symptoms, socially observable anxiety symptoms, and cognitive dyscontrol. These effects mean exercise may be an intervention for individuals who suffer from anxiety.

In a study by Smits and colleagues (2008), 60 participants were recruited with elevated levels of anxiety sensitivity (a score greater than 25 on the Anxiety Sensitivity Index, ASI). The Beck Anxiety and Depression Inventories were used to assess anxiety and depression levels while exercising in 6, 20-minute exercise sessions completed over a 2-week period. Results showed that exercise reduced anxiety sensitivity, anxiety, and depression (Smits et al., 2008).

Blacklock and colleagues (2010) explored the effects of acute exercise on state anxiety in breast cancer survivors as compared to healthy controls. The women completed pretesting and were randomly assigned to a light or moderate intensity exercise condition. Participants cycled for 20 minutes maintaining 60-rpm. The light exercise group remained within 30-35% of their heart rate reserve (HRR) and the moderate exercise group maintained 60-65% of their HRR. State anxiety was evaluated based on a 10-item State Anxiety Inventory (SAI YI) and the researchers found that both cancer survivors and healthy controls experienced reductions in their state anxiety following exercise (light exercise n=0.18, moderate exercise n=0.32). Exercise at a light to moderate intensity may provide another strategy for reducing state anxiety.

Mackay and Neill (2010) studied the effect of green exercises on state anxiety. One-hundred and one participants in eight outdoor exercise groups (road cycling, mountain running, orienteering, cross-country running, fitness boxing near a lake, mountain biking, kayaking, and walking) were recruited and given the State-Trait Anxiety Inventory for Adults at the pretest and posttest. The results showed that outdoor exercises significantly reduced state anxiety.

Looking at other forms of exercise, Johansson and colleagues (2011) looked at the acute effects of Qigong exercise on anxiety. They recruited 59 regular qigong exercisers who were randomly assigned to a Qigong group or non-exercise control group for one day during Biyun Summer School. The Qigong group exercised for 30 minutes on the day of the study. During the session, they used slow movements and mental concentration focusing on their joints and relaxing their whole body. Results showed that state anxiety, anger, and fatigue scores were significantly reduced in the Qigong group compared to the control group.

Other authors were interested in low intensity and aerobic exercise. Vancampfort and colleagues (2011) researched state anxiety in response to yoga and bicycling. The 40 participants completed 30 minutes of a yoga session, 20 minutes of an aerobic exercise session on a bicycle ergometer at their own intensity and a 20-minute non-exercise control in a randomly assigned order. Results showed that the participants had significant reductions in state anxiety following both single bouts of yoga and aerobic exercise.

In a study looking at anxiety over a 12-week period, Carraro and Gobbi (2012) recruited 27 participants with intellectual disabilities (ID) who were randomly assigned to either an exercise group or control group. All the participants lived at home and volunteered for the study and were either classified as mild ID or moderate ID. Physical activity sessions were conducted by an exercise specialist, who adjusted intensity and duration according to each participant's skills and physical fitness. Each session involved an initial warm-up, a main exercise period, and a cool down. Most workouts involved dumbbells, balls, ropes and other standard gym equipment. The results showed that exercise had an anxiety reducing effect and the participants reported significant reductions in generalized, trait and state anxiety compared to the control group. The results indicate that exercise is more effective at reducing anxiety compared to a general control. The implications of this study show that chronic exercise also has a positive effect on anxiety.

In 2010, a systematic review was completed on the effects of exercise training on anxiety symptoms among patients with chronic illnesses (Herring et al., 2010). The researchers reviewed articles from 1995 to 2007 that adhered to the physical activity guidelines for Americans. Forty-five articles were found including both an anxiety outcome measured at baseline and after exercise training with a random assignment to either an exercise group or control group. The results revealed that exercise training decreased anxiety scores in patients with chronic illness.

In a meta-analysis by Bartley and colleagues (2013), 7 studies with 407 subjects were included in the analysis. Most of the studies examined only participants with 1 DSM-IV anxiety disorder. Results of the meta-analysis did not show a benefit of aerobic exercise for patients with anxiety disorders. However, this evidence was concluded in studies that compared exercise with cognitive behavior therapy control groups. Trials that used placebos or waitlist control conditions have shown to be significant in benefiting aerobic exercise to reduce anxiety symptoms. Bartley and colleagues concluded that a positive effect of aerobic exercise was confined only to trials involving a placebo control group and there is no evidence showing exercise is more effective than non-aerobic exercise in treating anxiety disorders. Implications for this study suggest that aerobic exercise may compare to non-aerobic exercise treatments in treating anxiety disorders.

From the research, anxiety has been shown to improve from exercise in both acute and long-term settings. It has also been shown to be effective in reducing anxiety over a variety of types of exercise. Reducing anxiety sensitivity through exercise intervention can help panic disorders where anxiety sensitivity appears to be the central part of the disorder. The implications of this research knowing that anxiety is a similar disorder to PTSD means if we know anxiety is able to decrease from exercise, PTSD may also see the same effects.

Exercise and Panic Attacks.

Literature on the effects of exercise and panic attacks are much more limited. Exercise has been shown to reduce anxiety as well as decrease anxiety sensitivity in patients whose anxiety is coupled with panic disorder. Patients who suffer from panic attacks report hyperventilation, tachycardia, palpitations and sweating as symptoms of anxiety and avoid exercise because these are the most discomforting symptoms. However, regular exercise may help patients to interpret bodily symptoms like the ones listed above, as normal signs of stress following either anxiety or physical activity (Martinsen, 2008).

Broocks and colleagues (1998) looked at the effects of therapeutic exercise for patients who suffered from panic disorder. In order to evaluate the efficacy of exercise, they compared the exercise treatment to a drug treatment and placebo. The intervention was 10 weeks long and 46 participants were recruited who were randomly assigned to each group. Participants in the exercise group were trained according to a protocol based on general recommendations for aerobic exercise. Results showed that the exercise group was significantly more effective than the placebo in improving anxiety symptoms in panic disorder patients. Implications of this study show that this placebo controlled, randomized study was effective at lowering anxiety levels in panic disorder patients by participating in aerobic exercise.

