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THE EFFECTS OF A 40-MINUTE BOUT OF AEROBIC EXERCISE ON STATE
ANXIETY IN COLLEGE AGE INDIVIDUALS

BY

RACHAEL DOZIER

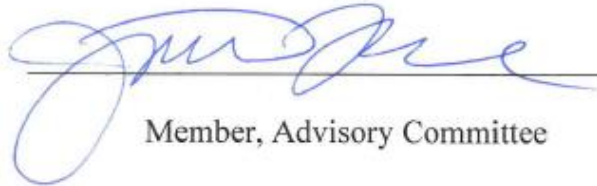
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THE EFFECTS OF A 40-MINUTE BOUT OF AEROBIC EXERCISE ON STATE
ANXIETY IN COLLEGE AGE INDIVIDUALS

BY

RACHAEL L. DOZIER

Submitted to the Faculty of the Graduate School of
Eastern Kentucky University
in partial fulfillment of the requirements for the degree of
MASTERS OF SCIENCE
2019

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DEDICATION

This study is wholeheartedly dedicated to my beloved husband, who has been my source of inspiration, given me the strength when I needed it the most, and continually provides moral, spiritual, emotional, and financial support.

ACKNOWLEDGEMENTS

This thesis became a reality with the kind support and help of many individuals. I would like to extend my sincere thanks to all of them.

I would like to express my gratitude towards my family for the encouragement which helped me in completion of this thesis, specifically, my beloved and supportive husband, TJ, who is always by my side when I need him the most.

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My thanks and appreciations also go to my colleagues and people who have willingly helped me out with their God given talents and abilities.

ABSTRACT

The purpose of this study was to determine if a forty-minute bout of aerobic exercise would decrease the state anxiety and heart rate of college aged individuals. This study was prompted due to the higher levels of anxiety in college aged individuals found in literature (Silva & Tucci, 2018). Specifically, college students need healthy alternatives to cope with their anxiety instead of turning to alcohol. Heightened levels of anxiety in this age range have been shown to increase negative coping habits, such as drinking, drugs, and eating disorders. These negative habits not only affect the individual physically, but also can affect their personal and professional lives. Identifying a healthy and safe coping mechanism is needed to lower the negative coping mechanisms and the harmful effects that coincide with them.

This study consisted of student volunteers (n= 37), between the ages of 18 and 25. All research was conducted during the fall semester of 2019 and examined two specific questions: Will a forty-minute bout of aerobic exercise lower state anxiety; and Is there a correlation between the survey results and heart rate? The study was conducted using the State Trait Anxiety Inventory Y-1 (STAI). Also, an SPO2 monitor was used to obtain accurate heart rates for each subject.

The study found there was a significant difference between the pre and post STAI survey. Both males and females averaged about the same pre and post STAI scores. Heart rate was significantly lower 10 minutes post-exercise than it was pre-exercise. It was hypothesized heart rate would be lower after exercise. Heart rate was taken directly prior to pre and post surveys being administered and directly after exercise. They contributed it

to the change in the survey results. It was concluded that heart rate was reduced but did not correlate with the way the questions were answered on the survey.

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CHAPTER I

INTRODUCTION

Over the last one hundred years, the study of mental health and exercise has become a popular research topic (Our History, 2017). Specifically, exercise and its effect on anxiety has become an increasingly trending sub-topic (Weiss & Gill, 2005). The prior research on this subject, in general, concludes exercise reduces the amount of anxiety an individual has (Asmundson et. al., 2013). However, research looking at how exercise affects the body psychologically and physiologically, in conjunction together, is not as clear. Specifically, looking at anxiety and whether it correlates with heart rate directly before and after aerobic exercise has not yet been researched.

Anxiety affects all individuals at some point in their life, but during the college years, coping with anxiety can be a significant challenge (Silva & Tucci, 2018). College students have ways of coping with anxiety that are both positive and negative. Negative coping mechanisms such as drinking alcohol, ingesting drugs, and not eating properly are all harmful ways to rid one's self of anxiety. However, exercise has been shown to reduce anxiety and is also extremely healthy for the body (Asmundson et. al., 2013).

Need for the Study

This study is needed because anxiety is a pervasive problem with which all humans struggle. Additionally, major life events have the potential to increase anxiety dramatically over a period of time (Holmes & Rahe, 1967). Negative effects of anxiety can be debilitating or dangerous to the person with anxiety. People cope with anxiety in different ways. Negative coping strategies can be hazardous to their well-being, while positive coping strategies are recommended for overcoming anxiety. It is known that

aerobic exercise is ameliorative in dealing with anxiety and is an ideal positive coping strategy for college students (Broman & Storey, 2008).

Purpose

The purpose of this research is to examine the effects of a 40-minute bout of aerobic exercise on state anxiety, in college aged individuals.

Hypotheses

It was hypothesized that there would be a reduction of state anxiety and heart rate. After aerobic exercise in the individuals tested. Responses on the STAI would show lowered state anxiety after engaging in a 40-minute bout of low intensity treadmill walking. Post-exercise heart rate responses, likewise, would be lower after aerobic exercise.

Assumptions

For this study the following assumptions were made: Subjects followed directions properly throughout the entire study; each student understood and truthfully answered his/her initial STAI survey; the treadmill speed and grade were consistent; the oximeter monitor worked properly.

Delimitations

Subjects were delimited to: students from Eastern Kentucky University; students who were able to complete the testing protocol; students who were healthy individuals according to the PAR-Q; overall subject selection was delimited to approximately 37 healthy individuals.

Limitations

A limitation of this study was that: a true representation of the population was not displayed in the sample of subjects, as all were volunteers and not a random sample; technology malfunctions may have caused data to be skewed; the efficiency and coordination of the walkers was an unmeasurable variable.

Definitions

Anorexia Nervosa: An emotional disorder characterized by an obsessive desire to lose weight by refusing to eat.

Anxiety: A negative emotional state characterized by nervousness, worry, and apprehension which is associated with activation or arousal of the body.

Anxiety Disorder: A mental health disorder characterized by feelings of worry, anxiety, or fears strong enough to interfere with one's daily activities.

Atherosclerosis: A disease of the arteries characterized by the deposition of plaques and fatty material on their inner walls.

Bonferroni Correction: A factor used to limit the possibility of getting a statistically significant result when testing multiple hypotheses.

Bulimia Nervosa: An emotional disorder involving distortion of body image and an obsessive desire to lose weight, in which bouts of extreme overeating are followed by depression and self-induced vomiting, purging, or fasting.

Cognitive Behavioral Therapy: A type of psychotherapy in which negative patterns of thought about one's self and the world are challenged in order to alter unwanted behavior patterns or treat mood disorders such as depression.

Cognitive State Anxiety: Concerns the degree to which one worries or has negative thoughts.

Depression: A mood disorder that causes a persistent feeling of sadness and loss of interest and can interfere with daily functioning.

Diaphoresis: Sweating, especially to an unusual degree as a symptom of disease or a side effect of a drug or anxiety.

Dyspnea: Difficult or labored breathing.

