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Effect of Body Size and Exercise on Mood State

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Effect of Body Size and Exercise on Mood State
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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Kinesiology

By

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University of Arkansas
Bachelor of Science in Kinesiology, 2009

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ABSTRACT

Exercising in the presence of nature (i.e., “green exercise”), has been shown to heighten the physiological and mental benefits of traditional exercise on non-obese individuals. The effects of green exercise on obese individuals are unknown. It is hypothesized that green exercise is more beneficial for obese (greater positive improvements in mental health scores), compared to non-obese individuals. For example, the benefits of green exercise could help lower feelings of depression, improve mood and self-esteem to increase the propensity of obese individuals to meet exercise recommendations. Accordingly, this study investigated the physiological and psychological effects of green exercise on 12 obese (body mass: 90.0 ± 15.4 kg, body fat: 29.0 ± 8.6 %) and 10 non-obese (body mass: 76.6 ± 8.1 kg, body fat: 12.7 ± 2.5 %,) males. Subjects viewed either 30 previously-validated pleasant images of a rural setting (green exercise) or a blank screen (control) while walking for 30-minutes at a moderate intensity (50% of heart rate reserve). Mental health questionnaires (Adult Mental Health Continuum Short Form, Satisfaction with Life, Profile of Mood States, Exercise Self Efficacy, and Beck’s Inventory) were completed pre- and post-exercise. Independent of subject groups, the control trial, versus green exercise, resulted in greater rating of perceived exertion (RPE; Control: 11 ± 0 vs Green Exercise: 10 ± 0; P = 0.006) and heart rate (Control: 126 ± 1 bpm, Green Exercise: 124 ± 2 bpm; P = 0.042). Independent of condition, obese individuals had significantly lower pre-exercise self-efficacy than non-obese (Non-obese: 46 ± 4; Obese: 33 ± 3, P = 0.017). Non-obese versus obese individuals had significantly greater improvements in overall mental health scores, as indicated by the MHC-SF Continuous category scores, regardless of condition (change from pre- to post-exercise in Non-obese: 6 ± 2; Obese: 0 ± 2; P = 0.041). Non-obese individuals had significantly greater improvements in the confusion-bewilderment mood state, independent of condition (post-
pre Obese: 0 ± 1; Non-obese: -2 ± 1; P = 0.019). Independent of body size, control exercise also significantly improved emotional health scores (MHC-SF Emotional category) more than the green exercise (Control: 1 ± 2; Green: 0 ± 2; P = 0.049). In conclusion, this data shows differences between obese and non-obese individuals when they exercise. Green exercise can lower RPE and HR in obese and non-obese individuals, and there is evidence to suggest that green exercise has important mental health benefits. However, improvements observed with green exercise were independent of body size, suggesting that green exercise is beneficial for non-obese and obese individuals.
This thesis is approved for recommendation
to the Graduate Council.

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Chapter 1: Introduction

Over the past 50 years, both European and North American adults have had a substantial decrease in physical activity, with approximately 500 less calories (kcal) being expended each day (Pretty, Peacock, Sellens, & Griffin, 2005). Increasingly sedentary lifestyles are due to less physical jobs, increased reliance on vehicular transportation and busy schedules (Pretty, Peacock, Sellens, & Griffin, 2005). Only 22% of US adults are meeting the minimum level of physical activity of at least 30 minutes of moderate intensity physical activity 5 days a week (Anderson et al., 1999). Unhealthy lifestyles, including inadequate exercise, have led to 30% of American adults being obese, as defined by a Body Mass Index (BMI) $\geq 30$ kg/m$^2$ (Annesi & Unruh, 2008). Obese individuals are prone to an extensive list of cardiovascular, pulmonary, psychological, orthopedic, reproductive, metabolic, and cancerous comorbidities and complications (Hill, Catenacci, & Wyatt, 2005; Annesi & Unruh, 2008; Weinstock, Huilliag, & Wadden, 1998; Berkowitz & Fabricatore, 2005; Faith, Matz, & Jorge, 2002).