During an acute bout of exercise, Caldirola and colleagues (2011) investigated the influence of exercise on anxiety levels and cardiovascular responses to exercise in patients with panic disorder. They recruited 10 patients with panic disorder and 10 patients with no lifetime psychiatric disorders to be included in the study. All participants completed a submaximal exercise test of a 4km/h walk on a treadmill. The grade was increased in order to achieve 65% of maximal heart rate. Heart rate and respiratory variables were recorded throughout the entire test. Patients experienced increased levels of anxiety compared to controls at all phases of the exercise test. It was found that patients with panic disorder showed poorer cardiovascular response with respect to heart rate and blood pressure. This group also had a lower tolerance to exercise and a higher perceived exertion during the exercise testing compared to the control group. The patients with panic disorder also reached their peak heart rate and ventilatory threshold faster than the controls. Although their anxiety levels and exertion were higher during exercise, they were significantly lower during their evaluations post exercise. The implications of this study show that those who suffer from panic disorder do see a benefit from exercise. However, the biggest hurdle for them is to complete the exercise in order to see those benefits. It is suggested that due to their lower tolerance for exercise, they may enjoy the activity less than most individuals. However, structured exercise programs may be the solution to helping panic disorder patients remain motivated to push through exercise so they can see the benefits after.

Recently, Hovland and colleagues (2013) compared group physical exercise to group cognitive behavioral therapy (CBT) for the treatment of panic disorder. Thirty-six panic disorder patients were randomized to either 3 weekly exercise sessions of physical activity or one weekly exercise session of CBT. The physical activity sessions were led by a team of three individuals who tracked the exercise and supervised their workout sessions. The frequency and duration was based on recommendations from previous research dealing with people who suffer from anxiety. They found that both groups were effective for the treatment of panic disorder however the effects were more consistent over time for the CBT group than for the physical exercise. While CBT overall was found to be more consistent over time, exercise groups reported more beneficial effects when evaluating how they perceived fear and bodily sensations. While CBT did have a more consistent response over time, physical exercise was still found to be beneficial and still should be recommended as a secondary way to treat panic disorders.

While there is less literature on panic disorder compared to the literature on depression anxiety, panic disorder patients may benefit from regular exercise programs by teaching the body to adapt to the typical stressors of panic disorder. However more research must be shown to know if exercise will benefit panic disorder patients consistently. While initially, exercise may be uncomfortable for panic disorder patients, post exercise they see the benefits. The implications for

PTSD patients, could suggest that post exercise they may receive the same benefits from exercise as our panic disorder patients.

Gaps in Literature.

From the evidence supporting the beneficial effects of exercise on depression, anxiety, and panic attacks, it would appear that a relationship might potentially exist between exercise and PTSD. Given the alarming statistics about the number of soldiers returning home with PTSD and the evidence supporting beneficial effects of exercise for symptoms of PTSD, it is surprising that researchers have not explored exercise and physical activity as a means to treat PTSD symptoms. By determining if there is a relationship between exercise and PTSD symptoms, future directions may be taken to understand the type of exercise, frequency and duration required for military personnel to receive the benefits of exercise on their PTSD symptoms.

CHAPTER III

OUTLINE OF PROCEDURES

Participants.

The participants for this study were active duty military and veterans who had combat deployment experience. Combat deployment was defined as having at least one military deployment to a hazardous duty zone regardless of the type of job they performed while they were there. Several questions were asked by participants through email in regards to if this meant just combat arms positions like infantry, special forces, airborne, etc. However, answers were provided indicating that the goal was to have anyone who had gone on a "deployment" to an area that was classified as dangerous or where they received "Hazardous Duty Pay". The most common example of this deployment would be Afghanistan or Iraq deployments.

With resources like The Wounded Warrior Project, Veteran Affairs, American Legion, as well as personal contacts in the military, it was intended to get 100 combat veterans from a broad range of ages, races, fitness levels, and backgrounds in both military and personal demographics. Participation in this study was voluntary and veterans were invited to participate primarily through email containing a link to an electronic survey. The survey was provided via Internet access. All data collected was anonymous and it was presented to participants as a

survey evaluating the relationship between exercise, emotional states, and behaviors post- deployment.

Procedures.

Those who participated in the survey confirmed their willingness to participate by reading over the consent information before proceeding to the start of the survey.

Measures.

The survey consisted of general demographic and deployment history for each veteran: rank, military branch, current service status and exercise based on ACSM guidelines. The other relevant variables were assessed using the International Physical Activity Questionnaire (IPAQ), the Centers for Epidemiological Studies Depression scale (CES-D), the Stait-Trait Anxiety Inventory (STAI), the Panic Attack Questionnaire (PAQ) and the Post-traumatic Stress Disorder (PTSD) Checklist (PCL). See Appendix A.

Demographic Questions. Participants were asked if they suffered from any emotional, behavioral or mental illness as well as if they had any prior injuries. Any affirmative answers were followed up to learn details about the illness or injury including whether or not the participants were diagnosed with PTSD. Those participants who indicated that they had been diagnosed with PTSD during these questions were categorized as PTSD diagnosed.

Physical Activity Measure. Questions were asked based on ACSM guidelines according to prescriptions of a healthy population. Participants were asked, "How many days per week do you participate in aerobic exercise defined as running, walking, biking, swimming etc? How many minutes per day do you participate in these activities?" The same questions were asked for anaerobic exercise defined as weight training, etc. Then each participate was divided into groups based on meeting ACSM guidelines or not meeting ACSM guidelines. In order to meet ACSM guidelines, participants needed to report a minimum of 150 minutes per week of moderate to vigorous cardiovascular activity per week plus resistance training on at least 2 to 3 days per week.

The International Physical Activity Questionnaire (IPAQ) long version is a 27 question, self-assessment measure assessing physical activity in different lifestyle settings. The IPAQ survey was found at http://www.ipaq.ki.se/ipaq.htm. Each participant filled out the frequency and duration of their physical activity. Questions were scored by the researcher based on a continuous scale of physical activity. For each question, based on how the participant answered, it was scored into one of the three categories: low intensity group (category 1) were those who do not meet criteria for 2 or 3 and are considered inactive; moderate (category 2) was 3 or more days of vigorous activity for at least 20 minutes or 5 or more days of moderate intensity activity of at least 30 minutes per day or 5 or more days of a combination of activities achieving at least 600 MET-min/week; high (category 3) was vigorous

intensity on at least 3 days and accumulate 1500 MET-min/week or 7 or more days of combined moderate/vigorous intensity with at least 3000 MET-min/week. Developed in 1998, this questionnaire has been shown to be valid and reliable in 12 countries and provides an acceptable measurement of comparable estimates of physical activity in a variety of settings (Craig et al., 2003).