Exercise: Activity requiring physical effort, intentionally scheduled into the day, carried out to sustain or improve health and fitness.

Greenhouse-Geisser Correction: Assesses the change in a continuous outcome with three or more observations across time or within-subjects.

Hypertension: Abnormally high blood pressure, above 120/80 mm Hg.

Hyperventilation: Condition in which you start to breath very fast, causing an upset of the balance of oxygen and carbon dioxide.

Mauchley's Test: Used to validate a repeated measure analysis of variance (ANOVA).

Post Hoc Analysis: Statistical analyses that were not specified before the data was seen.

Psychodynamic Therapy: A type of psychotherapy that draws on psychoanalytic theory to help people understand the roots of emotional distress, often by exploring unconscious motives, needs, and defenses.

P-Value: Level of marginal significance within a statistical hypothesis test representing the percent or probability of the occurrence of a given event.

R² Coefficient: Proportion of variance in the dependent variable that is predictable from the independent variable(s).

Shapiro-Wilk Test: Is a way to tell if a random sample comes from a normal distribution.

Somatic State Anxiety: The moment-to-moment changes in perceived physiological activation.

Sphericity: The condition where the variances of differences between all combinations of related groups (levels) are equal.

STAI Form Y-1: State Trait Anxiety Inventory used to assess state anxiety.

State Anxiety: Anxiety characterized by subjective, consciously perceived feelings of apprehension and tension accompanied by or associated with activation or arousal of the autonomic nervous system.

Tachycardia: A rapid heartbeat, with a heart rate above 100 beats per minute.

Trait Anxiety: Predisposes an individual to perceive as threatening a wide range of circumstances that objectively may not actually be physically or psychologically dangerous.

CHAPTER II

LITERATURE REVIEW

What is Anxiety

Weinberg and Gould (2015) defined anxiety as, “A negative emotional state characterized by nervousness, worry, and apprehension and associated with activation or arousal of the body (p. 78).” Anxiety can present itself in many different ways including these signs or symptoms: tachycardia, nervousness, restlessness, tension, panic, hyperventilation, sweating, trembling, weakness, fatigue, trouble concentrating, loss of sleep, gastrointestinal problems, and excessive worrying (Anxiety Disorders, 2018). If individuals are experiencing one or more of these signs or symptoms, they are likely experiencing some amount of anxiety.

State Versus Trait Anxiety

State anxiety and trait anxiety are the two main types of anxiety. State anxiety is defined as an emotional state “characterized by subjective, consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system” (Spielberger, 1966, p. 17). State anxiety is changing constantly. For example, college students will experience varying levels of state anxiety before taking an exam, during the exam, and after the exam. State anxiety can be further broken down into two forms: cognitive state anxiety and somatic state anxiety.

“Cognitive state anxiety concerns the degree to which one worries or has negative thoughts, whereas somatic state anxiety concerns the moment-to-moment changes in perceived physiological activation” (Weinberg & Gould, 2015, p. 78). Somatic state anxiety refers to the physical signs or symptoms someone feels. For example, when

someone sweats or gets butterflies in their stomach before an exam, they are experiencing somatic state anxiety. The way one responds to different circumstances involves state anxiety reactions.

Trait anxiety is not ever-changing like state anxiety, but refers to an individual's personality. It is more stable, and less transitory compared to state anxiety. "In particular, trait anxiety predisposes an individual to perceive as threatening a wide range of circumstances that objectively may not actually be physically or psychologically dangerous" (Weinberg & Gould, 2015, p. 79). An example of trait anxiety can be found by looking at one's personality. An individual may be constantly worried in general while another may be relaxed and carefree.

All anxiety is not necessarily detrimental. For example, college students experience increased anxiety during midterms and finals, due to the greater demands they are facing (Silva & Tucci, 2018). This anxiety is temporary and decreases once the stressors have diminished.

Major Life Events

Major life events, both positive and negative, have the potential to lead to increased anxiety (Lekalakala-Mokgele, 2018). For example, death in the family is something the majority of people will experience at least once in their lives. The amount of stress and anxiety triggered by an event like this has the potential to cause increased anxiety in these individuals' daily lives. Anxiety will vary in a situation like this, especially if the death is not expected. According to Holmes and Rahe (1967) the following are other common examples of major life events; divorce, relationship

termination, jail term, injury, marriage, pregnancy, work change, and major injury or illness.

Anxiety Disorders

An anxiety disorder is defined as a mental health disorder characterized by feelings of worry, anxiety, or fear that are strong enough to interfere with one's daily activities (Anxiety Disorders, 2018). In America alone, forty million individuals are currently diagnosed with an anxiety disorder (Managing Stress & Anxiety, 2018). This number is noteworthy because it does not include the individuals who have gone undiagnosed or do not realize they have an anxiety disorder. The most common mental illnesses in the United States are anxiety disorders, while depression is the leading mental illness in the world. It must be noted that anxiety disorders and anxiety are not the same thing; one can experience anxiety without having an anxiety disorder.

Many types of anxiety disorders exist including; panic disorder, social anxiety disorder, separation anxiety disorder, obsessive-compulsive disorder (OCD), post-traumatic stress disorder (PTSD), generalized anxiety disorder, and different phobias (Treating & Preventing Adolescent Mental Health Disorders, 2017). In these disorders, anxiety is the predominant feature.

Negative Effects of Anxiety

Tachycardia

A prominent physical effect of anxiety, is an increased heart rate (often referred to as tachycardia). Tachycardia and high blood pressure often go hand-in-hand with each other. According to the Mayo Clinic, tachycardia is a very common result of anxiety (Anxiety Disorders, 2018). Anxiety commonly causes the heart to beat faster and will

increase workload on the heart. Chronically, other complications are likely to follow such as heart failure, heart disease, and cardiomyopathy (American Heart Association, 2018).

Hypertension

One of the most common side effects of anxiety is high blood pressure, also known as hypertension. In a study by Ifeagwazi, Egberi, and Chukwuorji (2018), the following was concluded: “Anxiety was positively associated with blood pressure elevations, even after adjusting for control variables (e.g., age, family history of hypertension, and educational status).” Thus, with the increase in anxiety, there was also an increase in blood pressure. Having an increase in blood pressure may lead to various chronic health issues such as; heart disease, kidney damage, and retinopathy (Hypertension Guideline Resources, 2018).

Atherosclerosis

The number one cause of death in the United States is heart disease (American College of Sports Medicine, 2018). Individuals who suffer from anxiety have an increased likelihood of developing atherosclerosis (Barger & Sydeman, 2005). Atherosclerosis is a disease of the arteries characterized by the deposition and plaques of fatty material on their inner walls. Those who developed their anxiety after being diagnosed with heart disease had a higher chance of experiencing coronary events than those who did not have anxiety. According to Goodman (2003), adults more than doubled their risk of having a heart attack by having anxiety.

Suicide

According to the *American Foundation for Suicide Prevention* (2018), the tenth leading cause of death in the United States is suicide. Anxiety has played a key role in the

lives of the majority of individuals who have committed suicide. Men are 5.4 times more likely than women to commit suicide, and on average 123 suicides happen each day in the United States (Suicide Statistics, 2018). Over the last few years, suicide attempts have skyrocketed nationally, and there has been an increase in college-age suicides. The more professionals learn about anxiety, the better they are able to help combat suicide.

