THE EFFECTS OF A SIX WEEK WALKING INTERVENTION ON
CARDIOMETABOLIC RISK FACTORS AND MENTAL WELLBEING IN EAST
STROUDSBURG UNIVERSITY STUDENTS AND STAFF

By

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master
of Science in Exercise Science to the office of Graduate and Extended Studies of East
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ABSTRACT

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Exercise Science to the office of Graduate and Extended Studies of East Stroudsburg University of Pennsylvania.

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Title: The Effects of a Six Week Walking Intervention on Cardiometabolic Risk Factors and Mental Well Being in East Stroudsburg University of Pennsylvania Students and Staff

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Abstract

Less than half of the U.S. adults meet the current exercise recommendations for cardiorespiratory exercise. Exercise has been shown to positively impact cardiometabolic risk factors and mental well-being in adults. However, there is currently limited research on the impacts of a walking intervention on cardiometabolic risk factors and mental-wellbeing. The aim of this study was to investigate the effects of six-week moderate-intensity walking intervention on cardiometabolic disease risk factors and mental wellbeing in East Stroudsburg University students and staff. The participants were involved in three separate lab sessions to test cardiometabolic risk factors and mental-wellbeing scores. The participants were involved in a six-week walking intervention prescribed at individual moderate heart rate intensities. Results from the study showed that there were no significant changes among all the variables tested. Despite these findings, it is still suggested that adults should obtain 150 minutes of moderate intensity aerobic exercise per week.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Health Benefits of Regular Exercise and Physical Activity

Known benefits to regular exercise and increased physical activity for cardiometabolic disease reduction and improved mental wellbeing are widely accepted. However, children, adolescents, and adults throughout the United States do not meet the current recommendations for exercise. According to the Center for Disease Control, 53.5 % of adults aged 18 and older meet the recommendations for aerobic exercise and only 23.2 % meet the aerobic and muscle-strengthening guidelines (Center for Disease Control, 2020). With less than half of U.S. adults meeting exercise guidelines, there are concerns about the effects of prolonged sitting time on risk factors and chronic diseases. Research shows that prolonged sitting time is relevant to being overweight and obese in children, adolescents, and adults (Mussi et al., 2017).

The health benefits of regular exercise and physical activity are widely known for all individuals, but benefits are profound for individuals with cardiometabolic risk factors (Herbert et al., 2020). According to the American College of Sports Medicine (ACSM) exercise can modify cardiometabolic risk factors resulting in reduced resting and submaximal exercising heart rate, lowered systolic and diastolic blood pressure during submaximal exercise and at rest, reduced triglycerides, improved body composition,

1

decreased blood glucose, and increased high-density lipoproteins (American College of Sports Medicine, 2018). Other benefits to chronic exercise are lower rates of cardiovascular disease, strokes, type 2 diabetes, and an overall decrease in morbidity and mortality (American College of Sports Medicine, 2018).

Aerobic exercise (e.g., walking, running, cycling, swimming, treadmill) frequencies, intensities, and time recommendations for risk reduction were put forth by the World Health Organization (WHO) and ACSM. Healthy individuals should engage in 150 minutes of moderate-intensity aerobic exercise for 30 minutes per day, for 5 days a week or 75 minutes of vigorous-intensity aerobic exercise for 20 minutes per day, 3 times a week (World Health Organization 2010; American College of Sports Medicine, 2018). The American college of Sports Medicine defines moderate intensity as 40 to 59% of HRR and vigorous intensity as 60 to 84% of HRR (2018). The recommendations put forth internationally are recommended to maintain weight, improve cardiovascular fitness, and reduce weight gain.

The Effect of Exercise and Physical Activity on Mental Wellbeing

The benefits of regular, aerobic exercise extend beyond just physical benefits. Mental Well-Being is an umbrella term that encompasses psychological, mental, cognitive, and affective factors that enhance or impair the functioning of a person (Herbert, et al., 2020). ACSM also states that anxiety and depression are decreased with regular aerobic exercise (American College of Sports Medicine, 2018). With regular participation in exercise, self-reported anxiety was decreased independent of gender, age, and physical health status (Herbert et al., 2020). Perceived psychological stress in both males and females is also reduced with exercise, although the intensity, type, and

duration of exercise are unclear for maximal benefits (Herbert et al., 2020). Self-efficacy and self-concept are also positively affected by regular exercise participation (Evans et al., 2017). Body image, defined as the internal representation of a persons' outer appearance, is also affected with regular exercise in both males and females (Campbell and Hausenblas, 2009). Typical interventions for negative body image are cognitive, behavioral, and educational therapy. These therapies can often be time-consuming and costly, so exercise is another treatment option for body satisfaction improvement. Exercise intervention can positively influence body satisfaction in select groups of people. People that are motivated for fitness and health reasons had low levels of body dissatisfaction post-exercise sessions (Fuller-Tyszkiewicz et al., 2013). However, higher rates of body dissatisfaction can be present in people that are appearance and weight-motivated following an exercise session (Fuller-Tyszkiewicz et al., 2013).

Sedentary Time

Despite known benefits to regular exercise and physical activity, increased time spent sedentary is still a behavior adopted across the lifespan. On average, the American adult spends approximately 7.7 hours a day sedentary (Ford and Casperson, 2012). Recent research has suggested that increased time spent sedentary is a health risk, irrespective of physical activity time (Solbraa et al., 2015). Prolonged sitting time is associated with increased weight and obesity, BMI, waist circumference, blood pressure, and cardiovascular morbidity (Mussi et al., 2017; Luke et al., 2011). Increased sedentary time can be attributed to technological advancements replacing labor-intensive jobs, increased time spent in automobiles, sedentary occupations, and increased access to smart devices (televisions, phones, tablets, etc.).

University students compromise a unique subgroup within the United States population where sedentary time is prevalent. Sedentary time is a health issue due to time spent sitting in classes or while completing academic assignments. College students are presented with a pivotal time in their life where physical activity and exercise behaviors are developed (Mussi et al., 2017). Sedentary behaviors adopted in college carry over into adulthood, increasing the risk of being overweight and obese. Further, a study from 2018 found that University students have increased exposure to screen time and high use of the internet, exposing students to more sedentary time (Franco et al., 2018). With less than half of the adult American population meeting exercise guidelines and sedentary time being harmful to health, promotion of increased exercise and physical activity, as well as reducing sedentary time for cardiometabolic health and mental wellbeing in college aged individuals should be investigated.

Purpose of the Study

The aim of this study was to investigate the effects of six-week moderate-intensity walking intervention on cardiometabolic disease risk factors and mental wellbeing in East Stroudsburg University Students and Staff.

Hypotheses

It was hypothesized that there would be an improvement in the subjects' cardiometabolic risk factors and mental well-being following the 6-week walking intervention. For the anthropometric data it was hypothesized that waist circumference and hip circumference would reduce significantly, and body fat percentage would reduce significantly. According to the previous research it is hypothesized that weight and body mass index would not significantly change. For the cardiovascular variables it was

4

hypothesized that systolic blood pressure and diastolic blood pressure would both significantly reduce at a resting level, as well as resting heart rate. It was hypothesized for the blood assays that total cholesterol, low density lipoprotein, triglycerides, and blood glucose would significantly decrease. For the high-density lipoprotein levels, it was hypothesized that there would be a significant increase.

For the Mental-Wellbeing scores it was hypothesized that there would be a significant reduction in Generalized Anxiety Scores and perceived stress scores. General self-efficacy scores and body image scores were hypothesized to significantly increase.

Operational Definitions

- Anthropometrics: Subject height measured in cm, weight (WT) in kg, body mass index (BMI) in kg/m^2, body fat percentage (BF%), waist circumference (WC) in cm, and hip circumference (HC) in cm.

- Cardiovascular Risk Factors: Resting heart rate (RHR) measured in bpm, resting systolic blood pressure (SBP) measured in mmHg, and resting diastolic blood pressure (DBP) measured in mmHg.

- Blood Assay Risk Factors: Fasted total cholesterol (TC) in mg/dL, low-density lipoprotein (LDL) in mg/dL, high-density lipoprotein (HDL) in mg/dL, triglycerides (TG) in mg/dL, and blood glucose (BG) in mg/dL.

- Mental Wellbeing: Subject self-reported stress, anxiety, self-efficacy, and body image.
  - Stress: The Perceived Stress Scale (PSS) is a 10-item scale, 1-4 Likert Scale utilized to determine perceived psychological stress (Cohen et al., 1988).

- o Anxiety: The Generalized Anxiety Disorder (GAD) questionnaire is a seven-question 0-4 Likert scale used to determine symptoms of GAD (Spitzer et al., 2006).

- o Self-Efficacy: The General Self-Efficacy Scale (GSE) is a 10-item scale used for self-reported self-efficacy (Schwarzer and Jerusalem, 1995).

- o Body Image: The Body Image Questionnaire-NL (DBIQ-NL) is a 37-item nonclinical Likert scale from 1 to 5 on self-reported body image (Scheffers et al., 2017).

- Currently Sedentary: Not participating in at least 30 minutes of moderate-intensity physical activity on at least three days/week for at least three months.

- Currently Active: ACSM recommendations of 150 minutes per week at a moderate intensity.

- Moderate Intensity: 40 to 59% of heart rate reserve (HRR). Utilize HRmax of 220-age for calculation and RHR from lab assessment.

- Walking Intervention: Six weeks, five times per week, for 30 minutes at 40 to 59% of HRR.

Limitations and Delimitations

The first limitation to this study was the sample size. Only ten subjects were recruited and nine completed the intervention. If a study were completed in the future with similar methodology to this one, a larger sample size should be used. In relation to the sample, the sample was not homogenous, which can be seen through the large differences in the standard deviations from the anthropometric variables of height and weight measured. In the future a study should be conducted where the subjects are

randomly assigned to a walking intervention where there are no differences in the groups anthropometric data. Another limitation was that a physical activity screen questionnaire was not utilized to determine if the subjects were being truthful about their cardiovascular activity prior to the intervention. The information about the inclusion criteria for physical activity was included in the initial recruitment process but was not actually screened. There is a potential that the subjects recruited were already participating in cardiorespiratory exercise. An assessment which was intended to be utilized in this study was a baseline data analysis of steps and active time compared to during the intervention. A baseline data session was unable to be completed due to restrictions for bringing subjects into the laboratory due to COVID-19 and not getting the fitness trackers shipped to the university in time for the entire study to be completed by the end of the Spring 2021 semester. Another limitation was some of the assessment tools that were utilized. BF% was measured using BIA, which can be impacted by hydration status (American College of Sports Medicine, 2018). The subjects were reminded to hydrate the night before their lab sessions to ensure they were hydrated, however that does not guarantee euhydration. In the future, a test that is more valid and reliable should be utilized such as air displacement plethysmography. Lastly, as seen through the HR compliance in the sessions, walking may not be advised as a moderate intensity exercise for people aged 40 and younger. Rather, walking can be incorporated into a reduction of sedentary time and low intensity activity which can contribute to total daily energy expenditure.