Depression Measure. The Center for Epidemiologic Studies Depression Scale (CES-D) is a 20-question scale evaluating ways people have felt or behaved over the course of the past week. The rating scale includes: 0- rarely or none of the time (less than 1 day), 1- some or a little of the time (1-2 days), 2- occasionally or a moderate amount of time (3-4 days) or 3- all of the time (5-7 days). Scoring was based on 20 questions and the possible range is from 0-60. If more than 4 questions were unanswered, no score can be determined. A score of 16 or more points is considered depressed. Questions 4, 8, 12 and 16 were reverse scored and all other questions were scored regularly from 0-3 points. Validity was found through correlations with other self-report measures and correlations with clinical ratings of depression (Radloff, 1977).

Anxiety Measure. The State Trait Anxiety Inventory (STAI) is a measure of anxiety in adults. It differentiates between the temporary condition of state anxiety and long term trait anxiety. It evaluates how responders would feel in a specific situation that is likely to be encountered in the future. Only the TAI scale was used in order to evaluate long-term anxiety. The TAI scale consists of 20 statements of

how the participants feel generally and was evaluated based on a 4 point scale of 1- not at all, 2- somewhat, 3- moderately so, 4-very much so. Scores range from 20 to 80 correlating higher scores with greater anxiety. The STAI can be found at http://www.mindgarden.com.

Panic Attack Measure. The Panic Attack Questionnaire (PAQ) is a 23-question survey evaluating several components of Panic Attacks. For this questionnaire, we used the second section of this survey numbered a, b, and c to evaluate panic attacks during the past year. Questions a, b and c evaluate how many panic attacks they may have had over the past year, past month and past week. This survey can be found at http://www.midss.org/content/panic-attack-questionnaire.

Life Stressor Checklist. The Life Stressors Checklist (LSC) was used to determine the type of trauma participants might have encountered in their lifetime. Table 4 outlines the participants' responses based on trauma type. Each event was assessed as "It happened to you personally", "You witnessed it happen to someone else", "You heard about it happening", "You are not sure if it applies", "It did not happen to you". Each participant then based his or her PCL-S survey on answering, "It happened to you personally" or "You witnessed it happen to someone else". This allowed the researcher to assess a specific traumatic event and an individual's PTSD score related to that traumatic event.

PTSD Measure. The Post-traumatic stress disorder checklist-specific (PCL-S) includes 17 DSM symptom specific questions and asks about symptoms in relation

to an identified stressful experience. It is used to link symptoms to a specific event. The PCL-S has favorable accuracy and is the most commonly used screening instrument for PTSD. It is shorter compared to similar screenings and is useful in tracking the symptoms of PTSD (McDonald and Calhoun, 2010). Items on the PCL-S are scored from ratings of 1- not at all, 2- a little bit, 3- moderately, 4- quite a bit, 5- extremely. To score the PCL-S, one adds the scores of each of the 17 items yielding a total of between 17 to 85. Scores of 44 and above are considered an indicant of PTSD however, a score of 50 is considered to be PTSD positive in military populations based on Veterans Affairs guidelines. The PCL-S can be found at http://www.ptsd.va.gov/professional/pages/assessments/ptsd-checklist.asp.

Statistical Analysis.

To analyze the relationship between exercise and the symptoms of PTSD, several regression analyses will be used to determine the correlation between exercise and PTSD symptoms.

Sub problems:

1. Regression analysis was used to determine the correlation between exercise as assessed by the IPAQ and depression as assessed by the CES-D.
2. Regression analysis was used to determine the correlation between exercise as assessed by the IPAQ and anxiety as assessed by the STAI.
3. Regression analysis was used to determine the correlation between exercise as assessed by the IPAQ and panic attacks as assessed by the PAQ.

4. A follow up regression analysis was used to determine the correlation between exercise as assessed by the IPAQ and post-traumatic stress disorder as assessed by the PCL-S.

CHAPTER IV

RESULTS

Of 208 surveys collected on Qualtrics Survey Software, 122 surveys were used. Eighty-four surveys were excluded because insufficient information had been provided for inclusion, participants had not followed directions on physical activity recall (n=79), or participants did not report a stressful event on the Life Stressors Checklist (n=5). Two surveys were excluded due to scores on the IPAQ being above the recommended upper limit.

Frequency data for demographic information is presented in Tables 1, 2, and 3. To check the reliability of each test, a reliability analysis was conducted on the CES-D, TAI and PCL-S questionnaires. The CES-D was found to be reliable with Cronbach's alpha =.937 and the TAI was found to be not reliable with Cronbach's alpha= .245. The PCL-S was found to be reliable with Cronbach's alpha= .966

Table 1.

Participants by Branch of Service

Branch

	Frequency	Percent	Valid Percent	Cumulative Percent
Air Force	10	8.2	8.2	8.2
Army	36	29.5	29.5	37.7
National Guard	6	4.9	4.9	42.6
Navy	13	10.7	10.7	53.3
Marines	57	46.7	46.7	100.0
Total	122	100.0	100.0	

Table 2.

Participants by Rank

Renk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Enlisted	86	70.5	70.5	70.5
	Officer	36	29.5	29.5	100.0
	Total	122	100.0	100.0	

Table 3.

Participants by Military Discharge.

Discharge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	General Discharge	1	.8	.8	.8
	Honorable Discharge	63	51.6	51.6	52.5
	Less than Honorable Discharge	1	.8	.8	53.3
	Other	4	3.3	3.3	56.6
	Still in the military	53	43.4	43.4	100.0
	Total	122	100.0	100.0	

Evaluating the distribution of the data, every branch was represented; Army n=36 (29.5%), Air Force n=10 (8.2%), National Guard n=6 (4.9%), Navy n=13 (10.7%) and Marines n=57 (46.7%). Eighty-six participants were enlisted (70.9%) and thirty-six were officers (29.5%). Thirty-seven participants reported an injury that prevented them from participating in physical activity; fifty-two reported a known behavioral, mental or emotional illness of which thirty-five reported a PTSD diagnosis.

Data collected from the Life Stressors Checklist, gave information regarding the type of trauma military personnel are exposed to. Below, Table 4 outlines the trauma reported by the service members.

Table 4.

Reported Trauma from the Life Stressors Checklist.