Negative Coping Strategies

As the previous literature illustrates, the negative effects of anxiety are far reaching. Unfortunately, consumption and abuse of alcohol are the most common (unhealthy) coping strategies used for treating anxiety (Silva & Tucci, 2018). College age students use alcohol to cope with anxiety more than any other age group. In their research, Silva and Tucci concluded the consumption of alcohol and the consequences pertaining to it correlate highly with anxiety. According to Silva & Tucci (2018), college students need healthy alternatives to cope with their anxiety instead of turning to alcohol. It is vital to minimize alcohol consumption and the negative effects which go with it.

Eating disorders such as anorexia and bulimia are commonly associated with anxiety. In 2013, a study found social anxiety was significantly associated with emotional eating and binge eating in overweight and obese men and women (Ostrovosky, Swencionis, Wylie-Rosett, & Isasi, 2013). Many individuals find comfort in the indulgence of food to alleviate their anxiety. Ill health issues can arise from eating disorders, such as gastrointestinal system maladies, and also cardiovascular, nervous, and endocrine system damage (Health Consequences, 2018).

According to the American Psychiatric Association, 1994, p. 544-545, "Anorexia nervosa includes the following characteristics: refusal to maintain a minimal body weight

normal for a particular age and height (this is typically defined as weight 15% below normal); intense fear of gaining weight or becoming fat, despite being underweight; disturbance in how one experiences one's body weight, size, or shape (e.g. feeling fat even when obviously underweight); in females, the absence of at least three consecutive menstrual cycles otherwise expected to occur (primary or secondary amenorrhea)." The cardiovascular system is damaged by anorexia nervosa due to the lack of calories the individual is ingesting. In order for the body to survive, it must start breaking down its own tissue, and muscle is one of the energy sources to be broken down. The most important muscle in the body is the heart, and as it malfunctions it is not able to circulate blood efficiently.

"The diagnostic criteria for bulimia include: recurrent episodes of binge eating (rapid consumption of large quantities of food in a discrete period of time); a feeling of lacking control over eating behavior during the eating binges; engaging in regular, self-induced vomiting, use of laxatives or diuretics, strict dieting or fasting, or vigorous exercise to prevent weight gain; an average minimum of two binge-eating episodes a week for at least three months" (American Psychiatric Association, 1994, p. 549-550). Bulimia nervosa causes the depletion of electrolytes, specifically, sodium, potassium, and calcium. These elements are important in muscle contraction and maintaining a regular heartbeat. The imbalance of electrolytes can lead to heartbeat irregularity, possible heart failure, and death. Starvation, bingeing, and purging can slow digestion and lead to constipation, pancreatitis, and other infections (Health Consequences, 2018). Neurological symptoms caused by an eating disorder may include: slowed neuronal activity, reduction in the myelin sheath, seizures, muscle cramps, and sleep apnea. Within

the endocrine system, sex and thyroid hormones will decrease, resting metabolic rate will decline, a resistance to insulin may develop, core temperature will drop, and cholesterol levels may increase. Lastly, low caloric consumption can lead to dry skin, hair thinning, lanugo (fine hair) development, kidney failure, development of anemia, and a decrease in white blood cells (Health Consequences, 2018).

Positive Ways to Decrease or Cope with Anxiety

According to the Anxiety and Depression Association of America (ADAA, 2019), there are three main categories one should consider to cope with stress: mind, body, and action. The first category is the “mind” and is broken down into four methods to reduce anxiety: realize we cannot control everything, try one’s best, maintain a positive attitude, and learn what triggers the anxiety (Managing Stress & Anxiety, 2018). The second category, the “body” is also made up of four different methods: limit alcohol and caffeine use, eat well-balanced meals, get enough sleep, and exercise daily. The third category, “action” is made up of six different methods including: take deep breaths, slowly count to ten and repeat as needed, give back to the community, take a timeout, get help online, and lastly talk to a mental health professional. Any or all of these methods help combat anxiety. Unfortunately, many individuals do not choose these options to help combat their anxiety, and instead rely on negative coping mechanisms.

Once the anxiety in a person’s life has been treated, physical benefits will come. Therapies have been developed, but two specific (non-drug) therapies are used which are successful in treating not only anxiety, but also ease the symptoms of respiratory disease and chronic gastrointestinal disease (Monti, Tonetti, & Ricci 2014). The first is cognitive-behavioral therapy. This is broken down into two different components, cognitive and

behavioral. Cognitive therapy helps people recognize and avoid thoughts which cause anxiety. Behavioral therapy helps individuals with their reaction to anxiety causing situations. The type of treatment will vary depending on the type of anxiety, and the amount of anxiety the person has. For example, some may be asked to look at their lives and examine the patterns and habits causing dread, while others may be taught techniques for relaxation to reduce anxiety. Another therapy often used is psychodynamic therapy (Monti, Tonetti, & Ricci 2014). This method is used when people have experienced a traumatic event or an ingrained emotional conflict in their lives. Focused talk therapy was used and found to be very successful in treating anxiety. Medications are often not as effective as psychotherapies and may also come with unpleasant side effects (McHugh, Whitton, Peckham, Welge, & Otto, 2013). Some common medication categories include; anti-anxiety drugs, antidepressants, and beta blockers.

Exercise and Anxiety

Exercise as a treatment for anxiety has been well documented and shows evidence for working in many situations. A study by Broman, Abraham, Thomas, Canu, and Neiman (2018) was completed in order to look specifically at how exercise and anxiety/depression affect each other. The authors had 955 subjects complete a demographic questionnaire. This questionnaire was comprised of two parts: the Anxiety Sensitivity Index-3 and the Brief Symptom Inventory-18. The results showed a relationship between anxiety, anxiety sensitivity, depression, and somatization symptoms. On average, as exercise frequency increased, the level of anxiety decreased. Thus, supporting the beneficial association between anxiety and exercise.

A study was done by Kilziene, Kilzas, Cizauskas, and Spaviciene (2018) investigating how anxiety changed over the course of seven months in youth participating in an exercise program. The study looked at 428 subjects between the ages of fourteen and fifteen who attended the same school. The subjects were divided into two different groups, the control group (CG) and the experimental group (EG). The subjects in the EG took part in physical education classes twice each week. Once a month, they participated in a theory lecture where they learned about communication disorders in children their age and how to prevent them by ways of physical activity. During the exercise classes, the subjects learned different sports and games, including: basketball, football, volleyball, and Pilates. The authors used a modification method, created by Roger and Dymond (1954), to measure psychosocial adjustment. The anxiety measurement was developed by Reynolds and Richmond (1994). The results showed, after seven months, the subjects decreased their anxiety in the classroom. They also increased their self-esteem, emotional comfort, dominance, internality, positive self-evaluation, and evaluation by others.

Asmundson, et. al. (2013) investigated persistent and maladaptive expressions of anxiety. Specifically, the authors comprised all available data on the topic and put together a chart of the findings from the totality of their research. Every study they analyzed showed a reduction of anxiety related symptoms due to exercise.