Exercise has positive effects on both obese and non-obese individuals. Independent of body mass changes, exercise improves insulin sensitivity and glucose tolerance (Weinstock, Huilliag, & Wadden, 1998). Exercise is also effective in decreasing body mass, since increasing energy expenditure and metabolic rate can decrease adipose mass. Exercise-induced weight loss is known to reduce total fat significantly more than diet-induced weight-loss (Ross, Dagnone, Jones, Smith, Paddags, Hudson, & Janssen, 2000).

Exercise also has positive psychological effects. It improves mental health, self-efficacy, and mood, while decreasing depressive and anxiety symptoms (Nieman et al., 2000; Penedo &
Dahn, 2005). Improved mood and self-efficacy increases one’s propensity to follow an exercise program (Perri at al. 1997; Annesi & Unruh, 2008; Wadden et al., 1997).

The environment influences an individual’s behavior, interpersonal relationships, and mood states (Tuan, 1977; Frumkin, 2001; Pretty et al., 2005). Positive environmental experiences can aid in the enhancement of physiological, emotional, psychological and spiritual health perceptions, stress relief, improved concentration, and sense of renewal (Brymer, Cuddihy, & Brymer, 2010; Pretty at al., 2005). Recent evidence suggests that the acute psychological and physiological benefits of exercise can be magnified when individuals are in the presence of nature while exercising, also known as “green exercise” (Pretty et al., 2005). A study by Pretty et al. 2005, examined the mental and physical health outcomes of green exercise by testing the effects of viewing different images while males and females walked or jogged at a “fairly light” intensity on a treadmill. The images represented rural pleasant, rural unpleasant, urban pleasant and urban unpleasant settings. For example, pleasant images were of “clearly urban scenes enhanced by the presence of nearby nature in the form of green space” and unpleasant images were defined as “rural scenes compromised with pollutants or other visual impediments.” They found that green exercise (i.e., rural and urban pleasant images) had a significantly greater positive effect on self-esteem, when compared to a control setting in which no images were observed. Green exercise also significantly improved four out of six mood measures (confusion-bewilderment, depression-dejection, tension-anxiety, and vigour-activity).

Given that obese individuals are more prone to psychological disorders (e.g., anxiety, depression, and low self-efficacy), diminishing or eliminating these disturbances is an important
health goal. Green exercise has been shown to increase mood states in non-obese individuals (see above). However, it is unknown if green exercise has the same beneficial effects on obese individuals. Therefore, the purpose of this study was to compare the physiological and psychological effects of green exercise on obese and non-obese males. Green exercise consisted of viewing images representing pleasant rural images (same images used in Pretty et al., 2005) or control images (blank screen) during a 30 minute moderate intensity treadmill bout. It was hypothesized that green exercise would be more beneficial for obese, compared to non-obese individuals. If the hypothesis is supported, lowered levels of depression, improved mood and self-esteem may increase the propensity of obese individuals to meet exercise recommendations.
Chapter 2: Literature Review

Over the past 50 years, both European and North American adults have had a substantial decrease in physical activity, with approximately 500 less calories (kcal) being expended each day (Pretty, Peacock, Sellens, & Griffin, 2005). Increasingly sedentary lifestyles are due to less physical jobs, increased reliance on vehicular transportation and busy schedules (Pretty, Peacock, Sellens, & Griffin, 2005). Only 22% of US adults are meeting the minimum level of physical activity of at least 30 minutes of moderate intensity physical activity 5 days a week (Anderson et al., 1999). Unhealthy lifestyles, including inadequate exercise, have led to 30% of American adults being obese, as defined by a Body Mass Index (BMI) ≥30 kg/m² (Annesi & Unruh, 2008). Obese individuals are prone to an extensive list of cardiovascular, pulmonary, psychological, orthopedic, reproductive, metabolic, and cancerous comorbidities and complications. These consequences include: cardiovascular disease, hypertension, congestive heart failure, type 2 diabetes, stroke, depression, poor self-image, and poor quality of life (Hill, Catenacci, & Wyatt, 2005; Annesi & Unruh, 2008; Weinstock, Huiliag, & Wadden, 1998; Berkowitz & Fabricatore, 2005; Faith, Matz, & Jorge, 2002).