Life Stressor	It happened to you personally	You witnessed it happen to someone else
Fire or Explosion	67 (54.9%)	24 (19.7%)
Transportation Accident (car accident, boat accident, train wreck, plane crash	79 (64.8%)	17 (13.9%)
Serious accident at work, home, or during recreational activity	44 (36.7%)	35 (29.2%)
Exposure to toxic substances (dangerous chemicals, radiation)	48 (39.3%)	9 (7.4%)
Physical Assault (attacked, hit, slapped. Kicked beaten up)	73 (59.8%)	18 (14.8%)
Assault with a weapon (Shot, stabbed, threatened with a knife, gun, bomb)	57 (46.7%)	24 (19.7%)
Sexual Assault (rape, attempted rape, made to perform any type of sexual act through force or threat of harm)	4 (3.3%)	9 (7.4%)
Other unwanted or uncomfortable sexual experience	16 (13.2%)	8 (6.6%)
Combat or exposure to a warzone (in the military or as a civilian)	120 (98.4%)	1 (0.8%)
Captivity (kidnapped, abducted, held hostage, prisoner of war)	3 (2.5%)	7 (5.8%)
Life-threatening illness or injury	19 (15.6%)	62 (50.8%)
Severe human suffering	19 (15.6%)	71 (58.2%)

Sudden, violent death (homicide, suicide)	12 (9.8%)	74 (60.7%)
Sudden, unexpected death of someone close to you	73 (60.3%)	14 (11.6%)
Answer any of the previous events as "It happened to you personally" or "You witnessed it happen to someone else"	**Yes** 121 (100%)	**No** 0 (0.0%)

It was hypothesized that exercise would influence military soldiers' symptomatology of PTSD; therefore the more physically active veterans were the fewer symptoms of PTSD they would exhibit.

By using regression analysis, relationships between the IPAQ and PTSD, anxiety, and depression were tested. It was projected that there would be a relationship between exercise and PTSD. We found that the IPAQ is not a significant predictor of PTSD, $F(1, 119)= .388$. $P>.05$, $R^2= .006$. We anticipated that there would be a significant relationship between exercise and depression. We found that the IPAQ is not a significant predictor of depression, $F(1, 112)= .061$. $P>.05$, $R^2= .031$. Looking at the relationship between exercise and anxiety in military populations, IPAQ is not a significant predictor of anxiety, $F(1, 105)= .288$. $P>.05$, $R^2= .011$.

Further regressions were conducted for PTSD, depression and anxiety with main effects for PTSD diagnosis (a binary variable – diagnosed with PTSD or not diagnosed with PTSD) and physical activity (IPAQ) entered in the first step of analysis, followed by the interaction term for PTSD diagnosis x physical activity

(IPAQ). Additionally, these same regression analyses were conducted with leisure recreation activity such as sports and exercise used instead of the total IPAQ score. PTSD diagnosis and leisure activity scores (IPAQ) were entered on the first step of analysis, followed by the interaction term for PTSD diagnosis x leisure activity. Finally, parallel regression analyses were conducted for the experience of panic attacks (a binary variable – have experienced panic attacks or have not experienced panic attacks) and IPAQ scores with main effects entered in the first step and the interaction term entered in the second step and with criteria of PTSD, depression, and anxiety.

PTSD. Results indicated that PTSD diagnosis and physical activity significantly predicted PTSD, $F(2,116)=20.71$, $p<.001$, $R^2=.263$. The interaction did not predict an additional significant percent of variance, $F_{change}(1, 115)=1.268$, $p>.05$, $R^2_{Change}=.008$. Analysis of regression coefficients suggested that the IPAQ was not a significant predictor, ($p>.05$), but that PTSD diagnosis was a significant predictor ($p<.05$). Prediction equations were as follows:

PTSD Diagnosis: PTSDsymptoms=58.41

No PTSD Diagnosis: PTSDsymptoms=36.87

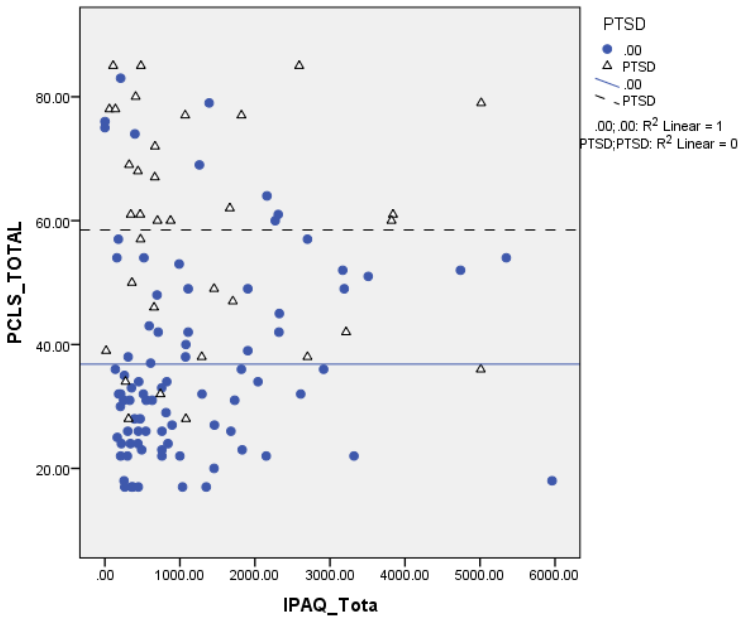

Figure 1. PCL-S Total versus IPAQ Score by PTSD Diagnosis.

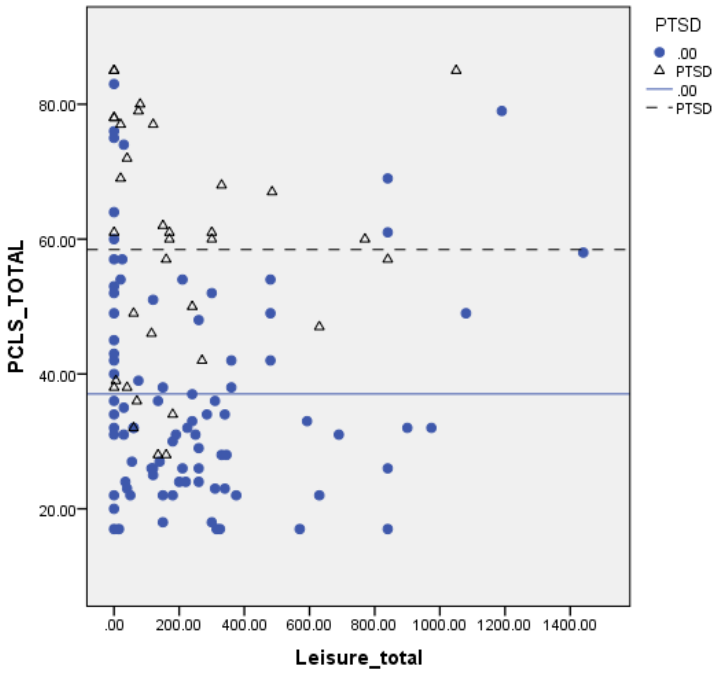

Figure 2. PCL-S Total versus Leisure Score by PTSD Diagnosis.