Anaerobic resistance exercise and how it affects anxiety is not as often researched as aerobic exercise and its benefits on anxiety. Bibeau, Moore, Mitchell, Vargas-Tonsing, and Bartholomew (2010) specifically researched this topic to study the effects of different rest periods and intensities during resistance exercise on anxiety. There were 104 subjects

in a weight training class given one of five conditions in which to exercise. The intensities and rest times of the subjects varied. Measurements of anxiety and negative and positive effects were accumulated promptly following the workouts. Significant reductions in anxiety at both 20-minutes and 40-minutes post-exercise were found. These results concluded both rest time and variation of intensity had a short-term positive effect on the subjects' psychological state following resistance exercise.

Anxiety and exercise can present similar symptoms when compared side by side. Individuals may see the following signs and symptoms present in both individuals with anxiety and those exercising: tachycardia (high heart rate), hypertension (high blood pressure), dyspnea (shortness of breath), diaphoresis (sweating), and fatigue may be observed. The intensity of these symptoms will depend on the amount of anxiety an individual is experiencing or the amount of exercise they have completed. One study took note of these similarities between anxiety and exercise. Twenty-four subjects who had a high anxiety sensitivity score greater than 28 took part. Half of the subjects were part of the control group, while the other half completed six 20-minute sessions of aerobic exercise (Broman-Fulks & Storey, 2008). It was concluded that the individuals who took aerobic exercise classes reported significantly less anxiety than those who did not.

The Relationship between Serotonin and Exercise

Serotonin is a “feel good” chemical produced in the brain that helps the body transmit messages throughout the nervous system (Vafamand, Kargarfard, & Marandi, 2012). Serotonin specifically regulates the following functions; mood, sleep cycles, and appetite. Past research has concluded the increase of serotonin in the blood has led to

increased cognitive function and decreased anxiety and depression (Wipfli, B., Landers, D., Nagoshi, C., & Ringenbach, S., 2011; Zimmer et al., 2016).

The production of serotonin is increased post-exercise in both animals and humans (Jacobs & Fornal, 1993; Chaouloff, 1997; Wipfli, B., Landers, D., Nagoshi, C., & Ringenbach, S., 2011). Exercise may affect blood serotonin levels similarly to those of antidepressants and may lead to alterations in the human brain that are comparable to the impact of antidepressants. Wipfli, Landers, Nagoshi, and Ringenbach (2011) concluded that changes in serotonin were a mediating variable between exercise and depression. Their findings suggested changes in serotonin levels somewhat determines the relationship between depression and exercise. Zimmer et al. (2016) concluded after a thirty-minute bout of aerobic exercise, serotonin levels in the blood of participants were significantly elevated. In their study, participants did significantly better on the post-test as compared to the pre-test. Specifically, the participants who improved the most on the post-test also showed the greatest increase in serotonin.

Using exercise to increase serotonin levels can have a positive effect on one's life. The increase of serotonin could help improve the mental health of an individual. The reduction of negative mental health and the improvement of cognitive function can both improve the overall wellbeing of those who take advantage of this natural hormone produced by the body.

Conclusion

Anxiety is often a common aspect of life and can impact an individual's daily mood or their entire personality. It is normal for individuals to experience small amounts of anxiety in their everyday life, from getting the house clean in time for guests, to having

a paper done in school. However, it is important to handle all anxiety in a safe and non-harmful manner. Alcohol and drug use are negative or maladaptive coping mechanisms, and only “mask” anxiety for a short amount of time. Using exercise as a form of anxiety relief has been proven to lower anxiety significantly and is beneficial to the body, as long as the exercise is done properly. Numerous studies show aerobic exercise is an effective form of intervention to decrease anxiety symptoms.

CHAPTER III

METHODS

Participants/Recruitment

The participants of this study were student volunteers from Eastern Kentucky University. The subjects were recruited from several different departments on campus, however, the majority of candidates came from the Exercise and Sport Science department. Visits were made to numerous classes announcing the need for volunteers for the study. A list of names was collected. Volunteers were emailed dates and times they could participate in the study, along with a consent form (see Appendix A) and physical activity readiness questionnaire (PAR-Q, see Appendix B) to bring the day of their testing.

Scheduling

After the subject volunteered for the study, an email was sent to them with detailed information about the study. This email (see Appendix C) specified who did not qualify for the study, an overview of what the study entailed, where the study took place and, lastly, the days and times the subjects could attend. Candidates listed their top four available times for the study when responding to the email. Once the schedule was set, the research took place in the Weaver Fitness and Wellness Center. The subjects received a reminder email (see Appendix D) the day before their scheduled date.

Testing Protocol

Pre-Exercise Testing

The subject arrived at the exercise lab room at their assigned time. As soon as the subject arrived, each student signed their consent form and PAR-Q prior to testing. They

read and signed their informed consent form. Next, they were given five minutes to relax from their walk to the building. After that five minutes was over, their resting heart rate was taken and they were handed two surveys to assess their state anxiety. Once they completed their survey the subject was moved over to a treadmill.

Survey Instrument

The State-Trait Anxiety Inventory, also referred to as the STAI Form Y-1 (see Appendix E), was used to assess state anxiety, the anxiety of an individual at the time the survey was given. It consists of twenty questions with statements people have used to describe themselves. Each question had four possible answers; 1- not at all, 2- somewhat, 3- moderately so, 4- very much so. The subject chose the answer which best described how they felt at that time. The STAI survey was scored the following way: 10 questions relating to lowered anxiety (ex. I feel calm and I feel secure) were scored from 1 to 4, as answered; and 10 questions relating to increased anxiety (ex. I am tense and I feel strained) reverse scored from 4 to 1, opposite of answered. The STAI Form Y-1 was developed by psychologists Spielberger, Gorsuch, Lushene, Vagg, and Jacobs (1983). In 1983, it underwent a revision to its current form. The higher the score the lower the state anxiety. The Perceived Stress Scale (see Appendix F), was also used to measure stress in the recent past. It consists of 10 questions with statements asking people how they have felt over the past month. This second survey was used to throw the participants off, so they did not subconsciously answer the questions in the way they felt the researcher wanted them to, and so the participants did not know they were focusing only on state anxiety.

Pulse Oximeter

The Walgreens Pulse Fingertip Oximeter C20 was used. It measured both the heart rate and oxygen level of the subject. This oximeter required two triple A batteries.

Treadmill

The treadmill used was a BH Fitness variety created by the BH Group. The model of the treadmill was LK500Ti, manufactured December 26, 2013. The serial number was 1123LK500Ti0116. This treadmill was made in Taiwan by the Tung Keng Enterprise Co., LTD.

Aerobic Exercise Testing

Subjects were given instructions on how to properly use the treadmill and were shown proper walking form. Once the subject understood all the instructions, they began walking. The speed of the treadmill was set to 3.0 miles per hour, with an incline of 0%. Using a timer, they continued walking at this pace for forty minutes. At the forty-minute mark, each subject turned off their treadmill, stopped walking, and sat down on a folding chair.