LITERATURE REVIEW

Cardiometabolic Disease Improvement with Increased Exercise and Physical Activity and Reduced Sedentary Time

Exercise training impacts cardiometabolic risk factors in males and females over a broad age range. A study in 2019 conducted a randomized controlled trial on sedentary, middle-aged adults to determine if exercise training impacted cardiometabolic risk (Amaro-Gahete et al., 2019). 71 middle-aged males and females (40-65) were randomly assigned to 4 different treatment groups. The first group was no exercise, the control group. Subjects were instructed to not change any physical activity or dietary habits for the 12 weeks. The second group was training based on physical activity recommendations. Subjects were asked to complete 150 min per week at 60-65% of their HRR using a cycle ergometer, treadmill, or elliptical ergometer. Participants also completed two full-body resistance training sessions per week for 60 minutes. The third group was high intensity interval training (HIIT) where they completed two training sessions a week. The first training session was a long session of 40-65 minutes per week at 95% of VO2 max. The second session, the short interval, was circuit-based weight training circuit where the subjects wanted to reach 6-9 on perceived exertion on a 0-10 scale. The fourth group was HIIT plus whole-body electrostimulation (EMS). The

HIIT+EMS group followed the same HIIT procedure but incorporated the EMS training of 15-20 Hz in the long interval and 35-75 Hz in the short interval. Cardiometabolic risk scores were calculated for all four groups over the course of the 12-week program. Weight, BMI, waist circumference, body composition, blood pressure and fasted blood samples were all measured. The cardiometabolic risk was scored using the International Diabetes Federation. There was a significant reduction in cardiometabolic risk for all the groups compared to the control group (Amaro-Gahete et al., 2019). HDL levels increased, total cholesterol decreased, and blood pressure decreased in the physical activity group (Amaro-Gahete et al., 2019). Insulin sensitivity was significantly different from the control group to the physical activity group with sensitivity increasing (Amaro-Gahete et al., 2019). The group that experienced the greatest reduction in cardiometabolic risk was the HIIT+EMS group (Amaro-Gahete et al., 2019). As lean body mass increased, cardiometabolic risk factors decreased (Amaro-Gahete et al., 2019). HIIT+EMS may be the most effective training for improving cardiometabolic risk compared to HIIT or physical activity (Amaro-Gahete et al., 2019).

Physical activity volume and intensity are important factors for cardiometabolic risk for factor reduction. Increased physical activity time is known to improve resting and submaximal blood pressure, resting and submaximal exercise heart rate, total cholesterol, and total triglyceride levels (Sumner et al., 2020). Walking-based physical activity can be an advantage because it is a modality that can be easily incorporated and is widely available to people (Sumner et al., 2020). To determine the effects of volume and intensity stepping activity on cardiometabolic risk factors, 2686 people were invited to take part in an accelerometer-based study in Singapore. Of 2686 invited, 635 completed

9

the study. Participants were male and female with an average age of 48.4 years. Body mass index (BMI), height and weight, waist circumference, systolic (SBP) and diastolic blood pressure (DBP), fasted cholesterol, and fasted glucose were all recorded. Participants had to wear the accelerometer for seven consecutive days for their usual routine, excluding bathing, sleeping, and swimming. When looking at step volume lower triglyceride levels were statistically significant (Sumner et al., 2020). Lower BMI, waist circumference, SBP, and DBP, as well as fasted blood glucose were seen with 30 minute and 60-minute step cadences (Sumner et al., 2020). Inactive time was statistically significant with a higher DBP. Overall, the results from the study found that step intensity was associated with a greater reduction in risk factors compared to step volume (Sumner et al., 2020).

A reduction in sedentary time may be just as important as increased exercise and physical activity for all-cause mortality and cardiometabolic health (Mussi et al., 2017). In 2017 a cross-sectional study was completed by Mussi et al. to identify the sitting time cutoff point for overweight, obesity, abdominal obesity, and lipid disorders in university students. The sample was 137 females attending a University in Brazil studying nursing. Students that participated in the study were approached in a class where the objectives and procedures were introduced by the researchers. The students voluntarily joined the study and were evaluated on sitting time, blood assays, and anthropometric measurements. Time spent seated was recorded using a series of questions that students responded to with a time. These questions related to activities that are typically spent seated such as class attendance, academic tasks, time spent on the cellphone, time spent watching television, etc. The blood assays measured total cholesterol, low-density

10

lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides. Anthropometric measurements recorded were BMI, weight, waist circumference (WC), and height. Results from the study showed that 8 hours a day of sedentary time is a discriminator for abdominal obesity in undergraduate nursing students (Mussi et al., 2017). Sitting time during the week or weekend was not statistically significant for lipid disorders (Mussi et al., 2017).

Accumulation of 10,000 steps has become a number that people should aim to reach every day, which is based on epidemiological studies which report that reaching 10,000 steps a day may reduce SDP and DBP in postmenopausal women (Tully and Cupples, 2011). However, the effects of reaching 10,000 steps per day in university students are not as researched. In 2011 a stepping intervention was prescribed to 12 students attending Queen's University. The participants completed an activity questionnaire to indicate willingness to participate in the program. Then, seven days before the trial subjects were allocated randomly into a 10,000 group or a control group. The measurements of height, body mass, waist and hip circumferences, aerobic fitness, BP, and HR were obtained pre intervention and post intervention. The intervention was 6 weeks in length. Results from the study found that there were no significant differences pre-intervention in step count (Tully and Cupples, 2011). All the participants in the 10,000-step group significantly increased their daily step count, with adherence to the program being 84.8% (Tully and Cupples, 2011). After the six-week intervention, there was also a significant drop in SBP and DBP (Tully and Cupples, 2011). Data from the study suggests that pedometer intervention may be suitable in university students to

increase step count for modifying later in life cardiovascular risk (Tully and Cupples, 2011).

Walking is a readily accessible mode of moderate intensity physical activity for almost all population types (Murphy et al., 2002). Current studies demonstrate that regular walking is associated with a lower risk of coronary events and type 2 diabetes (Murphy et al., 2002). Long bouts of walking and short bouts of walking can increase aerobic fitness in obese and overweight populations (Murphy et al., 2002). The purpose of this study was to determine if short, intermittent bouts of walking could elicit similar improvements in aerobic fitness, cardiovascular risk, and psychological health. Subjects in the study were assigned to a crossover design so that each subject would undergo a long bout and short bout of walking. Each program had the subjects walk at 70 – 80% of the predicted maximal heart rate for a total of 30 minutes, 5 days a week. In the long bout program, the subjects completed the 30 minutes in one session while the other short bout design was 10 minutes of walking separated by $\geq$ 3 hrs. There was a wash-out period of two weeks where afterward the subjects switched protocol. Measurements were recorded at baseline, after the first program, before the second program, and after the second program. The blood samples were obtained 2 days after each training program. 32 middle-aged subjects were recruited that were sedentary and did not have any known cardiovascular disease or orthopedic limitations. Waist and hip circumference, skinfold for body fatness, resting arterial blood pressure, blood samples (HDL and total cholesterol), and a field walking VO_2 max test were completed prior to the interventions and post interventions. The subject's mood was assessed, barriers to exercise scale, and perceived self-efficacy were measured. Results from the study showed that subjects

assigned to the short/long intervention undertook more walking, but it was not statistically significant (Murphy et al., 2002). There were no significant changes in body mass (Murphy et al., 2002). Body fat percentage, waist, and hip circumference, and diastolic blood pressure decreased significantly with both programs. Predicted VO_2 max increased significantly with both programs, but subjects in the short/long showed greater increases (Murphy et al., 2002). Total cholesterol, triglycerides, and HDL concentrations increased significantly in both interventions (Murphy et al., 2002). There was no statistical significance in mood state from either program, but subjects did report greater confidence in walking (Murphy et al., 2002). Perceived barriers to physical activity, effort, time, obstacles, and health decreased with both programs, but was only significant for the effort barrier (Murphy et al., 2002). Results from the study showed that accumulating 30 minutes of brisk walking is effective in increasing aerobic fitness, improving blood lipid profiles, and enhancing psychological well-being (Murphy et al., 2002).

Mental Wellbeing Improvement with Increased Exercise and Physical Activity

Exercise can also affect mental wellbeing positively. Mental wellbeing encompasses self-reported anxiety, perceived psychological stress, self-efficacy, and body image. A study done in 2020 by Herbert et al., investigated the effects of regular physical activity on mental wellbeing and a short-term weekly aerobic exercise intervention for mental wellbeing. The randomized control trial was completed either in a laboratory or online. There were two groups' subjects were randomly assigned to: online pilot study or laboratory study. One group (n=74) had male and female subjects. The subjects were randomly assigned to an exercise intervention or an expressive writing

intervention. In the exercise group, for six weeks the subjects completed a low to moderate intensity aerobic exercise session two times per week in their own home. Participants were provided with two exercise programs in the format of videos and tables. The sessions lasted 16 minutes. For the expressive writing group, the subjects were prescribed 6 weeks of expressive writing, twice a week. This group also tracked changes in mental wellbeing. Expressive writing was chosen as the other intervention because of previous demonstration in studies that expressive writing can be beneficial for mental wellbeing. The subjects wrote about distressing weekly events for approximately 15 minutes, twice a week. The second group (n=30) was all females, and the subjects completed the aerobic exercise sessions in a laboratory for 2 weeks. Self-reported depression, anxiety, perceived stress, body dissatisfaction, and quality of life were measured. All the participants received two different video recordings of the exercise program. For the online group after the intervention, participants assigned to the exercise intervention group had a decrease in self-reported depressive symptoms (Herbert et al., 2020). State anxiety was marginally increased but there were no significant changes in trait anxiety (Herbert et al., 2020). Perceived stress was also significantly changed across time and group with the aerobic exercise group decreasing significantly (Herbert et al., 2020). Quality of life was not impacted in either group (Herbert et al., 2020). Exercise and body dissatisfaction were significantly affected over time with both groups decreasing (Herbert et al., 2020). The results from this study concluded that physical activity and regular aerobic exercise for 6 weeks are beneficial for reducing subclinical depressive symptoms and perceived stress among university students. Exercise

interventions should be incorporated into daily university schedules as an intervention for subclinical depression and perceived stress (Herbert et al., 2020).

Both low-intensity and moderate-intensity exercise are effective at reducing general anxiety and anxiety sensitivity (O'Neill and Dogra, 2020). However, there is not a lot known about anxiety levels in individuals with asthma and exercise at a higher intensity. The purpose of the study was to determine if a 6-week HIIT intervention would reduce anxiety among adults with asthma and whether sex would influence the reduction (O'Neill and Dogra, 2020). Participants completed a 6 week, 3 times a week HIIT protocol on a cycle ergometer. The session started with a 5-minute warm-up followed by 10% at peak power output for a minute and then 90% at peak power output for one minute. This was repeated 10 times. Participants were aged 18-44 years old and were male and female. The Anxiety Sensitivity Index (ASI), Body Sensations Questionnaire, and Generalized Anxiety Disorder scale were used to determine anxiety among the participants. For asthma related anxiety an open visual scale was utilized. Pre-Intervention to post-intervention the peak power output improved (O'Neill and Dogra, 2020). The total ASI was improved as well as the Body Sensations Questionnaire (O'Neill and Dogra, 2020). The VAS measurements did not change from pre-intervention to post-intervention (O'Neill and Dogra, 2020). There were also no significant reactions between sex and any anxiety outcomes (O'Neill and Dogra, 2020). Results overall showed that 15% of participants experienced a clinically meaningful improvement in anxiety sensitivity from the HIIT intervention (O'Neill and Dogra, 2020).

Broadly, exercise is known to improve psychological wellbeing (Evans et al., 2017). Anxiety and depressive symptoms are reduced, and quality of life is improved.