When looking at leisure time exercise, PTSD diagnosis and leisure activity significantly predicted PTSD, $F(2,119)=21.06$, $p<.001$, $R^2=.261$. PTSD diagnosis was the only significant predictor. There was no significant interaction, $F_{Change}(1,118)=.007$, $p>.05$, $R^2_{Change}=.000$.

Depression. Results suggested that PTSD diagnosis and physical activity as assessed on IPAQ significantly predicted depression, $F(2, 109)= 10.868$, $p<.001$, $R^2=.166$. There was no significant interaction effect, $F_{Change}(1, 108)= .243$, $p>.05$, $R^2=.002$. Examination of regression coefficients indicated that the IPAQ was not a significant predictor, ($p>.05$), but that PTSD diagnosis was a significant predictor ($p<.05$). Prediction equations were as follows:

PTSD Diagnosis: PTSDsymptoms=25.71

No PTSD Diagnosis: PTSDsymptoms=14.46

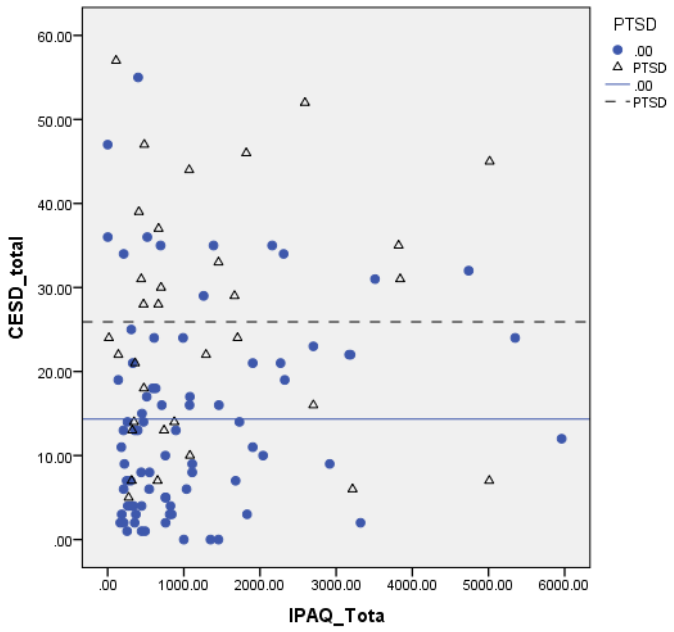

Figure 3. CESD Total versus IPAQ Score by PTSD Diagnosis.

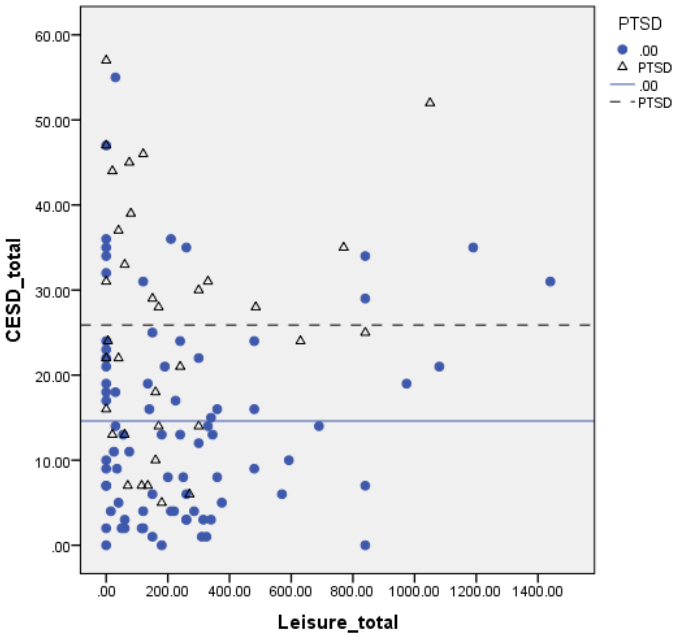

Figure 4. CESD Total versus Leisure Score by PTSD Diagnosis.

Significant results were found for PTSD diagnosis and leisure activity as a predictor of PTSD, $F(2,112)=10.128$, $p<.001$, $R^2=.153$. Again, PTSD was the only significant predictor. There was no significant interaction found, $F_{Change}(1,111)=.128$, $p>.05$, $R^2_{Change}=.001$.

Anxiety. Results show that PTSD diagnosis and physical activity from the IPAQ significantly predicted anxiety, $F(2,103)=10.056$, $p<.001$, $R^2=.163$. There was no significant interaction, $F_{Change}=(1,102)=.093$, $p>.05$, $R^2_{Change}=.001$. Follow up examination of regression coefficients showed that the IPAQ was not a significant predictor ($p>.05$), but that PTSD diagnosis was a significant predictor ($p<.05$). Prediction equations were as follows:

PTSD Diagnosis: PTSDsymptoms=49.12

No PTSD Diagnosis: PTSDsymptoms=36.58

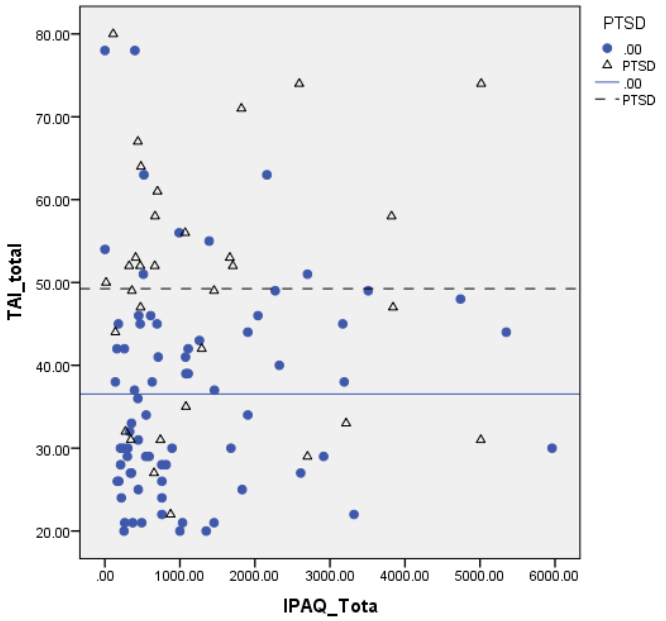

Figure 5. TAI Total versus IPAQ Score by PTSD Diagnosis.