Physiological Effects of Obesity

Understanding physiological differences between obese and non-obese individuals will facilitate the understanding of possible mechanisms by which green exercise may be beneficial. There is a strong correlation between cardiac dysfunction and magnitude of obesity. A study assessing cardiovascular function and atriovenous oxygen difference [(a-v)O₂ difference]) at rest and during exercise in young obese and non-obese individuals, suggests that the ability to extract
oxygen during exercise may be hindered in obese individuals during submaximal exercise (Vella, Ontiveros, & Zubia, 2010). Specifically, obese individuals had a greater cardiac output, cardiac index, and stroke volume, but lower (a-v)O₂ difference during submaximal exercise when compared to non-obese individuals. There were no significant differences between submaximal and peak heart rate in the two groups. These results suggest that obese individuals may experience greater cardiovascular stress during moderate-intensity exercise compared to non-obese counterparts.

A study comparing the cardiac output (Q) and stroke volume (SV) in overweight and non-overweight individuals during exercise found that peak oxygen uptake (VO₂ peak) was the greatest independent predictor of stroke volume during exercise, responsible for an average of 76% of the variance in stroke volume between individuals (Vella, Zubia, Burns & Ontiveros, 2008). The association between VO₂peak and stroke volume during exercise can be explained by an increase in end-diastolic and a decrease in end-systolic volume. Similarly, there is a positive correlation between left ventricular chamber size and mass at rest (Barbier et al. 2006), and enhanced diastolic function during exercise (Stickland et al. 2006).

Ample evidence suggests an association between hypertension and obesity. Specifically, increases in both resting systolic and diastolic blood pressure are correlated with increases in BMI above ≥25 kg/m², regardless of age and gender (Ferrannini, 1995). Cardiac adaptation includes eccentric hypertrophy, regardless of arterial pressure levels (Messerli et al, 1983). This is due to a feedback mechanism that increases left ventricular stroke work in response to greater body mass, which leads to an elevated blood pressure (Ferrannini, 1995).
Psychological Effects of Obesity

In 1985, the National Institutes of Health Consensus Development Panel on the Health Implications of Obesity stated that “obesity creates an enormous psychological burden…In terms of suffering, this burden may be the greatest adverse effect of obesity” (Nieman, Custer, Butterworth, Utter, & Henson, 2000). Although the findings are mixed (Nieman et al., 2000), recent evidence suggest that obese individuals are at a greater relative risk for an array of mental health dysfunction compared to non-obese individuals (Berkowitz & Fabricatore, 2005).

The Centers for Disease Control and Prevention (CDC) developed a system for measuring population health status and health-related quality of life. Quality of life is defined as “an overall sense of well-being, including aspects of happiness and satisfaction with life as a whole” (Measuring Healthy Days, 2000). Health Related Quality of Life (HRQOL) is a multidimensional construct covering physical, emotional, mental, social and behavioral components of well-being and functioning as subjectively perceived by a person depending on the cultural context and value system in which one lives (Rüden, 2007). The measurement of HRQOL can be done with the Medical Outcomes Study 36-Item Short-Form Health Survey (MOS SF-36) (Ware & Sherbourne; 1992). The MOS SF-36 uses eight constructs to assess the following general health concepts, or quality of life domains: physical functioning, role limitations due to physical health problems (role physical), bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems (role emotional), and mental health. These health concepts are defined as the following:
• Physical Functioning - measures the extent of ability to perform all types of physical activities including the most vigorous without limitations due to health.

• Role Physical - assesses the degree of problems an individual experiences with work or other daily activities as a result of physical health over the past 4 weeks.

• Bodily Pain - measures the degree of pain, or limitations due to pain over the past 4 weeks.

• General Health Perceptions - a rating of personal health, from excellent to poor.

• Vitality scale - measures energy level and degree of fatigue.

• Social Functioning - measures the degree to which individual’s emotional or physical problems disrupt his/her normal social activities.

• Role Emotional - quantifies the extent to which individual’s emotional problems interfere with his/her work or other daily activities.

• Mental Health - includes one or more items from each of the four major mental health dimensions including: anxiety, depression, loss of behavioral or emotional control, and psychological well-being (Ware & Sherbourne, 1992).