Varied intensities, frequencies, and modalities have been studied to determine the effect of mental wellbeing. The purpose of the study from Evans et al., in 2017 was to determine how different dimensions of exercise are associated with psychological well-being among healthy, physically active adults participating in self-selected exercise (Evans et al., 2017). Frequency, duration, and intensity over 2 months were tracked and related to mental health outcomes. Depressed mood, anxiety, quality of sleep, ability to concentrate, alertness, sense of confidence, satisfaction with weight, perceived physical fitness, appetite, stress experience, and satisfaction with physical shape and appearance were measured. 173 adults completed the study and were recruited over posted announcements. The participants recorded for 8 weeks their exercise diary with frequency, duration, intensity, and omitted workouts. The psychological wellbeing was measured using a 0-10 Likert Scale at the end of the week. Exercise frequency improved 8 of the 11 psychological variables (quality of sleep, ability to concentrate, alertness, sense of confidence, satisfaction with physical shape and appearance) (Evans et al., 2017). Exercise duration improved depressed mood and anxiety. There was a difference among males and females, too, with increased duration showing lower ratings of depressed mood and anxiety among only males (Evans et al., 2017). Exercise intensity improved 8 out of the 11 variables (all except anxiety, satisfaction with weight, and amount of stress experienced). There were also significant gender differences. Males had lower ratings of depressed mood interaction with increased intensity. Exercise omissions negatively impacted 10 of the 11 variables, exception of weight (Evans et al., 2017). There were also significant gender differences with males only having detrimental impacts on the ability to concentrate, alertness, perceived physical fitness, and appetite

(Evans et al., 2017). Overall, higher-intensity exercise is associated with improvements in cognition and mood, as well as increased appetite and quality of sleep (Evans et al., 2017).

CHAPTER 3

METHODOLOGY

Subject Recruitment

Subjects were recruited from East Stroudsburg University graduate and undergraduate programs that had face-to-face instruction for the Spring 2021 semester. The subjects were sent an email regarding the study information. To participate in the study, the subjects had to meet the inclusion criteria of sedentary or not being physically active based on ACSM recommendations. Subjects were included if they were not currently getting 150 minutes of moderate-intensity aerobic activity within one week. Any resistance training that a subject was participating in was not included in the 150 minutes of moderate intensity training. Participants were aged 18 to 40 years old and both males and females were recruited. ESU faculty and staff were also recruited via email, utilizing the same recruitment process as ESU students.

Equipment

- Surgilance One Touch Safety Lancets (Medi purpose, 2017, United States)
- PTS Diagnostics CardioChek PA Analyzer (PTS Diagnostics, 2021, Indiana, United States)
- PTS Diagnostics Lipid Panels (PTS Diagnostics, 2021, Indiana, United States)

- PTS Collect Capillary Tubes (PTS Diagnostics, 2021, Indiana, United States)

- Omni Trust Powder Free Latex Examination Gloves (Omni International Corp, 2021 New Hampshire, United States)

- Clorox Bleach Disinfecting Wipes (The Clorox Company, 2021, California, United States)

- Hydrox Isopropyl Alcohol 99% (Med Lab Supply, 2021, Florida, United States)

- Element Non-Woven Gauze Sponges (McKesson, 2021, Texas, United States)

- Lifescan Ultra 2 Blood Glucose Meter (Lifescan, 2021, Pennsylvania, United States)

- One-Touch Ultra Glucose Test Strips (Lifescan, 2021, Pennsylvania, United States)

- Detecto Adult Mechanical Stadiometer (Detecto, 2021, Missouri, United States)

- Befour PS- 6600 ST Portable Digital Scale (Befour, 2021, Wisconsin, United States)

- Baseline Evaluation Instruments 60-inch Gulick Tape (Baseline Evaluation Instruments, 2021, New York, United States)

- Omron HBF- 306 C Bioelectrical impedance Analysis (Omron Healthcare, 2006, Illinois, United States)

- Omron BP7200 5 Series Automatic Blood Pressure Cuff (Omron Healthcare, 2019, Illinois, United States)

- Fitbit Inspire 2 Heart Rate Monitor (Google, 2019, China)

- American Sociological Association Perceived Stress Scale

- GAD-7 Scale

- Generalized Self-Efficacy Scale

- DBIQ Scale

- PPE: Face Shield, Face Masks, and Laboratory Coats

Laboratory Data Collection

Once recruited, the subjects were asked to set up a time for their first laboratory session to collect baseline data. 12 hours prior to their first lab session all subjects were instructed to complete a 12 hour fast and to abstain from physical activity for 12 hours. The subjects were instructed that they could drink water for the 12 hours leading up to the fasted tests. They were also instructed to bring along a light snack and water for the following morning. Once in the lab for the first baseline session a standard PAR-Q (Appendices) and informed consent were given to the subjects to complete the subjects were given time to read the PAR-Q and informed consent and were asked by the researcher if they had any questions. The total time for the study was explained to the subjects, which was eight weeks. There was one week prior for baseline data collection, 6-weeks for intervention, and one-week post- intervention data collection.

Once the PAR-Q and informed consent was completed, data collection began. The subjects were instructed to sit in a chair for five minutes without movement, using their phone, or talking to other people. Once the five minutes was complete, the Omron Automatic Blood Pressure cuff was used to measure RHR and BP. The left arm was used for every subject, and they were instructed to rest their left arm on the table. The cuff was placed along the upper arm by the brachial artery with a supinated palm.

Anthropometric data of height (cm) and weight (cm) were measured to track changes in weight and for changes in BMI. Guidelines for height and weight

20

measurement followed the current ACSM recommendations. Height was measured using a Detect Stadiometer and weight was measured with the Befour Digital Scale. BMI (kg/m^2) and BF% were calculated using the BIA. The practitioner entered the age, sex, activity level, and height/weight. Once all the information was entered the subjects were instructed to hold out the machine using both hands and gently press down onto the silver bars on the side until the readings for both measurements appeared. Lastly for anthropometrics WC and HC were recorded. A Gulick Tape and tensiometer were used to measure WC and HC. Three measurements were taken for each circumference and followed ACSM recommendations.

Once all the anthropometric data was collected, the blood assay measurements were recorded. The laboratory table was disinfected, and the subjects were asked to sit down. The researcher asked for the non-dominant hand to clean off the fingertips with rubbing alcohol and gauze. The first and second fingers were predominantly used, although for some subjects the third and fourth fingers were cleaned. A one-touch lancet was used to prick the finger. The lancet was pushed into the lateral or medial side of the bed of the finger. BG was measured first using the OneTouch glucometer and test strips. If necessary, a second finger prick was performed to record TC, HDL, and TG levels. The CardioChek machine and pipe were used to measure fasted HDL, LDL, and TG levels.

Next, all the mental wellbeing scales were completed. They were completed after the blood measurements so that any anxiety or stress about the fingerpick would not alter the mental wellbeing data. Self-reported anxiety, stress, self-efficacy, and body image scale were completed by the subjects in person so that the researchers were available to

answer questions. These four scales used were not diagnostic scales and data from the four scales was only utilized to track changes in mental wellbeing from the walking intervention. The GAD-7 was used as a validated scale to assess symptoms of generalized anxiety (Spitzer et al., 2006). The GAD-7 was a 7 question, Likert scale of 0 (not at all sure) to 3 (nearly every day). A score of 5, 10, and 15 were the cutoff points for mild, moderate, and severe anxiety. These anxiety classifications were not used to diagnose any of the subjects but rather to monitor if there were any changes in anxiety scores at each lab visit. The PSS was used to measure the perception of stress. The PSS is a validated scale on how people measure the degree to which one's life is stressful (Cohen et al., 1988). The PSS was 10 questions in length and based on a 0 (never) to 4 (very often) scale. Questions four, five, seven, and eight were reverse scored. All the scores were then totaled from each column and added together for the total score. A higher score indicated higher perceived stress. The GSE was used as a validated questionnaire to measure self-efficacy and was 10 questions in length based on a 1 (not at all true) through 4 (exactly true) Likert scale (Schwarzer and Jerusalem, 1995). Scores from each column were combined for a total score from 10 to 40, with a higher score indicating higher self-efficacy. The DBIQ Scale was a 35 question, validated scale to measure self-reported body image. A modified version of the DBIQ, the DBIQ-NL was utilized to assess body image. The modified version was a validated and reliable scale that was used in a non-clinical setting for body image (Scheffers et al., 2017). 24 questions were included that focus on self-aggrandizement and vitality. Questions about sexual fulfillment and physical contact were omitted for 24 questions total. Responses were scored on a 5-point (1= not at all agree, 5= fully agree) Likert scale. Questions two, three, six, fifteen,

eighteen, twenty-three, and twenty-six were reverse scored. Self-aggrandizement and vitality were calculated separately for a total body image score. A higher DBIQ score indicates a better-perceived body image. The researcher did all the scoring, and the subjects were only instructed to read the statements on each scale and write down the associated number from each scale.

Once the baseline data collection was completed the walking intervention was prescribed to the subjects. The subjects were asked not to change any of their other current activities and to maintain their current diet. The walking intervention was a prescribed 30 minutes of walking 5 times a week, for 6 weeks. The intensity of the walking was at moderate intensity, which was 40 to 59% of HRR. Maximal HR (MHR) was based on the age-predicted maximal heart rate formula (APMHR) of 220-age. RHR was based on the number from the Automatic Omron BP cuff. For the entire eight weeks, each subject was given a Fitbit Inspire 2 to measure compliance to the walking protocol. The subjects were asked to record their 30 minutes of walking on the Fitbit Inspire 2 and sync their information with the Fitbit application on their cell phone. Time and HR from the walking sessions was recorded in the Fitbit application. The Fitbit trackers were given to the subjects at the first laboratory session. Instructions for wearing the Fitbit monitor were based on Sumner et al., study where the monitor was removed for charging, showering, and swimming activities only (2020). Instructions on how to wear the monitor were from Fitbit manufacturer recommendations for placement. The monitor was to be worn on the top of a selected wrist with the back of the watch should be in contact with the skin for optimal tracking (Fitbit, 2020).

The subjects were asked to return to the lab two more times. Once after completing session 15 at the end of week three and again after completing session 30 at the end of week six. The previously mentioned lab tests were completed at these two lab sessions A follow up email was sent to each subject outlining information on how to wear the Fitbit, record sessions, and information about the study. The contact information of the primary researcher was also given to each subject at the baseline session. At the end of the six-week session, the subjects returned their Fitbits to the researcher and were given instructions on how to download excel files from the past two months off the Fitbit website. The subjects emailed the Fitbit excel files to the researcher, which the researcher then used for data analysis.

At the first laboratory session the subjects were verbally informed to not change any dietary habits and at each follow up session a verbal check was completed with each subject that there were no dietary changes. A verbal check in was also completed at each session regarding if there were any changes to exercise beyond the study intervention. If the subjects confirmed there were any changes in diet or exercise, the intervention was stopped for that individual participant.

Data Analysis

Data was recorded on Microsoft Excel 2016 or placed into a binder for the study. Once all the data was collected from the subjects the data was reorganized in Microsoft Excel to calculate means, standard deviations, and delta scores. Data analysis was broken up into four different categories for each variable tested: anthropometrics, cardiovascular, blood assays, and mental wellbeing. WT, BF%, BMI, WC, and HC were organized under the anthropometrics category. SBP, DBP, and RHR were organized under the

cardiovascular category. TC, LDL, HDL, TG, and BG were all categorized within blood assays. Lastly, each of the four scales was organized under the mental wellbeing section. IBM SPSS Version 27 was used for data analysis. A one-way repeated measures ANOVA was calculated for each variable, comparing participants' baseline week, week three, and week six of testing. Each variable was tested at an alpha of .05 and a confidence interval of 95% of the mean. A paired samples t-test was run using SPSS to determine if there were differences in HR compliance from weeks one to three versus weeks three to six. The paired samples t-test was tested at a .05 alpha level and 95% confidence interval of the mean. Total compliance was determined by counting the total number of walks that the participants completed compared to the total number of walks (30) that should have been completed. The total walks completed was then divided by 30 walks to give a compliance percentage. The same process was used for the total six weeks but instead using the prescribed HR zones. The HR from each recorded session was looked through by the researcher and any walks not within the HR zone were not counted towards intervention compliance.