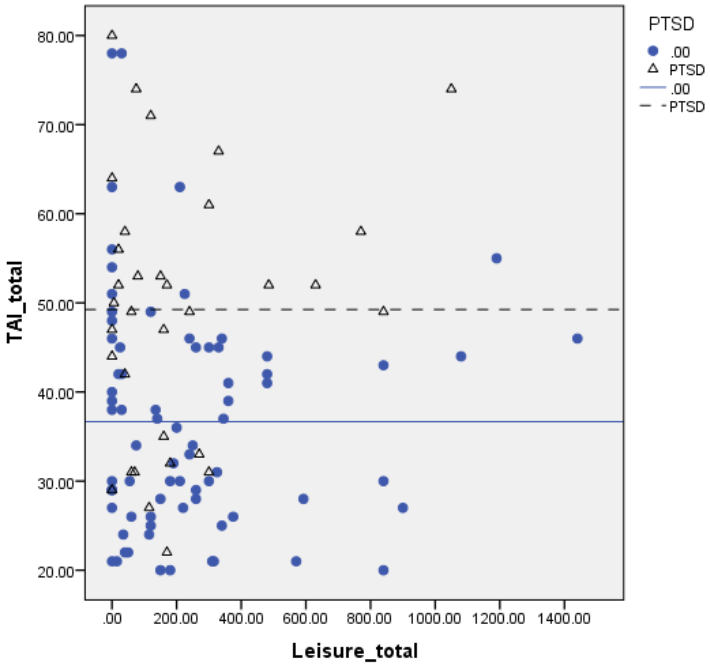

Figure 6. TAI Total versus Leisure Score by PTSD Diagnosis.

Results reveal that PTSD diagnosis and leisure activity significantly predicted PTSD, $F(2,105)=10.08$, $p<.001$, $R^2=161$, but again that only PTSD diagnosis was a significant predictor ($p>.05$). There were no significant interactions, $F_{Change}(1,104)=1.42$, $p>.05$, $R^2_{Change}=.011$.

Panic Attacks. Results show that a history of panic attacks and physical activity on the IPAQ survey were significant predictors of PTSD symptoms [$F(2,109)=14.49$, $p<.001$, $R^2=.210$], anxiety [$F(2,103)=20.42$, $p<.001$, $R^2=.284$] and depression [$F(2,107)=16.69$, $p<.001$, $R^2=.238$]. Examination of regression coefficients indicated that the IPAQ was not a significant predictor ($p>.05$), but that panic attacks were a significant predictor ($p<.05$) for all three outcomes with persons experiencing panic attacks reporting significantly more PTSD symptoms (Panic attacks = 53.40; No Panic attacks = 35.98), depression (Panic attacks= 24.85; No Panic attacks=12.49), and anxiety (Panic attacks= 48.40; No Panic attacks = 33.61). However, there were no interaction effects between physical activity and panic attacks on PTSD symptoms, depression or anxiety.

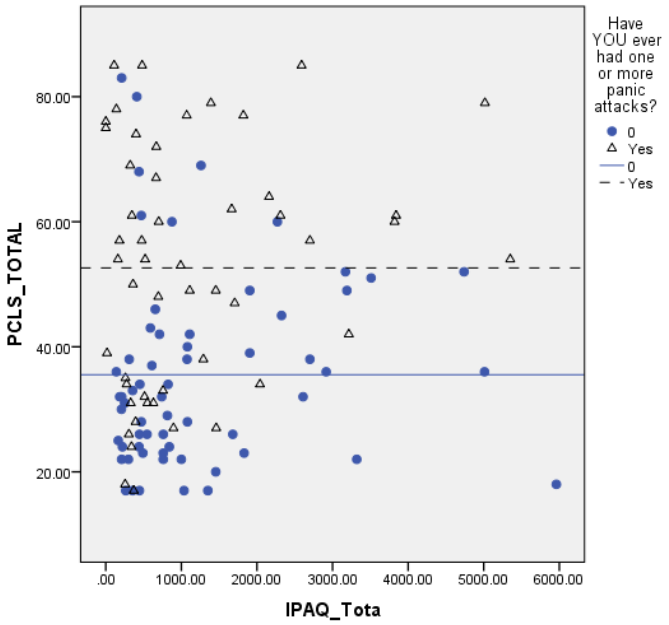

Figure 7. PCL-S Scores versus IPAQ Totals by Panic Attack History.

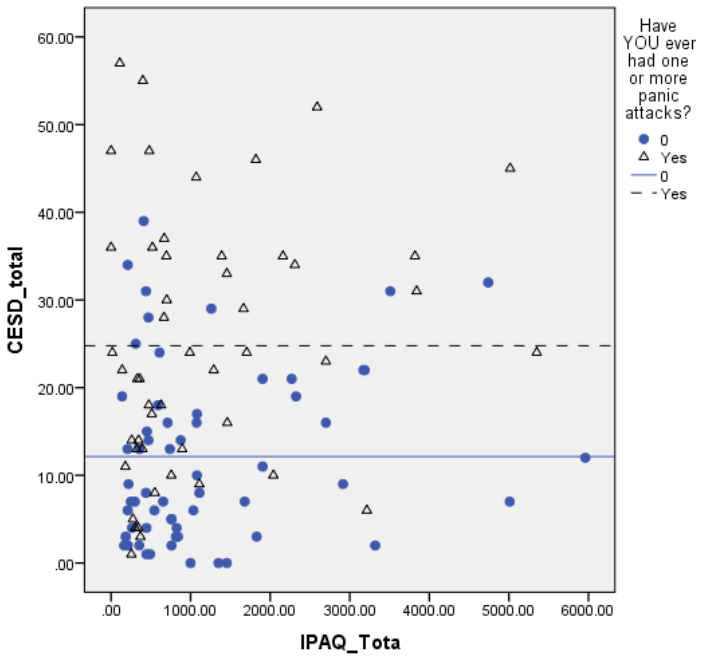

Figure 8. CESD Total versus IPAQ Scores by Panic Attack History.