Using the MOS SF-36, it has been identified that obese individuals are more impaired in all eight quality of life domains, especially lower scores in bodily pain and vitality. Higher levels of obesity were associated with significantly worse physical, social, and role functioning, worse perceived general health, and greater bodily pain than their less obese counter-parts. Interestingly, the bodily pain reported by obese individuals may result in greater self-reported
disability than reported by individuals with chronic medical conditions (Hill, Catenacci, & Wyatt, 2005).

It has been consistently shown that higher levels of mental health disturbances are associated with obesity. For example, there is a linear relationship between symptoms of depression and BMI (Berkowitz & Fabricatore, 2005; Stunkard, Faith, & Allison, 2003; Heo, Pietrobelli, Fontaine, Sirey, & Faith, 2006). A community study from Sweden involving 1743 obese individuals and 89 non-obese controls revealed significantly greater depression, anxiety, depression, and poorer mental well-being in obese individuals (Faith, Matz, & Jorge, 2002). This is noteworthy because independent of obesity, depression is correlated to increased risk of heart disease, myocardial infarction, heart failure, low bone mineral density, and mortality (Faith, Matz, & Jorge, 2002). Additionally, symptoms of depression can also cause overeating relapses and weight gain (Wadden et al., 1997).

**Physiological Benefits of Exercise**

Obesity is considered a modifiable health risk factor (Annesi & Unruh, 2008). Maintenance of a healthy weight requires a balance between energy consumption and energy expenditure, and obesity occurs when energy consumption exceeds energy expenditure. Overeating and inactivity are recognized as the causal factors of obesity (Sullivan et al., 1993), and increased caloric intake is generally presumed to be the primary cause. However, this assumption lacks sufficient evidence (Dehghan, Akhtar-Danesh, & Merchant, 2005). Importantly, obese adults expend less energy (i.e. more sedentary) than non-obese adults (Perri, Lauer, McAdoo, McAllister, Yancey, 1986; Pavlou, Krey, & Steffee, 1989). Therefore,
increasing energy expenditure through exercise may be an ideal method for managing obesity. Exercise has both acute and chronic positive physiological effects on both obese and non-obese individuals.

The acute physiological effects of exercise are limited however; a single session of prolonged aerobic exercise (30–60 min at ~60–70% of maximal oxygen consumption) can significantly lower plasma glucose levels via contraction-induced stimulation of GLUT-4 glucose transporter translocation and glucose transport activity in insulin-resistant skeletal muscle (Henriksen, 2002). Chronic physiological effects of exercise include improvement in insulin sensitivity and glucose tolerance (Weinstock, Huilliag, & Wadden, 1998). Chronic exercise increases maximum oxygen uptake by increasing maximum cardiac output and the uptake of oxygen from the blood to use by muscles. It decreases myocardial oxygen demands for equivalent levels of external work by decreasing the product of heart rate and systolic arterial blood pressure (Fletcher, American Heart Association).

In summary, the physiological and psychological benefits of exercise are well-established, but how to maximize these beneficial effects is unknown. Although maximal benefits of exercise are obtained from chronic repeated bouts, the failure to successfully complete an acute, one-time bout of exercise may be detrimental to one’s ability to successfully complete a training program. It is possible that one’s ability to successfully complete an acute exercise bout is dependent on their “experiences” during exercise. If the exercise is perceived as being less stressful, for example, they may be more likely to complete the exercise bout and more importantly, may be more likely to successfully complete a training program.
Psychological Benefits of Exercise

The psychological detriments associated with obesity can be improved with exercise by improving mental health and self-efficacy factors (Nieman et al., 2000). The World Health Organization (WHO) defines mental health as “a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community” (WHO, 2007). Similarly, self-efficacy theory suggests that confidence in one’s ability to perform a given action is strongly associated with one’s actual ability to perform that action (Marcus, Selby, Niaura, & Rossi, 1992). An individual’s confidence is a determinant of the initial decision to perform an action, the effort completed, and persistence in the presence of difficulty (Sherer, Maddux, Mercandante, Prentice-Dunn, Jacobs, & Rogers, 1982). The positive psychological effects of improved mood and self-esteem associated with acute exercise may increase the propensity to follow a lifestyle in which daily exercise is performed (Perri et al. 1997; Annesi & Unruh, 2008; Wadden et al., 1997).