During the first week, one participant did not fill out the DBIQ correctly, so this data was not utilized for the mean score calculation for the DBIQ in the first lab session. At week three of the study, two subjects had to quarantine so data was unable to be collected for those two subjects at week three. One subject did not have their blood triglyceride, HDL, and LDL levels recorded because of almost passing out in the first baseline session. These three variables were not recorded from this subject again for weeks three and six.

Figure 1. Methodology Flowchart
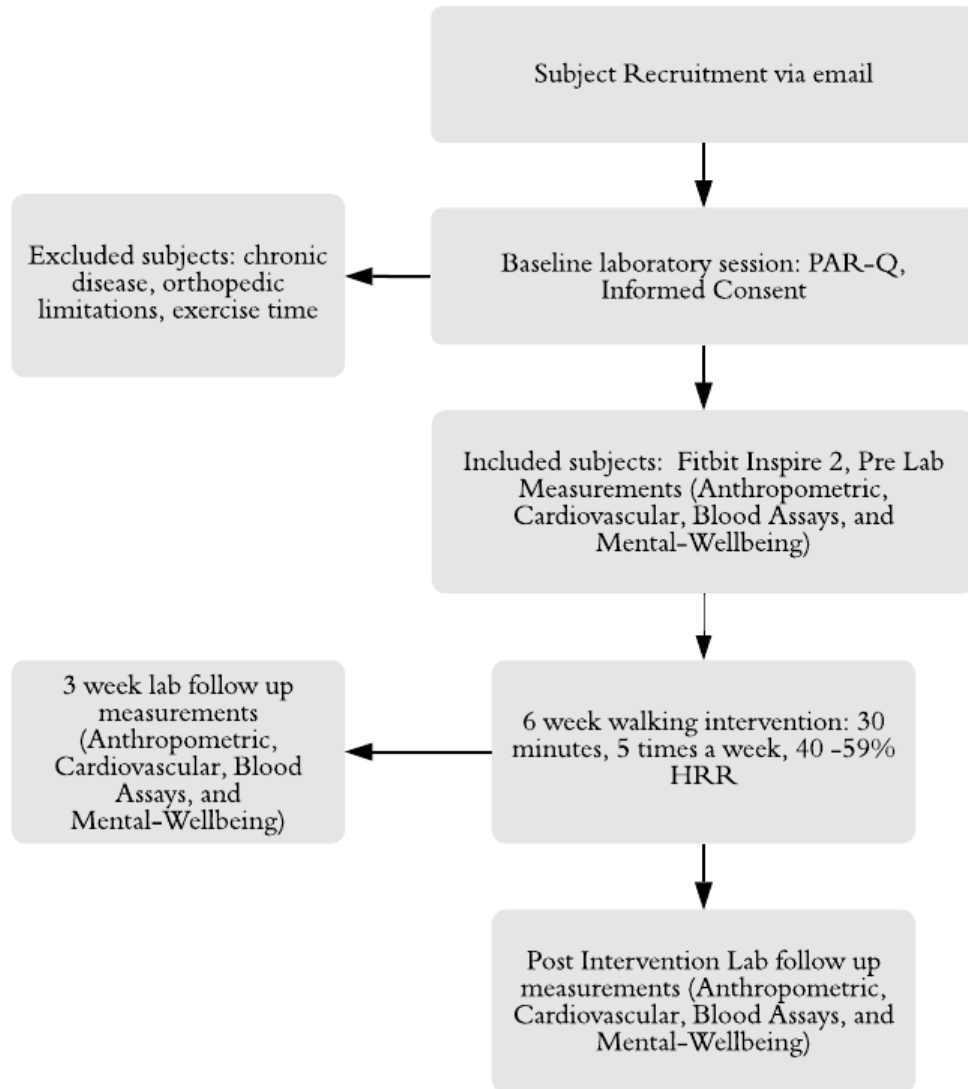
CHAPTER IV

RESULTS

Subject Demographics and Subject Dropout

A total of 10 subjects were recruited via email. There were three undergraduate students, four graduate students, and three faculty initially recruited. Two undergraduate students, four graduate students, and three faculty members completed the full duration of the intervention. Four males and six females were initially recruited for the study via email. Four males and five females completed the six-week intervention. The mean age of the subjects was 24.78 ± 2.99 years, and the mean height was 175.10 ± 8.33 cm.

Table 1

Intervention Compliance

Walking Compliance	Mean and STDEV	p-value
% Total Walks	94.815 ± 6.479	
% Walks within HR zones	57.415 ± 37.949	
% Walks within HR zones weeks 1 to 3	65.643 ± 39.753	.124
% Walks within HR zones weeks 3 to 6	57.661 ± 38.137	.124

Note. Compliance with the walking intervention is displayed in Table 1. The mean and

standard deviation are shown for the total % of walks out of 30 that all the subjects

completed. The walks within the prescribed HR zones are also shown. Compliance for

the walks within the HR zones is also presented as percentages out of the 30 walks that

were completed. The compliance was also broken up into weeks one to three compared to

weeks three to 6. A paired samples t-test was run using SPSS to determine if there were

any differences in HR compliance in weeks one to three versus three to six. A p-value of

.124 showed that there was no difference in HR compliance during the walks between the

two sets of weeks.

Figure 2

Body Mass measurements for the three laboratory sessions
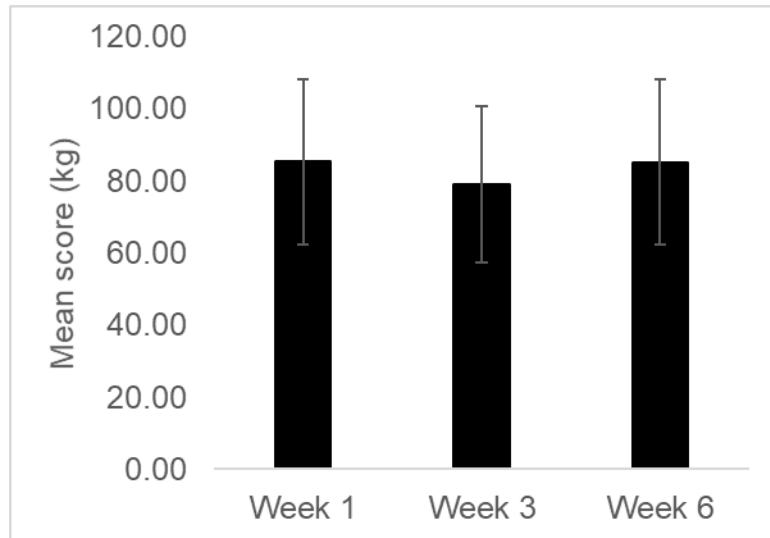
Note. The mean scores for changes in weight over the course of the three lab sessions are presented above. The mean weight from the first session was 85.392 ± 22.997 kg, $79/177 \pm 8.204$ kg at the second session, and 85.277 ± 22.908 kg in the final session. A one-way ANOVA test was utilized to test for differences in the means between weeks one to three, three to six, and one to six. A p-value of .831 revealed that there was no difference in weight between the three sessions.

Figure 3

Body Fat Percentage measurements for the three lab sessions
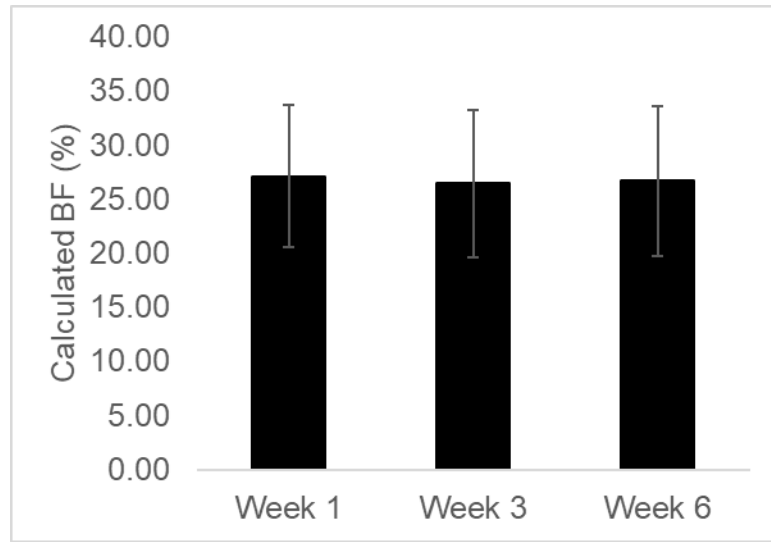
Note. The BF% for each week of testing is displayed above in figure 2. The mean BF% from week one was 27.133 ±6.624, 26.443 ± 6.847 % in week 3, and 26.6778 ± 6.957% in week six. A one-way ANOVA test was utilized to see if there were any differences in the mean BF% for each week of testing. A p-value of .979 revealed that there was no difference in body fat % between weeks one to three, three to six, and one to six.

Figure 4

Body Mass Index measurements for the three laboratory sessions
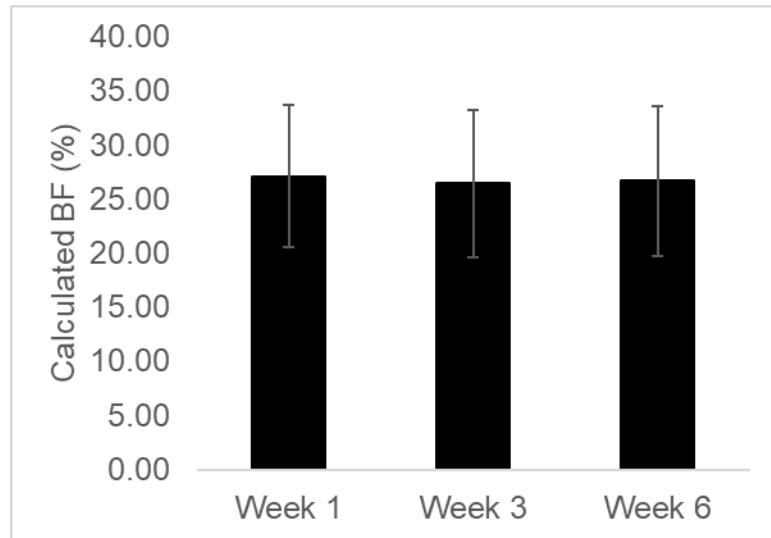
Note. The mean scores for BMI are displayed in figure 4 for each lab session. The mean

BMI from week one was 27.611 ± 5.377 kg/m^2, 26.343 ± 5.009 kg/m^2 in week 3, and

27.622 ± 5.261 kg/m^2 in the sixth week. A one-way ANOVA was run to determine if

there were any differences in the subjects BMI measurements for each lab session. A p-

value of .862 showed that there was no difference in BMI between each lab session.