Post-Exercise Testing

Immediately after walking forty minutes, their heart rate was taken, and a timer was set for ten minutes. Once the ten minutes came to an end, each subject had their heart rate taken one last time. Lastly, the STAI survey was administered. The instructor collected the surveys once they were completed. The subject was then finished.

Statistical Analysis

Descriptive/summary statistics were performed for all demographic variables and were reported as means and standard deviations. The distribution of data for each variable

was assessed for normality using the Shapiro-Wilk test. Pre-exercise survey scores were compared to post-exercise scores using dependent t-tests. Independent t-tests were utilized to assess between sex differences for each survey. Heart rate was compared using a repeated measures analysis of variance (ANOVA). Mauchley's test was utilized to assess sphericity. In the event sphericity had been violated, a Greenhouse-Geisser correction was employed. Bonferroni post-hoc analyses were employed to determine if differences existed for each variable per time point and group (3 levels of heart rate and sex). Pearson correlation coefficients (r) helped assess if there were associations between survey scores and level of heart rate. Correlations were interpreted as follows: 0.0-0.30=negligible, 0.31-0.50=low, 0.51-0.70=moderate, 0.71-0.90=high, 0.91-1.0=very high. Alpha was set at $p < 0.05$ for all comparisons. All statistical calculations were performed using SPSS 26 (IBM, Armonk, NY).

CHAPTER IV

RESULTS

This chapter will present information related to data collection, demographic data of the participants and the statistical analyses utilized in this study. The overall purpose of this study was to look at college students' state anxiety before and after a forty-minute bout of aerobic exercise and heart rate response pre versus posttest. The State Trait Anxiety Inventory (STAI; Spielberger, 1983) was used to determine whether there were differences in anxiety before and after the aerobic intervention. It was hypothesized that there would be a reduction of state anxiety and heart rate, after aerobic exercise, in the individuals tested. Responses on the STAI would show lowered state anxiety after engaging in a 40-minute bout of low intensity treadmill walking. Post-exercise heart rate responses, likewise, would be lower after aerobic exercise.

In order to compare the research questions in the STAI form Y-1 with heart rate, the results of each survey and all heart rate information was inputted into STATA. The STAI results were scored and totaled using an Excel spreadsheet and copied into STATA for evaluation. The mean scores, standard deviations, and p-values were computed for the overall population, males, and females. T-tests were used to compare the surveys and the differences between sexes. An analysis of variance (ANOVA) was used to compare the heart rates pre, post, and 10 minutes after exercise.

The STAI surveys were all completed at the same location at approximately the same time of day. The STAI form Y-1 contains 20 items that measure state anxiety, or how the participant felt at that exact moment. The scores ranged between 20 and 80. The higher the STAI score, the less anxiety the participant had.

A total of 37 participants fully completed this study. There were 18 males and 19 females within the group. The participants varied in education major/concentration and were not all from the same department. Some participants were graduate students. The ages of the participants ranged from 19 to 24 years old.

For the STAI, a sample size of 34 subjects would have 80% power to detect a difference in means of -6 (the difference between a pre-exercise mean of 50 and a post-exercise mean of 44) assuming that the common standard deviation is 6 using a two group t-test with a two-sided significance level of 0.05. Sample size was determined using G-Power 3.1.9.2 (Franz Faul, Universitat Kiel, Germany, 2019) (Table I).

Descriptive Statistics

Table I. Descriptive Statistics for Demographic Variables

	Overall (n=37)	Male (n=18)	Female (n=19)	P-Value
Age (years)				
Mean \pm SD	21.1 \pm 1.4	21.2 \pm 1.3	20.9 \pm 1.4	0.47
Range	19-24	19-23	19-24	
Height (cm)				
Mean \pm SD	170.9 \pm 8.9	177.4 \pm 6.6	164.8 \pm 6.0	<0.001
Range	152-191	168-191	152-173	
Weight (kg)				
Mean \pm SD	76.2 \pm 19.2	88.4 \pm 17.0	64.5 \pm 13.0	<0.001
Range	50-132	64-132	50-95	

SD = standard deviation

Table I above displays the overall descriptive statistics for the demographic variables. The average age of the overall population was 21.1 \pm 1.4 years. The average

age of the male subjects was 21.2 ± 1.3 years, and the female participants was 20.9 ± 1.4 years. The average height of all participants was 170.9 ± 8.9 cm. However, the average height of the male population was much higher at 177.4 ± 6.6 cm than the female population at 164.8 ± 6.0 cm. Lastly, the average weight of the overall population was 76.2 ± 19.2 kg. Their average weight was 88.4 ± 17.0 kg and 64.5 ± 13.0 kg, for the males and females, respectively (Table II).

Pre-Exercise and Post-Exercise Anxiety Survey Comparisons

Table II. Pre-Exercise versus Post-Exercise STAI Anxiety Scores

STAI	Pre	Post	P-Value
Overall (n=37)	70.8 ± 8.9	75.0 ± 5.5	<0.001
Males (n=18)	70.5 ± 9.6	74.8 ± 5.9	0.010
Females (n=19)	70.5 ± 8.3	75.2 ± 5.3	0.003

STAI= State Trait Anxiety Inventory Y-1

Table II indicates the overall average post-test State Trait Anxiety Inventory Y-1 (STAI) score for the population (N= 37) was 4.2 points higher than the pretest score. Dependent t-tests were used to compare pre and post surveys, while independent t-tests were used to compare the differences between the sexes for each survey. The average score of the males (n=18) increased from pre to post by 4.3-points. The average score of the females (n=19) increased from pre to post by 4.7-points. All results from the STAI survey were significantly higher post-exercise ($p < 0.001$). A higher overall score indicated lowered state anxiety. It was hypothesized that there would be a reduction of state anxiety after an aerobic intervention. The results were significant and agreed with the hypothesis (Table III).

Pre-Exercise and Post-Exercise Heart Rate Comparisons

Table III. Pre-Exercise Versus Post-Exercise Heart Rate Responses

Subjects	Pre	Post	10-Minute
Overall (n=37)	75.3 ± 11.5**	104.8 ± 17.2	70.8 ± 11.5†
Males (n=18)	74.0 ± 12.1**	99.1 ± 15.1	67.9 ± 11.9†
Females (n=19)	76.6 ± 11.2**	110.2 ± 17.7*	73.5 ± 10.8†

*Females significantly greater heart rate versus males $p=0.048$

**Significantly lower heart rate compared to post-exercise $p<0.001$

†Significantly lower heart rate compared to pre and post-exercise $p\leq 0.03$

Heart rate was compared using ANOVA. The overall population recorded a significant decline in heart rate 10-minutes post-exercise. It was hypothesized that responses on the STAI results would show lowered state anxiety after the intervention, thus ten minutes post-exercise heart rate responses would be lower. However, the correlation between heart rate reduction and the survey answers was negligible. This was true for all the comparisons (overall, males, and females) (Table IV).