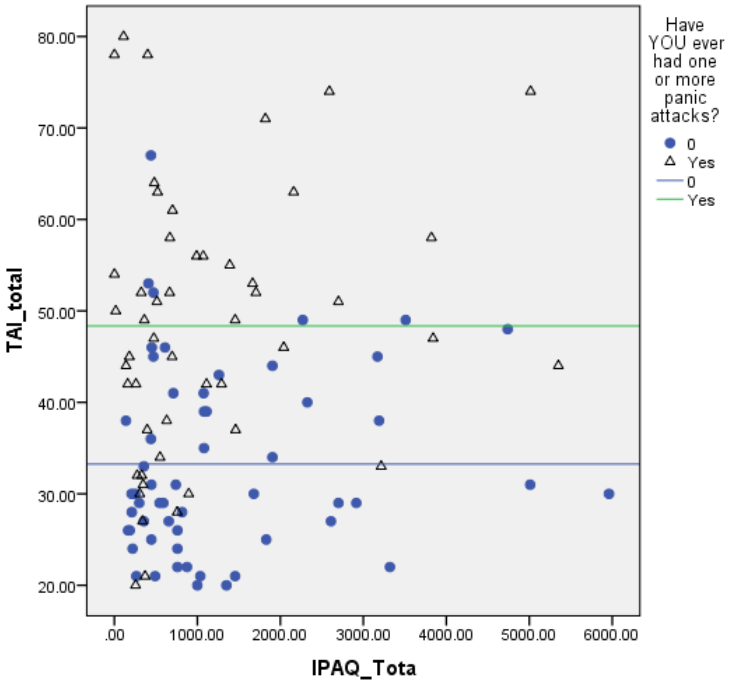

Figure 9. TAI Total versus IPAQ Scores by Panic Attack History.

CHAPTER V

DISCUSSION

The purpose of this study was to evaluate the relationship between exercise and symptomatology of PTSD in military populations. A secondary aim was to evaluate the relationship between exercise and depression and anxiety. The hypothesis was that exercise would influence military soldiers' symptomatology of PTSD. Primarily, there would be a significant relationship between exercise behaviors and PTSD in military personnel. Secondly, there would be a significant relationship between exercise behaviors and depression and anxiety in military personnel. Finally, there would be a significant relationship between exercise behaviors and panic attacks in military personnel.

Since this survey was open to all veteran or active duty service members, it allowed for those who potentially had no symptoms of PTSD, depression or anxiety to complete the survey. The difference between the PTSD diagnosed group and the non-PTSD diagnosed group shows that on average, those diagnosed with PTSD reported higher PCL-S, TAI and CES-D scores. In fact, scores were at or above the diagnosis level on all of these measures. When comparing the non-PTSD diagnosed group to those diagnosed, the non-PTSD diagnosed group's averages were below the levels of diagnoses for all 3 questionnaires (Table 5). An interesting trend occurred

with drop out, if a participant made it past the IPAQ assessing physical activity, the highest area of drop out after that was during or following the PCL-S assessing PTSD.

Table 5.

Group Averages by PTSD Diagnoses.

Test Name	PTSD Diagnosed	No PTSD Diagnosis
PCL-S (PTSD Survey)	58.46	37.02
TAI (Anxiety Survey)	49.24	36.67
CES-D (Depression Survey)	25.88	14.60
IPAQ (Physical Activity)	1317.56	1181.31

Results indicated that physical activity as reported on the IPAQ was not a significant predictor of depression, anxiety or PTSD. Since the IPAQ assessed job, yard, transportation and leisure type physical activity as a total, we can conclude that these types of activity did not make any difference when totaled together on depression, anxiety and PTSD scores in military populations as a whole. Assessing leisure type activities such as sports, recreation and exercise on depression, anxiety and PTSD, it was concluded that leisure activity also did not influence depression, anxiety, or PTSD. Given that military populations are engaged in physical activity for their jobs, these findings suggest that military populations as a whole may not

further benefit from physical activities of daily living. There was no prior literature evaluating how exercise may play a role in decreasing the symptoms of PTSD in military populations.

Prior literature looking at exercise and depression found that a dose-response relationship existed between exercise intensity and duration on depression levels in both clinical and non-clinically diagnosed patients. In a survey study where participants self reported the type, frequency and duration of their exercise along with depression as assessed by the BDI, researchers found that people who exercise tend to be less depressed compared to non-exercisers (De Moor et al., 2006). In a follow up study by De Moor et al (2008), the results showed that exercise lowered depression if it was monitored and a part of a therapeutic program. This could potentially be a limitation of the current study since exercise was assessed as a self-report versus implemented in conjunction with a therapeutic program. Decreases may have been noticed in their depression levels if they were monitored in a therapeutic program. It may be that future research needs to consider other variables such as type of exercise, duration of each bout and intensity when assessing the effects of exercise on depression in military personnel in a research or community-based intervention.

The majority of prior research on anxiety evaluated state anxiety following an acute bout of exercise. Since the goal of this research was a correlational study surveying military personnel's exercise behaviors over the previous weeks, trait

anxiety measures were used. We found that those diagnosed with PTSD reported more anxiety than those without the diagnosis. Trait anxiety is thought to improve over time as a result of habitual exercise intervention and improvements in state anxiety. A limitation of this study, is that participants self reported these measures and we are not sure how long they have been physically active. This could potentially impact their chronic anxiety scores since they may not be influenced if the individual has only recently begun a physical activity program.

Prior literature has shown that exercise helps reduce PTSD, anxiety and depression in non-military populations (Rutter et al., 2013, De Moor et al., 2008, Dunn et al., 2005, Brown et al., 2012, Blumenthal et al., 1999, Bridle et al., 2012, Martensen et al., 2008, Herring et al., 2010, Johanssen et al., 2011, Broocks et al., 1998, Caldirola et al., 2011). Results from this study bring about an interesting insight that military personnel may not benefit in the same way as non-military personnel do. Since exercise and physical activity were evaluated based on the IPAQ, it may be that a different measure should be used in the future to specifically assess exercise only. By assessing physical activity in general performed during a workday, during transportation or for leisure, this may have limited the likelihood of observing significant results. Future research may need to address specific intensities, durations and modalities of exercise to further our understanding of the potential role of exercise in military populations.