Figure 5

Waist and Hip Circumference measurements for the three laboratory sessions
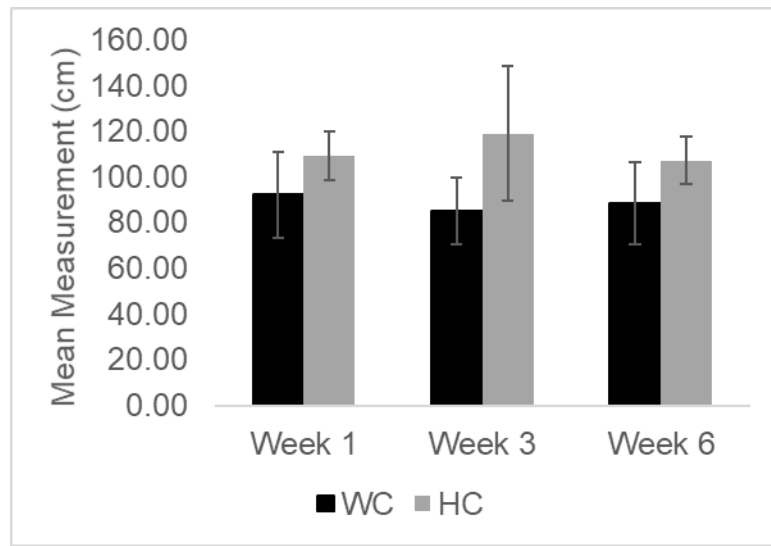
Note. The mean measurement for WC and HC are presented in figure 5. The mean WC in week one was 92.257 ± 18.961 cm, 85.233 ± 14.685 cm in week three, and 88.586 ± 18.099 cm in week six. For the HC, the mean measurement for week one was 92.257 ± 18.961 cm, 85.233 ± 14.685 cm in week three, and 88.596 ± 19.099 cm in week six. A one-way ANOVA test was used to calculate any differences between each lab session. For the WC, a p-value of .751 revealed that there was no difference in the measured WC between each lab session. For the HC, a p-value of .751 also showed that there were no differences in the measured hip circumference for each lab session.

Table 2

Descriptive Statistics and Significance for Cardiovascular Variables

Variable	Week	Mean and Stdev	Sig
SBP (mmHg)	1	122.777 ± 10.662	
	3	122.222 ± 11.773	0.996
	6	122.480 ± 15.449	
DBP (mmHg)	1	69 ± 8.154	
	3	73.850 ± 9.063	0.532
	6	71 ± 8.306	
RHR (bpm)	1	66.666 ± 7.123	
	3	68.571 ± 8.580	0.510
	6	71.444 ± 9.976	

Note. The mean and standard deviation are shown for SBP, DBP, and RHR from each lab session. The significance is also displayed for each variable. For the SBP there was a mean change of -2.875 ± 12.988 mmHg from week one to week six. The DBP had a mean change of 1.375 ± 8.86 mmHg from the week one lab session to the last lab visit. The RHR had a change of 4.75 ± 10.209 bpm from week one to week 6. A one-way ANOVA was used to calculate any changes in cardiovascular adaptations for the walking intervention. For the SBP a p-value of .996 showed that there was no difference in SBP from pre- to post-intervention. For the DBP a p-value of .532 also showed that there was no difference from pre-intervention to post-intervention. A calculated p-value of .510 for the RHR also showed that there was no difference in RHR for week one to week six of the intervention.

Table 3

Descriptive statistics and significance for measured blood assays

Variable	Week	Mean and Stdev	Sig
TC (mg/dL)	1	160.125 ± 42.367	
	3	161.167 ± 32.676	0.706
	6	173.500 ± 26.645	
TG (mg/dL)	1	107.250 ± 39.881	
	3	73.666 ± 23.720	0.165
	6	97.875 ± 27.126	
HDL (mg/dL)	1	54.500 ± 19.603	
	3	55.333 ± 13.276	0.990
	6	55.625 ± 14.802	
LDL (mg/dL)	1	88.625 ± 34.070	
	3	77.830 ± 44.090	0.532
	6	89.180 ± 20.858	
BG (mg/dL)	1	91.333 ± 10.988	
	3	83.428 ± 6.477	0.191
	6	89.111 ± 6.622	

Note. The descriptive statistics and significance for the blood assays are presented in

table 4. The means and standard deviations from weeks one, three, and six are displayed

for TC, TG, HDL, LDL, and BG. For the TC there was a mean change of 13.375 ±

39.813 from week one to week six. The TG levels had a mean change of -9.375 ± 43.996

from the first to the last lab visit. The HDL levels had a calculated mean change of 1.125

± 16.89 from week one to week six. The calculated LDL levels change 9.625 ± 36.578

from the first to the last lab visit. BG measurements had a mean change of -3.125 ±

11.813 from week one to week 6. For each variable, a one-way ANOVA was used to

calculate differences in week one, three, and week six mean scores. For TC, a p-value of

.706 determined there was no difference in the mean TC from each lab session. A

calculated p-value of .165 for the TG also determined that there was no difference in the

TG level from each lab session. For HDL levels, the calculated p-value was .990 showing that there was no difference between each lab session for the HDL levels. A calculated p-value of .532 for the LDL also revealed that there were no differences between each lab session. For the BG, a p-value of .191 showed that there was no difference in BG levels from each lab visit.

Figure 6

Generalized Anxiety Disorder Scores
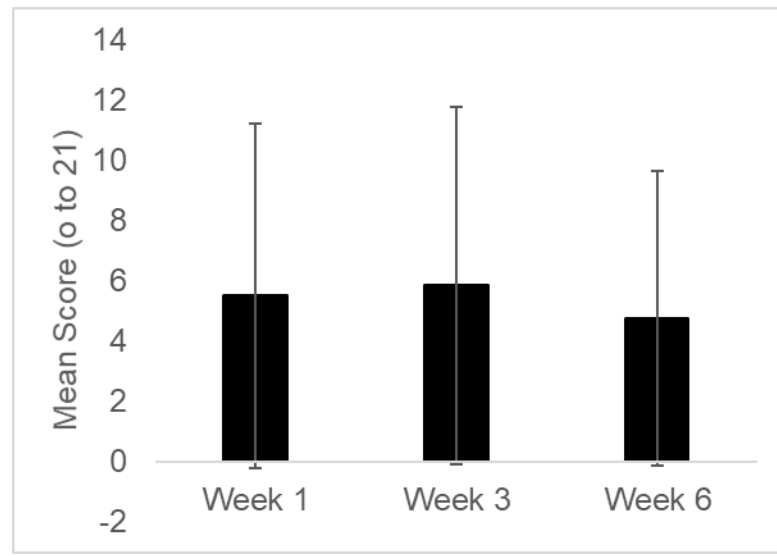
Note. The mean scores and standard deviation for the results from the GAD-7 are presented in figure 6 above. The mean GAD score from the first lab session was 5.5 ± 5.7532, 5.833 ± 5.947 at week three, and 4.750 ± 4.8917 in the sixth week. A mean delta score of -0.75 ± 3.37 was calculated from week one to week six. A one-way ANOVA was calculated to determine if there were any differences in the recorded anxiety scores from each lab visit. A p-value of .951 showed that there was no difference in anxiety scores that were reported from each lab session.

Figure 7

Perceived Stress Scores
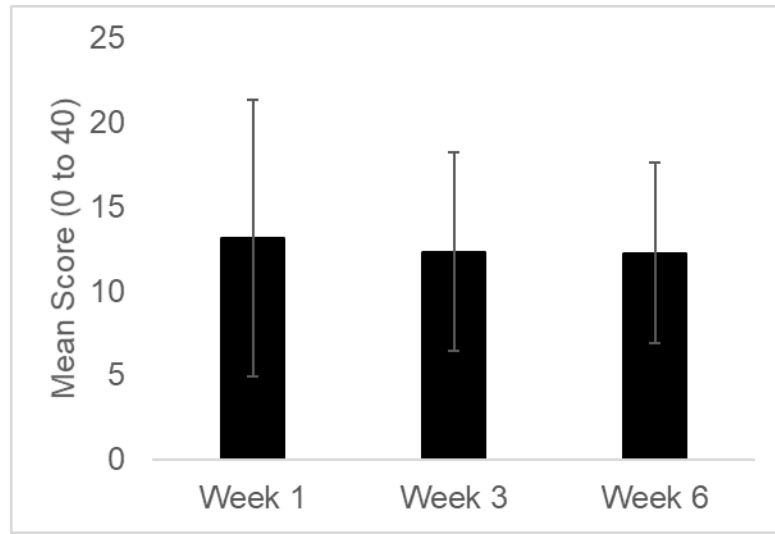
Note. The mean scores and standard deviation for the results from the PSS are displayed

in figure 7 above. The mean PSS score from week one was 13.125 ± 8.167, $12.333 \pm$

5.854 for the third week, and 12.250 ± 5.339 for the sixth week. For the PSS, there was a

mean calculated change of -0.875 ± 9.775 from week one to week six. A one-way

ANOVA was calculated to determine if there were any differences in the recorded

perceived stress scores from each lab visit. A calculated p-value of .903 showed that there

was no difference in perceived stress scores that were reported from each lab session.

Figure 8

Body Image Scores
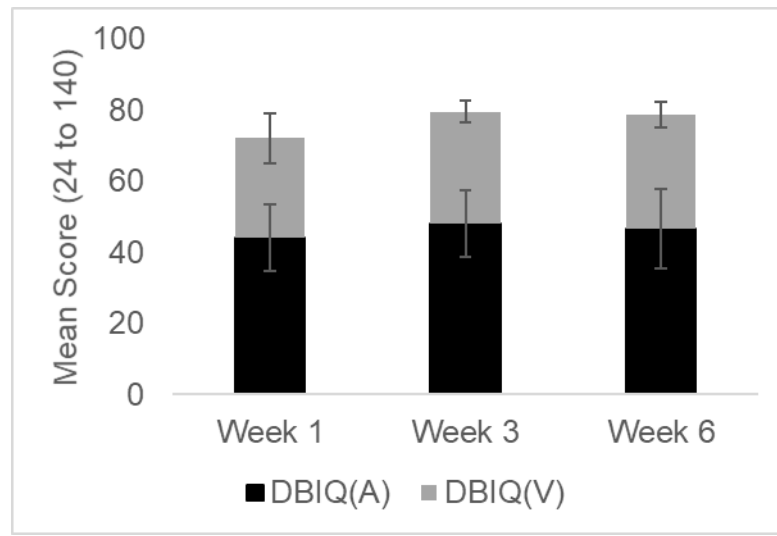
Note. A total body image score is represented in figure 8 above from the breakdown of DBIQ (V) and DBIQ (A). The mean score from the DBIQ (V) and DBIQ (A) was added together to calculate a mean DBIQ score. Reported values were calculated from each lab session. The total DBIQ score from week one was 72.143 ± 11.596, 97.500 ± 9.376 for week three, and 78.625 ± 23.537 for week six. There was a total mean change of 15.5 ± 23.537 for the total DBIQ score from week one to week six. The DBIQ (V) mean score from week one was $28/143 \pm 6.962$, 31.333 ± 3.011 in week three, and 32 ± 3.703 in the sixth week. DBIQ (A) mean scores were initially measured at 44 ± 9.398, 48.167 ± 9.347 in week three, and 46.625 ± 11.275 for the sixth week. The total mean change for the total DBIQ score came from an increase in the mean DBIQ (V) score of 7.375 ± 11.8676 and from the DBIQ (A) change of 8.125 ± 12.088. A one-way ANOVA was calculated on the DBIQ (V), DBIQ (A), and total DBIQ score to determine if there were any differences in the scores from each lab session. A calculated p-value of .350 for the DBIQ (V) and a calculated p-value of .761 revealed that there were no differences in the

38

associated scores between each lab session. A p-value of .492 showed that there was no difference in the total DBIQ score from each lab visit.