Anxiety (STAI) and Heart Rate Comparisons

Table IV. Pre-Exercise Versus Post-Exercise Anxiety Versus Heart Rate Comparisons

Exercise	R ² Coefficient	P-Value
Pre	0.2356	0.1603
10-Minutes Post	0.0835	0.6231

The above table displays the r^2 coefficient and p -values for the comparison of heart rate to the anxiety (STAI) survey both pre-exercise and 10-minutes post-exercise. The pre-exercise r^2 coefficient was 0.2356 and the p -value was 0.1603. Ten minutes post-exercise the r^2 coefficient was 0.0835 and the p -value was 0.6231.

CHAPTER V

DISCUSSION

Introduction

The purpose of this study was to examine how state anxiety and heart rate are affected after a forty-minute treadmill exercise. Due to the prevalence of anxiety in college age individuals, it was important to conduct this study (Keiffer & Reese, 2009; Silva, É., & Tucci, A, 2018; Sizoo, Malhotra, & Shapero, 2008). The literature showed negative coping strategies for those with anxiety were much more prevalent in college-aged individuals (Silva & Tucci, 2018). Simply, college-age individuals are using alcohol and drugs much more often than the rest of the population to cope with their anxiety.

This study examined two specific questions: 1) will a forty-minute bout of aerobic exercise lower state anxiety; and 2) is there a correlation between anxiety and heart rate? This study was unique because pre and post heart rate were assessed along with the pre and post-exercise anxiety survey results. The college aged population (18-25 years old) was specifically examined in this study. This final chapter discusses the conclusions of the results as compared to the literature, the limitations of this study, and areas for future research.

Discussion of Results

A convenience sample of 37 undergraduate and graduate students who varied in major, at a regional university, completed this research study. The sample consisted of males (49%) between the ages of 19 and 23 years old, and females (51%) between the ages of 19 and 24 years old. Each study participant completed a survey immediately

before and 10 minutes after, a 40-minute bout of aerobic exercise on a treadmill walking 3.0 miles per hour with no incline. Additionally, each subject's heart rate was taken directly before each survey and after their treadmill workout. The current study focused on one survey that analyzed state anxiety, the State Trait Anxiety Inventory form Y-1 (STAI). The STAI survey asked questions that addressed the "here" and "now," in other words, how subjects felt at the given moment.

The two primary research questions were the following: 1) Will a forty-minute bout of aerobic exercise lower state anxiety; and 2) Is there a correlation between the anxiety score results and heart rate? Regarding question one, a forty-minute bout of aerobic exercise on a treadmill at 3.0 miles per hour did significantly lower state anxiety. Overall, the post-exercise survey results for the STAI survey were about the same for males and females. The higher the score on the STAI survey, the lower the state anxiety of the individual.

There was no significance when comparing heart rate to the answers on the pre and post-exercise STAI surveys. Meaning, the way the subjects answered the questions on the surveys did not correlate with heart rate. However, there was on average a decline in heart rate overall from pre to 10 min post-exercise. Even though we hypothesized that heart rate would be lower after exercise, we attributed it to the change in the survey results, we concluded that the heart rate did significantly decrease, but it did not correlate with the survey results.

Relationship to Literature

The hypothesis of this study, stating state anxiety and heart rate will decrease after a bout of aerobic exercise, was partially consistent with several studies found in the

literature. The literature review revealed aerobic exercise is an effective way to combat anxiety (Broman et al., 2018, Kilziene et al., 2018; Asmundson, et al., 2013). The results of this study agreed with their conclusions. The uniqueness of the current study was shown with the addition of the heart rate monitoring before, after, and ten minutes after a bout of aerobic exercise. The study compared heart rate with the pre-exercise survey scores and with the post-exercise survey scores, in order to see if there was a correlation between heart rate and how they answered their survey.

Past research has shown exercise is an effective way to treat anxiety (Broman & Storey, 2008). However, research has not been able to pinpoint which mechanism in exercise causes these effects. One theory is that exercise causes physical sensations related to anxiety, and exercise is used as a method of exposure because of this (Asmundson et al., 2013). Similar to past research, the results of this study indicated that individuals who engage in aerobic exercise, even a single bout of aerobic exercise, will on average see a reduction in anxiety (Broman et. al., 2018). Specifically, as the exercise frequency increases, the level of anxiety will decrease. This study revealed a significant change in state anxiety after a forty-minute bout of aerobic exercise, thus agreeing with the results of Broman et. al., 2018.

Past literature has shown exercise can reduce resting heart rate (Kang, Kim, & Ko, 2016). This is “due to the inhibition of the sympathetic nervous system (SNS) activation and increased activation of the parasympathetic nervous system owing the effects of cardiovascular adaptation elicited by aerobic exercise” (Goldsmith, Bloomfield, & Rosenwinkel, 2000; Carter, Banister, & Blaber, 2003). Simply stated, aerobic exercise seems have an important role in decreasing resting heart rate. The current study showed

heart rate did significantly decrease after an aerobic workout, however, there was no significant correlation between heart rate and how the participants answered the questions on the STAI.

In conclusion college students experience increased anxiety during the time of their higher education. Negative coping strategies like alcohol and drugs are turned to in order to cope with the increased anxiety. The results of the current study showed a bout of 40-minute aerobic exercise significantly decreased anxiety and resting heart rate in the population tested. Use of this positive coping strategy is recommended to both lower anxiety and improve the health of college students.

Limitations

There were several identified limitations that may have affected the validity associated with this study. The first one being selection bias. The participants were selected through a convenience sample of undergraduate and graduate students from a few different degree programs of a single public university. Therefore, the findings may not be consistent with other universities in different demographics with subjects from different majors. Most of the volunteers in this study came from the Exercise and Sport Science Department, but there were others from the Psychology, Athletic Training, and Biology departments. The subjects may have personal reasons for participating in this study not disclosed to the researchers. Another limitation which may have affected the validity is technology. Technology malfunctions may have caused data to be skewed. There were three major systems that relied on technology including; the treadmill, SPO2 monitor, and the stopwatch. However, each of these were believed to be correctly functioning during the study.

The STAI Y-1 survey was a self-report assessment. The STAI specifically looked at anxiety. The data obtained from the survey may have been affected by different stressful situational and environmental factors. All subjects took the survey at the same place and approximately the same times of day. Each subject completed the survey at their own pace, and in their own area of the room with only the researcher present. The researcher had no control over recent anxiety, either chronic or transient, experienced by each subject. Anyone could have been experiencing anxiety from school or a non-school related outside influence of any kind. The data collection was conducted during the summer and early fall (June-October) of 2019, and the validity of the results may have been affected by the seasonal timing of the data collection. The start of the school year or the first few weeks of school may have added to the anxiety of some of the subjects and this may have caused higher levels of anxiety.

Future Research

Future research should continue in order to examine the hormone fluctuations pre, post, and 10 minutes after, using saliva test strips. Understanding cortisol hormone fluctuations, for example, can help researcher better pinpoint how different hormones change with exercise. Another possible future research study could include finding the ideal treadmill speed and the ideal amount of time it takes to have the most influence on state anxiety. Lastly, how fast does someone have to walk in order to have the optimal affect impact on lowering state anxiety.