Psychological and Physiological Benefits of Green Exercise

Recent evidence suggests that the acute psychological and physiological benefits of exercise can be magnified when individuals are “in the presence of nature” while exercising. This concept is referred to as green exercise (Pretty et al., 2005). The environment in which one lives influences behavior, interpersonal relationships, and “actual mental states” (Pretty et al., 2005; Tuan, 1977; Frumkin, 2001;). Viewing, being in the presence of, and interacting with nature can positively enhance physiological, emotional, psychological and spiritual health.
perceptions (Brymer, Cuddihy, & Brymer, 2010). This includes stress relief, improved concentration, and sense of renewal.

The three levels of experiencing nature are based on depth of engagement. The first is simply viewing an image of nature. The second is being in the presence of nature, and the third level is interaction with the environment (Pretty et al., 2005). Investigations on viewing nature simply have subjects view pictures of different nature scenes, and subsequent changes in emotion and cognition are measured (Sorte, 1975; Pretty et al., 2005). However, the beneficial effects of viewing nature depends on the type of nature scene viewed. Studies comparing urban and rural scenes consistently yield stress reduction and enhanced mental well-being (versus control) but the effect appears to be magnified when viewing pleasant rural scenes versus unpleasant urban scenes (Purcell & Lamb, 1998; Staats & Hartig, 2004; Pretty et al., 2005).

“Perceived environmental naturalness” is the degree to which individuals recognize their environment as artificial or natural (Mackay & Neil, 2010). A study by Mackay & Neil (2010) aimed to examine the relationship between perceived environmental naturalness for the exercise environment and the psychological and physiological benefits of green exercise. Greenness was measured with a 10-point Likert response scale ranged from (1) “100% artificial; 0% natural” to (10) “0% artificial; 100% natural,” with a high-rise building icon representing most artificial and a tree icon as most natural. The combination of exercise and nature is expected to have a synergistic effect, and higher degrees of perceived “greenness” in an exercise environment result in greater reductions in state anxiety (Mackay & Neil, 2010). A study by Hug et al. (2009), concluded that when 319 members of fitness centers in Zurich compared indoor and outdoor
exercise settings, outdoor settings were rated as more restorative. Restorative quality is measured by the extent of “the renewal of cognitive capabilities that a person needs to manage the demands of everyday life” (Hug, Hartig, Hansmann, Seeland, & Hornung, 2009). A specific example is the renewal of the ability to focus one’s attention. It follows that outdoor education programs, which often include physical activity, are known to improve multiple personal and social outcomes (Hattie, Marsh, Neill, & Richards, 1997; Pryor, Carpenter, & Townsend, 2005; Mackay & Neill, 2010).

Pretty et al. (2007) investigated the effects of green exercise on mood and self-esteem for individuals participating in activity clubs. The exercise groups included bushwalking, horse riding, cycling, fishing, conservation volunteers, mountain biking and boating. The green exercise improved tension-anxiety, depression-dejection, confusion-bewilderment, anger-hostility, and self-esteem scores. Interestingly, these findings were independent of age, gender, exercise intensity, exercise mode, and exercise duration. Similarly Mackay and Neill (2010) observed that green exercise reduces anxiety, but this change is dependent on the type of green exercise. Road cycling, boxercise, and mountain biking leads to the largest reductions in anxiety. It appears that improvements in mood state are correlated to the perception of environmental greenness; activities that have greater perceived environmental greenness have greater decreases in anxiety.

A laboratory study by Pretty et al. (2005) examined the mental and physical health outcomes of green exercise by testing the effects of rural pleasant, rural unpleasant, urban pleasant and urban unpleasant images on participants walking on a treadmill. Pleasant images
were of “clearly urban scenes enhanced by the presence of nearby nature in the form of green space” and unpleasant images were defined as “rural scenes compromised with pollutants or other visual impediments.” Green exercise, specifically the rural pleasant images, improved self-esteem, and had significant positive effects on four out of six mood measures. Vigor and self-esteem were also improved while reducing confusion-bewilderment and tension-anxiety, when compared to the control.