Some limitations of this study were that it was an online survey distributed via snowball recruitment. Many questions were asked by participants regarding what defined a combat deployment, and many jobs are considered combat deployments that never actually see combat given their Military Occupational Specialty (MOS). The goal was to have any person who has deployed regardless of their MOS complete the survey. It was important to assess those who many have still experienced a trauma defined on the LSC but not a combat trauma. This would have allowed the ability to assess combat arms jobs versus non-combat arms. However, given how the advertisement read, the sample recruited ended up mainly consisting of combat arms positions. As a result, a large portion of the sample was male (96%), which represents how combat arms jobs currently are in the military. However, women do still deploy to warzones and still may encounter experiences that would qualify as traumatic. The sample was representative of the current population of combat arms jobs but as the military is shifting towards incorporating women into combat roles, it is important that we assess PTSD with a well-distributed sample of males and females. Another limitation of the study was that panic attacks were not defined on the questionnaire. Therefore, participants may have interpreted panic attacks as non-clinical when the survey was intended to assess those who are suffering from panic attack disorder or clinically diagnosed panic attacks. While the IPAQ assessed daily physical activity based on the last 4 weeks, the leisure physical activity, which assessed recreation, sport and exercise, did not give us any

information on what specific type of activity was performed. Currently, other researchers from the STRONG STAR program have been looking at the potential benefits of structured running on disorders like PTSD in military populations. Evaluating the effectiveness of exercise on PTSD by using specific modalities of exercise may help us determine if a specific type of exercise needed.

Although significant relationships were not observed in this study, given the evidence with other populations supporting beneficial relationships between exercise and PTSD, depression, anxiety and panic attacks, it may be important to conduct additional studies with military personnel. Future research may need to address whether weight lifting, running, biking, rowing, crossfit or other types of exercise were beneficial in lowering symptoms of PTSD, depression and anxiety in military populations. Assessing group fitness activities versus individual activities may also be beneficial since we do not know if a difference of social support would help people cope with PTSD, depression and anxiety. Future research should also focus on more observational studies conducted in a laboratory or fitness facility where direct observations can be made in regards to the exercise program being administered.

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APPENDIX A

QUALTRICS SURVEY

Exercise and Post Deployment Behaviors

Thank you for your interest and participation in this survey! Before you begin, please click on the link to the consent form and read over the information. If you would like to retain a copy of the consent form, please make sure you save or print one from your computer before proceeding from this page. Consent Form By beginning this survey you are agreeing that you read and you fully understand the contents of this document and are willing consenting take part in this study. All of your questions concerning this study have been answered. By clicking this button, you are agreeing that you are 18 years of age or older and are agreeing to participate in this study described to you by the Principle Investigator, Lauren Williams.

- ❍ I have read and fully understand the Consent Form

Directions: This survey has no affiliation with any government agency and all data collected will not contain identifiable information. This survey takes approximately 20 minutes. If for any reason during the survey you need to go back to a previous question, please use the "back" button at the bottom of the survey box instead of the buttons on the address bar for your Internet browser.

Please define your current status.

- ❍ Active Duty
- ❍ Veteran
- ❍ Reservist

What was your branch of service? If you changed services, please select the service with the most deployments.

- ❑ Air Force (1)
- ❑ Army (2)
- ❑ National Guard (3)
- ❑ Navy (4)
- ❑ Marines (5)

What was your last rank? (ex. E-1, E-2, E-3... O-1, O-2, O-3...)

How many years in service?

How many combat related deployments did you have?

- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)
- ❍ 11 (11)
- ❍ 12 (12)
- ❍ 13 (13)
- ❍ 14 (14)
- ❍ 15 (15)

Please list each deployment and the location of each deployment?

When you left the military it was:

- ❍ General Discharge (1)
- ❍ Honorable Discharge (2)
- ❍ Dishonorable Discharge (3)
- ❍ Less than Honorable Discharge (4)
- ❍ Bad Conduct (5)
- ❍ Other (6) _____
- ❍ Still in the military (7)

Do you currently have an injury that prevents you from exercising or participating in physical activity

- ❍ Yes (1)
- ❍ No (2)

Please explain your injury:

Do you have any known behavioral, mental or social illness? (e.g. depression, anxiety, personality disorder, post-traumatic stress, ADHD, OCD, etc.)

- ❍ Yes (1)
- ❍ No (2)

Please describe any behavioral, mental, or social illness:

Please select the number of DAYS per week you participate in AEROBIC exercise-defined as any exercise of various
sustained exercises, as jogging, rowing, swimming, or
cycling, that stimulate and strengthen the heart and lungs,
thereby improving the body's utilization of oxygen. (running, walking, biking, aerobic classes, etc for minimum of 10 minute bouts)?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7

How many MINUTES PER DAY do you participate in aerobic exercise?

Please select the number of DAYS per week you participate in NON-AEROBIC exercise (strength training, etc)?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7

How many MINUTES PER DAY do you participate in non-aerobic exercise?

IPAQ Physical Activity Questionnaire. We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The

questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous and moderate activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

LSC Listed below are a number of difficult or stressful things that sometimes happen to people. For each event check one or more of the boxes to the right to indicate that: (a) it happened to you personally, (b) you witnessed it happen to someone else, (c) you learned about it happening to someone close to you, (d) you're not sure if it fits, or (e) it

Did you answer any of the above events as "Happened to you" or "You witnessed it happened to someone else"?

❍ YES (1)
❍ No (2)

PCL-S By using the most stressful event from questionnaire before, answer these questions below reflecting upon that event. NOTE: this event can be one that happened personally to you, you witnessed it happened to someone else. Instructions: Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please read each one carefully, then select one of the buttons to the right indicating how much you have been bothered by that problem in the past month.

CES-D Below is a list of some of the ways you may have felt or behaved. Please indicate how often you have felt this way during the past week: (click one button on each line)

TAI DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then click the radio button for the number to the right of the statement to indicate how you generally feel.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer, which seems to describe how you generally feel.
Have YOU ever had one or more panic attacks?

- ❍ Yes (1)
- ❍ No (2)

How old were you when you experienced your FIRST panic attack?

When was your most recent panic attack? (Date)

In the PAST YEAR approximately how many panic attacks have you had

- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)
- ❍ More than 10 (11)
- ❍ None (12)

In the PAST FOUR WEEKS how many panic attacks have you had?

- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)
- ❍ More than 10 (11)
- ❍ None (12)

In the PAST WEEK how many panic attacks have you had?

- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)
- ❍ More than 10 (11)
- ❍ None (12)

Please select your gender

- ❍ Male (1)
- ❍ Female (2)

What is you current age?

Thank you for your time and participation in this survey. If you know of additional people who fit the criteria for the survey please feel free to forward the link to them: https://uncg.qualtrics.com/SE/?SID=SV_doFl05KrQWI0T5jThank you for your service to our Country!