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Appendices

Appendix A: Consent Form

Appendix A

Consent Form

Consent to Participate in a Research Study

The Effects of a 40-Minute Bout of Aerobic Exercise on Mental Health in College Age Individuals

Upon approval of your study, the IRB will place a stamp with a protocol number here. You are required to use only the stamped version when enrolling participants in your study.

Key Information

You are being invited to participate in a research study. This document includes important information you should know about the study. Before providing your consent to participate, please read this entire document and ask any questions you have.

Do I have to participate?

If you decide to take part in the study, it should be because you really want to volunteer. You will not lose any benefits or rights you would normally have if you choose not to volunteer. You can stop at any time during the study and still keep the benefits and rights you had before volunteering. If you decide to participate, you will be one of about 100 people in the study.

What is the purpose of the study?

The purpose of the study is to see how a 40-minute bout of aerobic exercise effects mental health in people between the ages of 18 and 25. In order to be an eligible candidate you must fill out a Physical Activity Readiness Questionnaire. Anyone who answers yes to any of the questions will be exempt from the study.

Where is the study going to take place and how long will it last?

The research procedures will be conducted at Weaver Wellness Center. You will need to come to the Weaver Wellness Center during your designated time on the recruitment email, during the study. This visit will take about one hour.

What will I be asked to do?

You will arrive in the exercise lab room at their assigned time. Each student will read and sign their consent form. You will be given 5 minutes to relax from their walk to the exercise lab. Heart rate will be taken after their relaxation period, with a finger pulse oximeter (finger heart rate monitor). Mental health surveys will be handed out. Once the surveys are completed, you will move to the treadmill. You will be given instructions on how to properly use the treadmill, and proper walking form will be demonstrated. You will begin walking at 3.0 miles per hour, at a 0% incline, for 40-minutes. When the 40-minutes are completed, you will turn off the treadmill, stop walking, and sit down. Heart rate will be taken immediately. A timer will be started for 10 minutes after the second heart rate is taken. When the 10 minutes is complete, heart rate will be taken one last time. Mental health surveys will be administered for the last time and the you will be finished.

Are there reasons why I should not take part in this study?

Subjects who answers yes to any of the questions on the Physical Activity Readiness Questionnaire, are under the age of 18, are older than the age of 25, or are pregnant will be exempt from the study.

What are the possible risks and discomforts?

There is a potential risk when performing exercise. However, this risk is minimal. The possibility of negative physical changes during exercise does exist. These changes include abnormal blood pressure, fainting, disorders in heartbeat, heart attack, and (in rare instances) death.

During the walking period we will frequently be monitoring hear rate. We will also use the rating of perceived exertion scle (see Appendix G) to monitor how the participant is feeling throughout the entire study.

According to a study done on older adults by the National Institute of Health (Parise, et. al., 2004), older men walked at an average speed of 3.5 mph and older women walked at an average speed of 3.44mph. The current study we will be looking at a much younger population and our speed will be 3.0 mph. This speed is slower than the average walking speed for older men and woman.

Although we have made every effort to minimize this, you may find some questions we ask you (or some procedures we ask you to do) to be upsetting or stressful. If so, we can tell you about some people who may be able to help you with these feelings. The ECU Counseling Center for ECU Students summer hours are Monday – Thursday 7:30am to 4pm, and Friday 7:30am to 12:30pm. They are located in the Whitlock Building room 571 and can also be reached by their phone number at (859) 622-1303.

You may, however, experience a previously unknown risk or side effect.

What are the benefits of taking part in this study?

You are not likely to get any personal benefit from taking part in this study. Your participation is expected to provide benefits to others by showing others the relationship between mental health and exercise.

Now that you have some key information about the study, please continue reading if you are interested in participating. Other important details about the study are provided below.

Other Important Details

Who is doing the study?

The person in charge of this study is Rachael Dozier at Eastern Kentucky University. She is being guided in this research by Dr. James Larkin. There may be other people on the research team assisting at different times during the study.

What will it cost me to participate?

There are no costs associated with taking part in this study.

Will I receive any payment or rewards for taking part in the study?

You will not receive any payment or reward for taking part in this study.

Who will see the information I give?

Your information will be combined with information from other people taking part in the study. When we write up the study to share it with other researchers, we will write about this combined information. You will not be identified in these written materials.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. For example, your name will be kept separate from the information you give, and these two things will be stored in different places under lock and key.

However, there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court. Also, we may be required to show information that identifies you for audit purposes.

Can my taking part in the study end early?

If you decide to take part in the study, you still have the right to decide at any time that you no longer want to participate. You will not be treated differently if you decide to stop taking part in the study.

The individuals conducting the study may need to end your participation in the study. They may do this if you are not able to follow the directions they give you, if they find that your being in the study is more risk

than benefit to you, or if the University or agency funding the study decides to stop the study early for a variety of reasons.

What happens if I get hurt or sick during the study?

If you believe you are hurt or get sick because of something that is done during the study, you should call Rachael Dozier at (785) 282-4515 immediately. It is important for you to understand that Eastern Kentucky University will not pay for the cost of any care or treatment that might be necessary because you get hurt or sick while taking part in this study. Also, Eastern Kentucky University will not pay for any wages you may lose if you are harmed by this study. These costs will be your responsibility.

Usually, medical costs that result from research-related harm cannot be included as regular medical costs. Therefore, the costs related to your care and treatment because of something that is done during the study will be your responsibility. You should ask your insurer if you have any questions about your insurer's willingness to pay under these circumstances.

What else do I need to know?

You will be told if any new information is learned which may affect your condition or influence your willingness to continue taking part in this study.

We will give you a copy of this consent form to take with you.

Consent

Before you decide whether to accept this invitation to take part in the study, please ask any questions that come to mind now. Later, if you have questions about the study, you can contact the investigator, Rachael Dozier at (785) 282-4515 or rachael_mcdowell7@mymail.eku.edu. If you have any questions about your rights as a research volunteer, you can contact the staff in the Division of Sponsored Programs at Eastern Kentucky University at 859-622-3636.

If you would like to participate, please read the statement below, sign, and print your name.

I am at least 18 years of age, have thoroughly read this document, understand its contents, have been given an opportunity to have my questions answered, and voluntarily agree to participate in this research study.

Signature of person agreeing to take part in the study

Date

Printed name of person taking part in the study

Name of person providing information to subject

Appendix B: Physical Activity Readiness Questionnaire

Appendix B

Physical Activity Readiness Questionnaire (PAR-Q)

2018 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or No	YES	NO
1) Has your doctor ever said that you have a heart condition <input type="checkbox"/> OR high blood pressure <input type="checkbox"/> ?	<input type="checkbox"/>	<input type="checkbox"/>
2) Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?	<input type="checkbox"/>	<input type="checkbox"/>
3) Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? (Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise).)	<input type="checkbox"/>	<input type="checkbox"/>
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? PLEASE LIST CONDITION(S) HERE: _____	<input type="checkbox"/>	<input type="checkbox"/>
5) Are you currently taking prescribed medications for a chronic medical condition: PLEASE LIST CONDITION(S) AND MEDICATIONS HERE: _____	<input type="checkbox"/>	<input type="checkbox"/>
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? (Please answer NO if you had a problem in the past, but it does not limit your current ability to be physically active). PLEASE LIST CONDITION(S) HERE: _____	<input type="checkbox"/>	<input type="checkbox"/>
7) Has your doctor ever said that you should only do medically supervised physical activity?	<input type="checkbox"/>	<input type="checkbox"/>

If you answered NO to all of the questions above, you are cleared for physical activity. Go to page 4 to sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow International Physical Activity Guidelines for your age (www.who.int/dietphysicalactivity/en/).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 and NOT accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.