A meta-analysis by Barton and Pretty (2010) of 1252 participants from 10 UK studies concluded that green exercise consistently improves mood and self-esteem. Positive effects on self-esteem and mood are observed after only 5 min of green exercise, suggesting an immediate beneficial effect from green exercise. Improvements in mood with light, moderate, and vigorous exercise followed a “U-curve” relationship. Greatest effects were observed with low- and vigorous-intensity exercise, while improvements in mood with moderate-intensity exercise were slightly less pronounced. The improvement in self-esteem was negatively correlated to exercise intensity; increases in exercise intensity lead to less pronounced improvements in self-esteem. In summary, research on green exercise is in the infantile stages, but early investigations on the combined and separate effects of exercise and nature consistently demonstrate positive improvements in mood, self-esteem, self-efficacy, anxiety, and other cognitive and emotional benefits.

Along with the psychological benefits, green exercise may also have physiological benefits. Pretty et al. 2005 suggest that green exercise, or exercise in pleasant environments, may have a greater effect than exercise alone on blood pressure. Blood pressure before and after
20 minutes of exercise significantly decreased after viewing pleasant images of rural settings (~8 mmHg) but did not change after control exercise in which no images were observed.

**Effect of Green Exercise on Obese Individuals**

Given that obese individuals are more prone to psychological disorders (e.g., anxiety, depression, and low self-efficacy), diminishing or eliminating these disturbances is an important health goal. Green exercise has been shown to improve mood states (e.g., increase self-esteem) in non-obese individuals. However, it is unknown if green exercise will have the same beneficial effects in obese individuals. We hypothesize that green exercise will be more beneficial for obese, compared to non-obese individuals. If the hypothesis is supported, lowered levels of depression, improved mood and self-esteem may increase the propensity of obese individuals to meet their exercise recommendations.

In summary, the purpose of this study was to compare the physiological and psychological effects of green exercise on obese and non-obese males. Green exercise consisted of viewing images representing pleasant rural images (same images used in Pretty et al., 2005) or control images (blank screen) during a 30 minute moderate intensity treadmill bout. Moderate intensity exercise 30 min in length was used because that is the recommendation set forth by ACSM to reap the health benefits of exercise (Haskell et al., 2007).
Chapter 3: Procedures

Subjects

Twelve obese (Body mass 90.0 ± 15.4 kg; Body fat: ≥ 19%) and 10 non-obese (Body mass 76.6 ± 8.1 kg; Body fat: ≤ 17%) males were investigated and told that this study was examining various responses before, during and after exercise. They were not informed that the primary objective was to examine the effect of “viewing nature” during exercise. Prior to participation, subjects filled out a Par-Q General Health Questionnaire and completed an informed-consent form. This study was approved by the University’s Institution Review Board.

Viewing of images

During exercise, subjects viewed images classified as either “rural pleasant,” to simulate green exercise, or a blank screen (control). Rural pleasant referred to the presence of nature and green space as opposed to pollutants or other visual impediments. The thirty “green” images utilized for this study were the same used in a similar investigation (Pretty et al., 2005). These images were projected onto a white screen (6 feet x 6 feet) and displayed in random order for each participant while they walked in a dimly lit room. The images rotated every 15 seconds.

Familiarization

At least 48 hours prior to their first experimental trial, subjects were familiarized with all aspects of the study. They filled out an International Physical Activity Questionnaire (Craig et al., 2003), and after measuring height and body mass (Detecto 339; Webb City, MO), participants were initially classified as obese (body mass index, BMI ≥ 30 kg/m²) or non-obese
(BMI < 25 kg/m²). Classification was confirmed and ultimately determined by measuring body fat percentage with Dual Energy X-ray Absorptiometry (DEXA) and using previously established obese and non-obese categories (non-obese: 7.7-16.5%; obese: 18.9-44.9%; Haskell et al., 2007) based off of adaptations from ACSM guidelines (Haskell et al., 2007).