Figure 9

General Self- Efficacy Scores
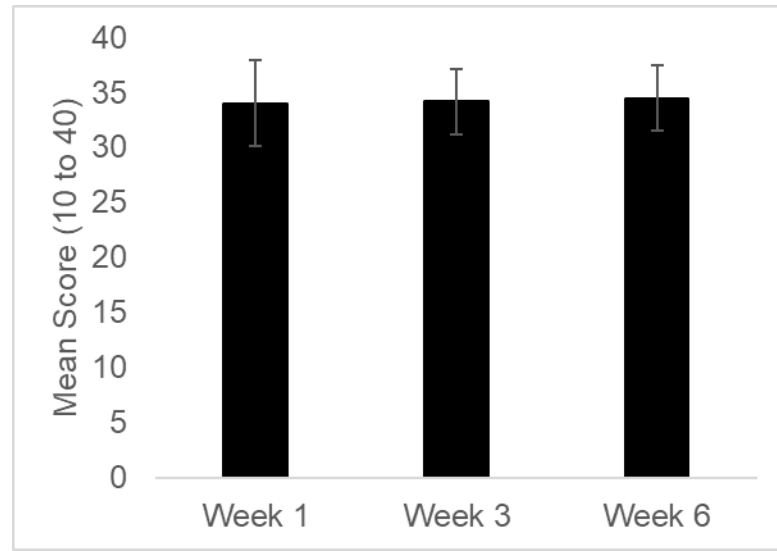
Note. The reported scores from the GSE scale are shown in figure 9 from each lab visit. The initial measurement from the GSE mean score was 34 ± 3.891, 34.167 ± 2.927 in week three, and 34.500 ± 3.024 in the sixth week. The total change from week one to week six was 0.5 ± 2.563 for GSE. A one-way ANOVA was run to determine if there were any differences in week one to three, three to six, and one to six in reported self-efficacy. A calculated p-value of .942 determined that there was no difference in reported self-efficacy from each lab visit.

CHAPTER V

DISCUSSION AND CONCLUSION

Students in a University setting spend time sedentary for completion of assignments and for class time (Mussi et al., 2017). This time spent sedentary, irrespective of physical activity time, is associated with increased weight, BMI, obesity, waist circumference, blood pressure, and cardiovascular morbidity (Mussi et al., 2017). Studies have shown that increase step count and moderate intensity walking interventions have positively impacted SBP, DBP, BF%, WC, and HC (Murphy et al, 2002; Tully and Cupples et al., 2011). In addition to cardiometabolic risk factors, mental-wellbeing can also be positively impacted through increased exercise and physical activity. Studies have shown that body dissatisfaction, subclinical depressive symptoms, and perceived stress can be reduced through increased exercise and physical activity (Herbert et al., 2020). This present study aimed to investigate if a six-week walking intervention would positively impact cardiometabolic risk factors and mental-wellbeing in university students and staff.

Subject Compliance

Table 1 displays the compliance from the involved subjects for the entire six-week walking intervention. Within the six weeks of the intervention each subject should have completed a total of 30 walks. The compliance to the total number of walks was 94.815 ± 6.479 %, which is consistent, and slightly higher, than a step count intervention from 2011 that had an adherence rate of 84.8% (Tully and Cupples, 2011). However, when breaking down the compliance by the prescribed HR intensities there was only 57.415 ± 38 % for the entire six weeks. When broken down further into the first three weeks the compliance at the HR intensities was 65.643 ± 39.753 % and 57.661 ± 38.137% from the last three weeks. A study from Murphy et al., had a compliance rate of 88.2 ± 1.1 % and 91.3 ± 4.1 % for the two walking interventions included in their study (2002). However, that compliance to their intervention was related to time and not HR intensities. Presently, a study could not be identified in relation to compliance in a walking intervention with prescribed HR at a moderate intensity.

Anthropometric Adaptations

The present WT results are consistent with previous studies. Table 4 (Appendices) and Figure 2 overview the descriptive statistics for WT. The subjects involved in the study had a weight of 85.392 ± 22.996 kg at the week one session, 79.171 ± 21.705 kg at week three, and 85.276 ± 22.907 and week six session for a total change in weight from week one to three of -0.12 ± 1.04. This small change in weight was determined to not be significant for this sample of participants. A walking intervention from 2002 also found that in middle aged adults there were no significant changes in body mass after the walking intervention (Murphy et al., 2002). The current findings for BF% are shown in

table 4 and figure 3. The changes in BF% from this study are not consistent with previous research on a six-week walking intervention. At the first laboratory session the BF% was 27.133 $\pm$ 6.623 %, 26.442 $\pm$ 6.847 % in the third week, and 26.677 $\pm$ 6.956 at the sixth week for a total change of -0.46 $\pm$ 3.50 from week one to week six. The previous study found significant reductions in BF% with their prescribed walking intervention (Murphy et al., 2002). The first BMI measurement for all the subjects was 27.611 $\pm$ 5.376, kg/m² at week three it was 26.342 $\pm$ 5.009 kg/m², and 27.622 $\pm$ 5.260 kg/m² at the sixth week. The total change in BMI was 0.01 $\pm$ 0.38 kg/m² from the first to the last session. These changes in BMI are consistent with a previous study that a walking intervention does not significantly impact BMI (Murphy et al, 2002). According to ACSM, the BMI scores obtained from this study would classify the subjects on average in the overweight category (ACSM, 2018). Data from the WC and HC changes are displayed in Table 4 and Figures 4 and 5. WC was measured at 92.257 $\pm$ 18.961 cm at the first session, 85.233 $\pm$ 14.884 cm in the third week, and 88.595 $\pm$ 18.088 cm at the final session for a total change of -3.66 $\pm$ 4.21 cm from week one to week six. The HC was measured at 92.256 $\pm$ 18.961 cm at week one, 88.233 $\pm$ 14.684 cm at the third week, and 88.595 $\pm$ 18.099 cm at the sixth week for a total change of -1.97 $\pm$ 4.51 cm from the first to last session. These changes were determined to not be significant for measured WC and HC. These findings do not agree with previous research that WC and HC should decrease significantly following a six-week walking intervention (Murphy et al., 2002).

These inconsistent findings could be explained by low compliance to moderate HR intensities. Since the overall compliance to the moderate HR intensities for the entire six weeks was 57.415 $\pm$ 37.949, there is a potential that there was not enough stress

placed onto the cardiovascular system to elicit adaptations in BF%, WC, and HC. A previous study mentioned that changes in BF%, HC, and WC that were identified in their study could lower the risk of cardiovascular disease (Murphy et al., 2002). Additionally, kilocalorie expenditure could have been impacted if the subjects were not reaching the moderate heart rate intensity that was initially prescribed. Higher heart rate intensities yield higher kilocalorie burn and can ultimately contribute to a reduction in body mass and body fat percentage (Falcone et al., 2015).

Cardiovascular Adaptations

The adaptations in the SBP from this study is not consistent with a previous study that a six-week walking intervention should reduce SBP (Tully and Cupples, 2011). Table 2 shows the results from the cardiovascular adaptations. At the beginning of the intervention in the first week SBP was measured to be 122.77 ± 10.662 mmHg. In the third week the SBP was 122.222 ± 11.773 mmHg and in the sixth week it was measured at 122.48 ± 15.499 mmHg for a total not significant change of -2.875 ± 12.988 mmHg. SBP in this study was also inconsistent with the previously mentioned study that SBP decreased following the 10,000-step intervention (Tully and Cupples, 2011). At the beginning of this study the DBP was 69 mmHg ± 8.154 mmHg. The measured DBP in week three was 73.85 mmHg ± 9.063 and in the sixth week it was 71 ± 8.306 mmHg with a total not significant change of 1.375 ± 8.863 mmHg. The study from Tully and Cupples also found a significant decrease in DBP following the 10,000 steps intervention. RHR was measured at 66.666 ± 7.123 bpm in the first week, 68.571 ± 8.58 bpm in the third week, and 71.444 ± 9.976 bpm in the sixth week for a total change in RHR of $4.75 \pm$

10.209 bpm. This study does not agree with previous research that RHR is reduced with an increase in physical activity and exercise (Sumner et al., 2020).

The inconsistent findings could again be attributed to the overall compliance to the walking intervention. With better compliance to the HR intensities prescribed from ACSM, there may have been more stress placed on the cardiovascular system which would elicit a reduction in SBP, DBP, and RHR. In addition to the stress placed on the cardiovascular system exercising at the moderate heart rate intensity or higher heart intensity yields in a higher number of kilocalories being expended to complete an exercise bout (Falcone et al., 2015). When more calories are expended within a session there will be a greater reduction in body mass (Falcone et al., 2015). The initial measurement for the SBP was on average classified as elevated according to newest guidelines released from the American College of Cardiology and the American Heart Association (AHA, 2021). However, SBP reading from this study was not near the ACSM risk factor of $\geq$140 mmHg. DBP was also below the risk factor category of >90 mmHg with the initial measurement at 69 mmHg. This group started out even below the risk factor stratification level which could be another reason why there were no significant changes which occurred.

Another explanation as to why there were not any changes could be explained by the subjects did not reach 10,000 steps each day. The step count data was unable to be used as the subjects did not keep the tracker on the entire day, so it could not be determined in total step count significantly changed. When comparing to Tully and Cupples study, the subjects increased their total step count to 10,000 steps and saw significant changes (2011). ACSM identifies 0 to 5000 steps as sedentary, 5,000 to

7,4999 steps as low active, 7,5000 to 9,999 as somewhat active, 10,000 to 12,500 as active, and 12,500 or more as highly active (American College of Sports Medicine, 2011). If the subjects only activity for the day was the walking intervention their step count could still be identified as low activity or sedentary, which could further explain a lack of significant changes.

Blood Assay Adaptations

Table 3 displays the blood assay adaptations that occurred over the course of the intervention. The changes which occurred in this study are not consistent with previous findings that a six-week walking intervention significantly reduces TC, HDL levels, and TG levels (Murphy et al., 2002). In the present study, the TC was initially measured at 160.125 ± 42.367 mg/dL, 161.167 ± 32.676 mg/dL in the third week, and 173.5 ± 26.645 in the final lab session for a total not significant change of 13.375 ± 39.8135 mg/dL from week one to week six. TG levels were initially measured at 107.25 ± 39.881 mg/dL in the first session, 73.66 ± 23.72 mg/dL in the third week, and 97.875 ± 27.126 mg/dL in the final week. The total change for the TG levels was -9.375 ± 43.996 mg/dL, which were not significant changes. The HDL levels were measured at 53.333 ± 19.603 mg/dl in the first lab session, 55.333 ± 13.276 mg/dL in the second lab session, and 55.625 ± 14.802 in the last lab session. The total change of the HDL levels was 1.125 ± 16.89 mg/dL, which were not significant changes. At the beginning of the intervention the LDL was 88.625 ± 34.07 mg/dL, 77.73 ± 44.09 mg/dL at the second lab session, and 89.18 ± 20.858 mg/dL in the final lab session for a total not significant change of 9.625 ± 36.578 mg/dL. Lastly, the initial measurement for the BG was 91.333 ± 10.988 mg/dL in the first week, 83.428 ± 6.477 mg/dL in the third week, and 89.111 ± 6.622 mg/dL in the final

week. There was a total change of -3.125 ± 11.813 mg/dL from week one to week six which were not significant.