Delay becoming more active if:

- ✓ You have a temporary illness such as a cold or fever, it is best to wait until you feel better.
- ✓ You are pregnant – talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at www.eparmedx.com before becoming more physically active.
- ✓ Your health changes – answer the questions of Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.

Appendix C: Recruitment Email

Appendix C

Recruitment Email

Dear Student,

The Eastern Kentucky University Department of Exercise and Sport Science is seeking current ECU students who are at least 18 years old and not older than 25 years old and consider themselves slightly active to participate in a research study. You were identified because you signed up saying you were interested in participating in this study. The purpose of this study is to examine the relationship between mental health and aerobic exercise.

Participation in this study involves:

- A 1 time, 1 hour commitment
- 40-minutes of walking on a treadmill at 3.0mph
- Resting heart rate and pre and post-exercise heart rate will be taken
- A mental health survey will be filled out pre and post-exercise
- The research study will take place in the Weaver Wellness Center

Individuals who answer yes to any question on the PAR-Q form may be prohibited from entering the study.

For more information about this study, please contact the principal investigator, Rachael Dozier, by phone at 785-282-4515 or email at rachael_mcdowell7@mymail.eku.edu.

Thank you,

Rachael Dozier
Principal Investigator

Study Title: The Effects of a 40-minute Bout of Aerobic Exercise on Mental Health In College Age Individuals

Appendix D: Reminder Email

Appendix D

Reminder Email

Dear Student:

Thank you for agreeing to participate in our research study entitled, The Effects of a 40-minute Bout of Aerobic Exercise on Mental Health In College Age Individuals. As I mentioned, you will be asked fill out a survey, have your heart rate taken, and walk for 40-minutes at 3.0 mph. You won't need to prepare anything before the session.

You are scheduled to participate as follows:

DATE: [DAY, DATE]

TIME: [TIME]

PLACE: [ADDRESS]

Thanks again!

Rachael Dozier
Exercise and Sport Science Department
Cell: (785) 282-4515
Email: Rachael_mcdowell7@mymail.eku.edu

Appendix E: State Trait Anxiety Inventory (STAI) Form Y-1

Appendix E

State-Trait Inventory (STAI) Form Y-1

State-Trait Anxiety Inventory STAI Form Y-1					
Name: _____ Date: _____ Age: ____ Sex: Male / Female					
<p>Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then write the number in the blank at the end of the statement that indicates how you feel right now, that is, at this moment. There is not right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.</p>					
		Not at all	Somewhat	Moderately so	Very much so
1.	I feel calm	1	2	3	4
2.	I feel secure	1	2	3	4
3.	I am tense	1	2	3	4
4.	I feel strained	1	2	3	4
5.	I feel at ease	1	2	3	4
6.	I feel upset	1	2	3	4
7.	I am presently worrying over possible misfortunes	1	2	3	4
8.	I feel satisfied	1	2	3	4
9.	I feel frightened	1	2	3	4
10.	I feel comfortable	1	2	3	4
11.	I feel self confident	1	2	3	4
12.	I feel nervous	1	2	3	4
13.	I am jittery	1	2	3	4
14.	I feel indecisive	1	2	3	4
15.	I am relaxed	1	2	3	4
16.	I am content	1	2	3	4
17.	I am worried	1	2	3	4
18.	I feel confused	1	2	3	4
19.	I feel steady	1	2	3	4
20.	I feel pleasant	1	2	3	4

Appendix F: Perceived Stress Scale (PSS)

Appendix F

Perceived Stress Scale (PSS)

Participation ID: _____ Date: _____ Age: _____ Sex: Male / Female

A more precise measure of personal stress can be determined by using a variety of instruments that have been designed to help measure individual stress levels. One of these is called the **Perceived Stress Scale**. The Perceived Stress Scale (PSS) is a classic stress assessment instrument. This tool, while originally developed in 1983, remains a popular choice for helping us understand how different situations affect our feelings and our perceived stress. The questions in this scale ask about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don't try to count up the number of times you felt a particular way; rather indicate the alternative that seems like a reasonable estimate.

For each question choose from the following alternatives:

0 – never,

1 - almost never,

2 – sometimes

3 - fairly often

4 - very often

_____ 1. In the last month, how often have you been upset because of something that happened unexpectedly?

_____ 2. In the last month, how often have you felt that you were unable to control the important things in your life?

_____ 3. In the last month, how often have you felt nervous and stressed?

_____ 4. In the last month, how often have you felt confident about your ability to handle your personal problems?

_____ 5. In the last month, how often have you felt that things were going your way?

_____ 6. In the last month, how often have you found that you could not cope with all the things that you had to do?

_____ 7. In the last month, how often have you been able to control irritations in your life?

_____ 8. In the last month, how often have you felt that you were on top of things?

_____ 9. In the last month, how often have you been angered because of things that happened that were outside of your control?

_____ 10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Figuring your Perceived Stress Scale (PSS) score:

You can determine your PSS score by following these directions:

First, reverse your scores for questions 4, 5, 7, & 8.

On these 4 questions, change the scores like this: 0=4, 1=3, 2=2, 3=1, 4=0.

Now add up your scores for each item to get a total.

My total score is _____.

Individual scores on the PSS can range from 0 to 40 with higher scores indicating higher perceived stress.

Stress Level Categories:

Scores ranging from 00-13 would be considered lower stress.

Scores ranging from 14-26 would be considered moderate stress.

Scores ranging from 27-40 would be considered higher stress.

The Perceived Stress Scale (PSS) is interesting and important because your perception of what is happening in your life is most important. Consider the idea that two individuals could have the exact same events and experiences in their lives for the past month. Comparing the two, depending on their perception, their total scores could put one of these individuals in the low stress category and the second person in the high stress category.

Appendix G: Rate of Perceived Exertion (RPE) Scale

Appendix G

Rate of Perceived Exertion (RPE) Scale

RPE Scale	Rate of Perceived Exertion
10	Max Effort Activity Feels almost impossible to keep going. Completely out of breath, unable to talk. Cannot maintain for more than a very short time.
9	Very Hard Activity Very difficult to maintain exercise intensity. Can barely breath and speak only a few words
7-8	Vigorous Activity Borderline uncomfortable. Short of breath, can speak a sentence.
4-6	Moderate Activity Breathing heavily, can hold short conversation. Still somewhat comfortable, but becoming noticeably more challenging.
2-3	Light Activity Feels like you can maintain for hours. Easy to breathe and carry a conversation
1	Very Light Activity Hardly any exertion, but more than sleeping, watching TV, etc