Subjects were then fitted with a heart rate monitor (Polar T31; Polar Inc., Kempele, Finland), and after 10 min of supine quiet rest, heart rate and blood pressure (manual sphygmomanometer) were measured. The lowest heart rate value measured was defined as resting heart rate. Maximal heart rate was calculated using the formula (Tanaka, Monahan, & Seals, 2001):

$$HR_{\text{max}} = 208 - 0.7 \times \text{age}$$

Using resting and maximal HR, 50% HRR was calculated using the following formulas:

$$HR_{\text{max}} - HR_{\text{rest}} = \text{HRR}$$

$$(\text{HRR} \times 0.5) + HR_{\text{rest}} = 50\% \text{ HRR}$$

This intensity was used because the ACSM guidelines to promote and maintain health recommend that healthy adults aged 18-65 need moderate-intensity (40-59% HRR) aerobic physical activity at least 30 min 5 days per week (Haskell et al., 2007). Mean arterial pressure was calculated as (1/3 systolic) + (2/3 diastolic). Participants were then familiarized with Borg’s 20 point rating of perceived exertion (RPE) scale using standard instructions (Borg, 1961), and practiced walking on a treadmill (Smooth Fitness 6.75; King of Prussia, PA) for ~10 min at an intensity equivalent to ~50% heart rate reserve (HRR).
Experimental trials

Twenty-four hours prior to each visit, participants were instructed to refrain from the consumption of alcohol, caffeine, and over-the-counter drugs. Pre-test compliance was verified with a 24-hour history questionnaire. Prior to each visit, euhydration was encouraged by having participants consume an additional 500 mL of water the night before testing, and 2-3 hours prior to arrival.

Participants were randomly assigned to one of two conditions: green exercise, or control (blank projector screen). The green exercise trial consisted of viewing images depicting pleasant rural settings during exercise, while the control involved a blank screen with no images. The trial order was assigned in a random counter-balanced fashion. The use of images presented during exercise was the only difference between trials.

Each experimental trial was separated by at least 48 hours. Upon arrival, subjects provided a urine sample to ensure euhydration. Urine specific gravity via a refractometer was measured from this sample, and euhydration was defined as a urine specific gravity < 1.030 (Sper Scientific Clinical Refractometer 300005; Scottsdale, AZ).

Subjects were first fitted with a heart rate monitor and automatic arm cuff sphygmomanometer (Prestige Medical Aneroid Sphygmomanometer 70; Northridge, CA). While subjects sat quietly, they completed the following psychological questionnaires: Adult MHC-SF; Satisfaction with Life Scale; Psychological Well-Being Scale (Ryff, 1989); Profile of Mood States Questionnaire (POMS; McNair et al., 1984); Exercise Self-Efficacy Questionnaire
(Marcus BH, VC Selby, RS Niaura, JS Rossi, 1992); and Beck’s Inventory for symptoms of depression. For all questionnaires, subjects were instructed to fill them out according to how they felt at that moment. See below for descriptions of these questionnaires.

BP was measured while standing on the treadmill, immediately prior to initiating exercise. The participants then walked for 30 min at an intensity equivalent to 50% HRR. Subjects were told to remain quiet, and to thoroughly engage and absorb all the images. Throughout the first trial, an investigator adjusted the treadmill speed and grade to maintain the required HR, and all adjustments were noted and replicated for the second trial. HR was measured every 5 min during exercise. RPE was measured every 10 min during exercise. A fan producing an air speed of 3.5 m/s was directed at the participants. BP was measured in the last minute of exercise, immediately after exercise while standing, and then again after 5 min of seated rest. The subjects then completed the same questionnaires that were filled out pre-exercise.

**Administered Scales**

The Profile of Mood States (POMS) questionnaire contains 5 questions for each of the six mood states: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment (McNair et al., 1984). Lower scores reflect a more positive mood state for the given construct except for vigor, in which a higher score represents a more positive mood state.
The Exercise Self-Efficacy Scale (Marcus et al., 1984) is used to quantify one’s confidence in his or her ability to utilize internal resources to overcome universal barriers to completing exercise bouts. It comprises of 5 items beginning with the phrase, “I am confident I can participate in regular exercise when:” with a response of “1” signifying no confidence, and “7” indicating full confidence. The items encompassed are complementary to maintaining consistent physical activity, including areas of negative affect, resisting relapse, and making time for exercise. A higher score reflects greater self-efficacy.