A possible explanation for a lack of changes in the blood measurements may stem from that the initial measurements for all the blood measurements could not be classified as a risk factor as they fell below the ACSM negative risk factor stratification. For TC to be considered a risk factor it needs to be ≥ 200 mg/dL, and the participants initial TC started at 160.125 mg/dL. The HDL levels were above the risk factor of ≤ 40 mg/dL measured at 55.33 mg/dL, meaning this was not a negative risk factor to initially start the intervention. The LDL levels were also below the risk factor of ≥ 130 mg/dL being initially measured at 77.83 mg/dL. There was an increase in LDL from the first week of testing to the last week of testing, but it was not a significant change. This increase in LDL levels could potentially be explained by if the subjects were not truthful about their diets and changed their eating behavior's part way through the study. One article from 2002 highlights that if dietary changes occurred during the intervention, it would be likely that carbohydrates would be decreased and fats would be increased to improve health (Murphy et al., 2002). If the subjects did modify their diets in this way, it would reflect a decrease in HDL cholesterol and an increase in TG and LDL levels (Murphy et al., 2002). TG levels were also below the risk factor of ≥ 150 mg/dl with the initial measurement being 107.25 mg/dL. Lastly, for metabolic health BG was initially measured at 91.33 mg/dL, which is also below the ACSM risk factor of ≥ 100 mg/dL. A study that was done in 2017 found that three weeks of uphill or downhill walking when adjusted for total energy expenditure significantly improved pre-diabetic male's oral glucose tolerance test (Philippe et al., 2017). Additionally, since the compliance to the

HR zones was 57.415 ± 37.949 % for this group of subjects this could explain why there were no significant changes which occurred.

Mental-Wellbeing Adaptations

Figure 6 shows the GAD-7 scores from the three separate lab sessions. The measured GAD score in week one was 4.889 ± 5.667, 5.00 ± 5.859 in the third week, 4.222 ± 4.841 in the sixth week. There was a total not significant change of -0.75 ± 3.370 from week one to week six. The GAD-7 results from this study are consistent with previous research that low to moderate intensity exercise twice a week in college students does not significantly impact self-reported trait anxiety (Herbet et al., 2020). However, a study from 2017 found that increased exercise intensity does positively impact perceived anxiety (Evans et al., 2017). Figure 7 presents the PSS scores from each session. The score from week one was 12.444 ± 7.970, 12.857 ± 5.520 in the third week, 11.444 ± 5.547 in the sixth week for a total not significant change of -0.875 ± 9.775 from the first lab session to the last lab session. The findings from this current study are currently inconsistent when comparing to previous research. Previous findings showed that low to moderate intensity exercise does significantly improve perceived stress among college students (Herbert et al., 2020). Another study found that increased exercise intensity also significantly improves perceived stress, anxiety, and depressive symptoms (Evans et al., 2017). Figure 8 displays the scores for the DBIQ total score, DBIQ (V), and DBIQ (A) from each laboratory visit. The measured DBIQ in week one 72.000 ± 10.714, 76.714 ± 11.294 in the third week, and 78.555 ± 11.938 in the sixth week for a total not significant change of 15.5 ± 23.537. The measured DBIQ (V) from week one was 28.250 ± 6.453, 29.714 ± 5.089 in the third week, 31.888 ± 3.480 in the sixth week. The DBIQ (A) from

week one was 43.750 ± 8.735, 47.000 ± 9.073 in the third week, and 46.666 ± 10.547 in the sixth week. This finding is also inconsistent with previous research which showed that exercise frequency and exercise intensity both improved satisfaction with physical shape and appearance (Evans et al., 2017). Lastly, GSE is shown in figure 9 with a score represented from each lab session. The GSE from week one was 33.888 ± 3.655, 34.428 ± 2.76 in week three, and 34.222 ± 2.948 in week six. The total difference from week one to week six for the GSE scores was a not significant change 0.5 ± 2.563. The GSE score is also inconsistent with previous research which showed that both exercise frequency and exercise intensity improve perceived self-confidence (Evans et al., 2017).

The inconsistent findings from this present study compared to previous literature could be explained by the intervention compliance. In the previously mentioned study from 2017, a moderate exercise intensity to higher exercise intensity showed improvements in body image and self-efficacy in physically active, older adults (Evans et al., 2017). For all the subjects involved in the study if the HR was not compliant with the prescribed intensity it was lower than the moderate HR intensity prescribed.

For the future it is recommended that a larger sample size be obtained. Additionally, a sample that is homogenous should be gathered to limit huge variability, which is seen in the present study. A randomized trial with a control group and placebo group should be implemented to see if there would be any significant changes in step count from pre-intervention to post-intervention.

Conclusion

This present study sought to determine if a six-week walking intervention in individuals aged 40 and younger would positively impact cardiometabolic risk factors

and mental-wellbeing. Of all the variables measured, none were found to be statistically significant to positively impact cardiometabolic risk factors and mental-wellbeing. However, results from this study should not undermine the positive benefits that have been seen in other studies regarding the benefits of low to moderate intensity exercise on cardiometabolic risk factors and mental-wellbeing (Herbert et al., 2020; Murphy et al., 2002; Tully and Cupples, 2011). Universities should still consider the importance of reducing sedentary time and increasing physical activity and exercise to reduce cardiometabolic risk factors and improve mental wellbeing in students and staff.

APPENDICES

IRB Approval

East Stroudsburg University Institutional Review Board

Human Research Review

Protocol # **ESU-IRB-030-2021**

Date: **February 9, 2021**

To: **Natalie Turbett and Emily Sauers**

From: **Shala E. Davis, Ph.D., IRB Chair**

Proposal Title: **"Effects of a Six Week Walking Intervention on Cardiometabolic Risk Factors and Mental Well-Being in College Aged Individuals"**

Review Requested:	Exempted	Expedited **X**	Full Review
Review Approved:	Exempted	Expedited **X**	Full Review

FULL RESEARCH

____ Your full review research proposal has been approved by the University IRB (12 months). Please provide the University IRB a copy of your Final Report at the completion of your research.

____ Your full review research proposal has been approved with recommendations by the University IRB. Please review recommendations provided by the reviewers and **submit necessary documentation for full approval.**

____ Your full review research proposal has not been approved by the University IRB. Please review recommendations provided by the reviewers and resubmit.

EXEMPTED RESEARCH

____ Your exempted review research proposal has been approved by the University IRB (12 months). Please provide the University IRB a copy of your Final Report at the completion of your research.

____ Your exempted review research proposal has been approved with recommendations by the University IRB. Please review recommendations provided by the reviewers and **submit necessary documentation for full approval.**

____ Your exempted review research proposal has not been approved by the University IRB. Please review recommendations provided by the reviewers and resubmit, if appropriate.

EXPEDITED RESEARCH

__**X**_ Your expedited review research proposal has been approved by the University IRB (12months). Please provide the University IRB a copy of your Final Report at the completion of your research.

_____ Your expedited review research proposal has been approved with recommendations by the University IRB. Please review recommendations provided by the reviewers and **submit necessary documentation for full approval.**

_____ Your expedited review research proposal has not been approved by the University IRB. Please review recommendations provided by the reviewers and resubmit, if appropriate.

_____
Please revise or submit the following:

Table 4

Table 4. Descriptive Statistics for Anthropometric Data

Variable		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
WT (kg)	1.00	9	85.392	22.997	7.666	67.715	103.069	54.100	123.030
	3.00	7	79.177	21.706	8.204	59.103	99.252	53.800	121.900
	6.00	9	85.277	22.908	7.636	67.668	102.885	54.300	121.900
	Total	25	83.610	21.839	4.368	74.596	92.625	53.800	123.030
BF (%)	1.00	9	27.133	6.624	2.208	22.042	32.225	16.200	39.800
	3.00	7	26.443	6.847	2.588	20.110	32.775	17.800	38.800
	6.00	9	26.678	6.957	2.319	21.330	32.025	16.700	39.300
	Total	25	26.776	6.524	1.305	24.083	29.469	16.200	39.800
BMI (kg/m²)	1.00	9	27.611	5.377	1.792	23.478	31.744	20.400	36.900
	3.00	7	26.343	5.009	1.893	21.710	30.976	20.200	35.800
	6.00	9	27.622	5.261	1.754	23.579	31.666	20.600	36.500
	Total	25	27.260	5.047	1.009	25.177	29.343	20.200	36.900
WC (cm)	1.00	9	92.257	18.961	6.320	77.682	106.831	68.930	129.000
	3.00	6	85.233	14.685	5.995	69.822	100.644	66.700	106.850
	6.00	9	88.596	18.099	6.033	74.683	102.508	66.700	126.750
	Total	24	89.128	17.140	3.499	81.890	96.365	66.700	129.000
HC (cm)	1.00	9	92.257	18.961	6.320	77.682	106.831	68.930	129.000
	3.00	6	85.233	14.685	5.995	69.822	100.644	66.700	106.850
	6.00	9	88.596	18.099	6.033	74.683	102.508	66.700	126.750
	Total	24	89.128	17.140	3.499	81.890	96.365	66.700	129.000

The descriptive statistics for WT, BF percentage, BMI, WC, and HC are shown above. The mean for each variable is presented for the baseline week, week three of testing, and week six of testing. The overall mean is also displayed for each variable. For WT the total change in weight from week one to week 6 was -0.12 ± 1.04. The BF% scores changed -0.46 ± 3.50 from week one to six. Recorded BMI changed 0.01 ± 0.38 from week one to week six. The calculated WC changed -3.66 ± 4.21 from the first lab session to the last lab session. HC changed -1.97 ± 4.51 from week one to week six.

PSS Scale

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____ Date _____

Age _____ Gender (*Circle*): **M   F**   Other _____

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?................................. **0   1   2   3   4**

2. In the last month, how often have you felt that you were unable
   to control the important things in your life?.................................... **0   1   2   3   4**

3. In the last month, how often have you felt nervous and "stressed"?............ **0   1   2   3   4**

4. In the last month, how often have you felt confident about your ability
   to handle your personal problems? **0   1   2   3   4**

5. In the last month, how often have you felt that things
   were going your way?.. **0   1   2   3   4**

6. In the last month, how often have you found that you could not cope
   with all the things that you had to do? **0   1   2   3   4**

7. In the last month, how often have you been able
   to control irritations in your life?.. **0   1   2   3   4**

8. In the last month, how often have you felt that you were on top of things?.. **0   1   2   3   4**

9. In the last month, how often have you been angered
   because of things that were outside of your control?................................. **0   1   2   3   4**

10. In the last month, how often have you felt difficulties
    were piling up so high that you could not overcome them? **0   1   2   3   4**

DBIQ Scale

Table 1. Dresden Body Image Questionnaire (DBIQ), English version[a].

1.a	I move gracefully.
2.v	I often feel physically run down. (R)
3.v	I lack energy and motivation. (R)
4.s	I experience intense and pleasurable feelings during sex.
5.p	Physical contact is important for me to express closeness.
6.v	I often feel physically exhausted. (R)
7.a	There are lots of situations in which I feel happy about my body.
8.v	I am physically fit.
9.s	I am very satisfied with my sexual experiences.
10.a	Other people find me attractive.
11.p	I look for physical intimacy and affection
12.a	I like my body.
13.a	I find it pleasant and exhilarating when someone looks at me attentively.
14.v	I have lots of energy.
15.a	I choose clothing that hides the shape of my body. (R)
16.s	I think sex is an important part of life.
17.v	I am in good physical condition.
18.a	I often feel uncomfortable about my body. (R)
19.p	I do not like people touching me. (R)
20.a	I feel more valued when someone pays attention to my body.
21.s	I am able to lay aside my inhibitions in sexual situations.
22.p	I like it when people put their arms around me.
23.a	I wish I had a different body. (R)
24.p	I consciously avoid touching other people. (R)
25.a	I am satisfied with my appearance.
26.v	I quickly reach my physical limits. (R)
27.s	I am able to enjoy my sexuality.
28.a	If I could change something about my body, I would do it. (R)
29.a	My body is expressive.
30.p	I only allow a few people to touch me. (R)
31.a	I use my body to attract attention.
32.v	I am physically strong and resilient.
33.a	I like showing my body.
34.a	I like to be the centre of attention.
35.s	My sexual experiences are satisfying.

Note: R = scored in the reversed direction. a = subscale self-aggrandizement; b = subscale body acceptance; p = subscale physical contact; s = subscale sexual fulfillment; v = subscale vitality.
a. Dresdner Körperbildfragebogen (DKB-35), original version in German; for Dutch version, see S1 Table.

GAD-7 Scale

Generalized Anxiety Disorder 7-item (GAD-7) scale

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all sure	Several days	Over half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3
Add the score for each column		+	+	+
Total Score *(add your column scores)* =				

GSE Scale

General Self-Efficacy Scale (GSE)

	Not at all true	Hardly true	Moderately true	Exactly true
1. I can always manage to solve difficult problems if I try hard enough	□	□	□	□
2. If someone opposes me, I can find the means and ways to get what I want.	□	□	□	□
3. It is easy for me to stick to my aims and accomplish my goals.	□	□	□	□
4. I am confident that I could deal efficiently with unexpected events.	□	□	□	□
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	□	□	□	□
6. I can solve most problems if I invest the necessary effort.	□	□	□	□
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	□	□	□	□
8. When I am confronted with a problem, I can usually find several solutions.	□	□	□	□
9. If I am in trouble, I can usually think of a solution	□	□	□	□
10. I can usually handle whatever comes my way.	□	□	□	□

Study Invitation

Department of Exercise Science

We invite you to take part in this research study. We would like you to understand why the research is being done and what it would involve for you. Please take the time to carefully read through. Thank you for your time and please reach out to the investigator if interested.

Inclusion Criterion:

- Currently not participating in 150 minutes of moderate intensity aerobic exercise each week.

- 18 to 40 years old.

- No known disease (cardiovascular, renal, musculoskeletal, metabolic, etc.).

Purpose of the study:

- Effects of a 6-week Walking Intervention on Cardiometabolic Risk Factors and Mental Wellbeing in College Aged Individuals and Faculty/Staff at East Stroudsburg University

What we would like you to do:

- 1-week baseline, walking for six weeks, 1-week post-intervention

- 3 total lab visits: Baseline week, week 3 of intervention, and post-intervention

    o Lab visits will be completed in the mornings: approximately 30 minutes for each lab session

- Intervention: 30 minutes individually prescribed walking to be completed outside of the laboratory 5 times per week

Contact information:

- Investigator: Natalie Turbett, nturbett@live.esu.edu

- Thesis Chair: Dr. Emily Sauers, esauers@esu.edu

IRB approval:

ESU-IRB-030-2021

Subject Information Sheet for the Six-Week Intervention

- Fitbit Wearing Instructions

  - Wear the Fitbit for the entire duration of the day

  - Can be removed for showering and charging
  - Wear to bed (can be removed if it causes discomfort)
  - Make sure the Fitbit is placed on the wrist that was selected when setting up the device
  - The back sensor should be in contact with skin
  - Make sure the strap is not too loose that the device is sliding up and down the wrist.
- Walking Intervention
  - 6 weeks of walking (30 minutes, 5 times a week)
  - Can be on weekends or weekdays
  - Make sure the device is worn during the walks
  - Either use the smart track feature for recording walking workouts or start a walking workout on the Fitbit app
  - Make sure that when walking your heart rate is within the individual prescribed intensities
  - Walks can either be done outside or on a treadmill indoors
- Nutrition
  - Do not change/modify your current eating behaviors for the duration of your time included in the study
- Exercise
  - Do not change/modify your current resistance training
- We will ask you to come into the lab two more times to test
- Once three weeks into the intervention and once at the end of the intervention
- We will try to schedule these on the same day of the week and time as your first lab session

REFERENCES

Amaro-Gahete, F., De-la-O, A., Jurado-Fasoli, L., Martinez-Tellez, B., Ruiz, J., and

    Castillo, M. (2019). Exercise Training as Treatment for Cardiometabolic Risk in

    Sedentary Adults: Are Physical Activity Guidelines the Best Way to Improve

    Cardiometabolic Health? The FIT-AGEING Randomized Controlled Trial.

    Journal of Clinical Medicine, 8 (2097), 2- 18. DOI: 10.3390/jcm8122097

American College of Sports Medicine (2018). ACSM's Guidelines for Exercise

    Testing and Prescription. Philadelphia, PA: Lippincott Williams & Wilkins

American College of Sports Medicine (2011). ACSM information on starting a walking

    program. https://www.acsm.org/docs/default-source/files-for-resource-

    library/starting-a-walking-program.pdf?sfvrsn=85e9d2d9_2

American Heart Association (2021). Blood Pressure Categories. heart.org/bplevels

Campbell, A., and Hausenblas, H. (2009). Effects of Exercise Interventions on Body

    Image. *Journal of Health Psychology*, *14* (6), 780-793. Doi:

    10.1177/1359105309338977

Centers for Disease Control and Prevention (2020). Exercise or Physical Activity.

    https://www.cdc.gov/nchs/fastats/exercise.htm

Cohen, S., Williamson, G. (1988). Perceived Stress in a Probability Sample of the United

    States. *Journal of Health and Social Behavior, 24*, 386-396.

Evans, M., Rohan K., Howard, A., Ho, S., Dubbert, P., Stetson, B. (2017). Exercise

Dimensions and Psychological Well-being: A Community Based Exercise Study.

Journal of Clinical Sport Psychology, 11, 107-125. DOI: 10.1123/jcsp.2017-0027

Falcone PH, Tai CY, Carson LR, Joy JM, Mosman MM, McCann TR, Crona KP, Kim

MP, Moon JR. Caloric expenditure of aerobic, resistance, or combined high-

intensity interval training using a hydraulic resistance system in healthy men. J

Strength Cond Res. 2015 Mar;29(3):779-85. doi:

10.1519/JSC.0000000000000661. PMID: 25162652.

Fitbit (2020). *How do I wear my Fitbit device*. Fitbit.

https://help.fitbit.com/articles/en_US/Help_article/1988.htm#:~:text=Wear%20yo

ur%20device%20on%20top,band%20isn't%20too%20tight.

Fuller-Tyszkiewicz, M., Skouteris, H., & McCabe, M. (2013). A re-examination of the

benefits of exercise for state body satisfaction: consideration of individual

difference factors. *Journal of Sports Sciences*, *31*(7), 706–713. https://doi-

org.navigator-esu.passhe.edu/10.1080/02640414.2012.746723

Herbet, C., Meixner, F., Wiebking, C., and Glig, V. (2020). Regular Physical Activity,

Short-Term Exercise, Mental Health, and Well-Being Among University

Students: The Results of an Online and a Laboratory Study. *Frontiers in

Psychology, 11,* 1-23. Doi: 10.3389/fpsyg.2020.00509

Luke, A., Dugas, L., Durazo-Arvizu, R., Cao, G., Cooper, R. (2011). Assessing physical

activity and its relationship to cardiovascular risk factors: NHANES 2003-2006.

BMC Public Health, *11*(387). doi:10.1186/1471-2458-11-387

Murphy, M., Nevill, A., Neville, C., Biddle, S., and Hardman, A. (2002). Accumulating

    brisk walking for fitness, cardiovascular risk, and psychological health. *Medicine*

    and Science in Sports and Exercise, *34* (9), 1468-1474. DOI:

    10.1249/01.MSS.0000027686.50344.77

Mussi, F., Pitanga, F., and Pires, C. (2017). Cumulative Sitting Time as a Discriminator

    of Overweight, Obesity, Abdominal Obesity, and Lipid Disorders in Nursing

    University. *Brazilian Journal of Kineanthropometry & Human*

    Performance, *19*(1), 40–49. DOI: http://dx.doi.org/10.5007/1980-

    0037.2017v19n1p40

O'Neill, C., Dogra, S. (2020). Reducing Anxiety and Anxiety Sensitivity with High

    Intensity Interval Training in Adults with Asthma. Journal of Physical Activity

    and Health, 17, 835-839. DOI: 10.1123/jpah.2019-0251

Philippe, M., Gatterer, H., Eder, E. M., Dzien, A., Somavilla, M., Melmer, A.,

    Ebenbichler, C., Müller, T., & Burtscher, M. (2017). The Effects of 3 Weeks of

    Uphill and Downhill Walking on Blood Lipids and Glucose Metabolism in Pre-

    Diabetic Men: A Pilot Study. *Journal of Sports Science & Medicine*, *16*(1), 35–

    43.

Scheffers, M., van Dujin, M., Bosscher, R., Wiersma, D., Schoevers, R., van Busschbach,

    J. (2017). Psychometric properties of the Dresden Body Image Questionnaire: A

    multiple-group confirmatory factor analysis across sex and age in Dutch non-

    clinical sample. PLOS ONE, 12 (7), 1-13.

    https://doi.org/10.1371/journal.pone.0181908

Schwarzer, R., and Jerusalem, M. (1995). Generalized Self-Efficacy Scale. *Measures in Health Psychology*, 35-37.

Solbraa, A. K., Ekelund, U., Holme, I. M., Graff-Iversen, S., Steene-Johannessen, J., Aadland, E., & Anderssen, S. A. (2015). Long-Term Correlates of Objectively Measured Physical Activity and Sedentary Time in Norwegian Men and Women. *Journal of Physical Activity & Health*, *12*(11), 1500–1507. http://dx.doi.org/10.1123/jpah.2014-0390

Sumner, J., Uijtdewilligen, L., Yee, A. C. H., Xian, S. N. H., Barreira, T. V., Sloan, R. A., Van Dam, R. M., & Müller-Riemenschneider, F. (2020). Volume and Intensity of Stepping Activity and Cardiometabolic Risk Factors in a Multi-ethnic Asian Population. *International Journal of Environmental Research and Public Health*, *17*(3). https://doi.org/10.3390/ijerph17030863

Spitzer, R., L., Kroenke, K., Williams, J.B.W., Lowe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of International Medicine, 166*, 1092-1097.

Tully, M., Cupples, M. (2011). UNISTEP (University Students Exercise and Physical Activity) Study: A Pilot Study of the Effects of Accumulating 10,000 Steps on Health and Fitness Among University Students. *Journal of Physical Activity and Health, 8*, 663-667.

Wooten, J., Biggerstaff, K., Anderson, C., Wooten, J. S., & Biggerstaff, K. D. (2008). Response of lipid, lipoprotein-cholesterol, and electrophoretic characteristics of

lipoproteins following a single bout of aerobic exercise in women. *European Journal of Applied Physiology*, *104*(1), 19–27. DOI 10.1007/s00421-008-0770-2

World Health Organization [WHO] (2010). Global Recommendations on Physical Activity for Health. Geneva: World Health Organization