The Adult MHC-SF (14 items) measures how often someone has felt certain emotions and provides a “Social,” “Emotional,” “Psychological,” and a total “Continuous” score. Higher scores reflect greater health in each category (Westerhof et al., 2011).

The Satisfaction with Life Scale (5 items) rates the extent of agreement of statements regarding one’s life. Higher scores reflect greater satisfaction with life (Diener et al., 1985).

Beck’s Inventory (21 items) for symptoms of depression involves selection of statements that reflect how one currently feels. Higher scores reflect greater feelings of depression (Beck et al., 1961).

**Statistical Analyses**

Statistical analyses was performed using SPSS v.12 for Windows (IBM SPSS Software., Armonk, New York). Data are reported as means ± standard deviation (SD). An alpha level of 0.05 was used for all significance tests. To test for differences between obese and non-obese individuals at rest prior to each experimental trial, a two-way (group vs condition) repeated
measures ANOVA was conducted on each pre-value. In order to examine the effect of control or green exercise on the various measures, a change score from pre- to post-exercise was calculated for each variable (i.e., post-pre). Then a two-way ANOVA (group vs. condition) was conducted on the change score to examine the effects of body size and control/green exercise. Greenhouse-Geisser corrections were made when the assumption of sphericity was violated. Follow-up repeated measures t-tests and the Bonferroni alpha correction were used when appropriate.
Chapter 4: Results

Subjects

There were significant differences between the non-obese and obese individuals’ age, body mass, body fat percentage, and IPAQ score (Table 1; P < 0.05).

Physiological Effects of Exercise

There were no differences in %HRR (Control: 50 ± 1 %HRR; Green Exercise: 48 ± 1 %HRR; P > 0.05) or MAP (Figure 1, P > 0.05) during exercise. However, RPE was greater in the control trial than green exercise (Control: 11 ± 0 RPE; Green Exercise: 10 ± 0 RPE; P = 0.006; Figure 2), as was HR (Control: 126 ± 1 bpm, Green Exercise: 124 ± 2 bpm; P = 0.042; Figure 3). These differences were independent of subject groups (i.e., non-significant interaction; P > 0.05).

Psychological Effects of Exercise: Pre-Exercise Questionnaire Comparisons

To examine differences at rest before each trial, pre-exercise values between obese and non-obese individuals were analyzed for each administered questionnaire. MHC-SF Psychological well-being scores showed significantly higher pre-exercise values for obese than non-obese (obese: 24 ± 3, non-obese: 21 ± 3, P = 0.006) individuals. Pre-exercise POMS Tension-Anxiety mood disturbance scores were slightly greater for control versus green exercise bouts (Control: 5 ± 4; Green: 4 ± 3; P = 0.04). Pre-exercise scores between non-obese and obese Self-Efficacy were significantly higher for non-obese versus obese individuals (Non-obese: 46 ± 4; Obese: 33 ± 3, P = 0.017).
Effect of Exercise (Post-Pre)

Changes in scores from post-pre-exercise are presented in Figures 4-17. Those changes scores that were significantly different are discussed below. Several change scores were significantly different between non-obese and obese individuals; however, these changes were independent of exercise condition (i.e., non-significant interaction P > 0.05). Overall MHC-SF Continuous change scores were significantly higher (higher score indicates greater mental health) in non-obese than obese individuals (non-obese: 6 ± 2; obese: 0 ± 2; P = 0.041; Figure 4). MHC-SF Psychological category change scores were significantly higher in non-obese than obese individuals (Non-obese: 3 ± 1; Obese: -1 ± 1; P < 0.001; Figure 5). Lastly, POMS Confusion-Bewilderment category change scores (negative score indicates a greater decrease in confusion-bewilderment) were significantly higher in non-obese than obese individuals (obese: 0 ± 1; non-obese: -2 ± 1; P = 0.019; Figure 6).

Independent of subject classification (i.e., main effect of condition), MHC-SF Emotional scores showed greater improvements after control versus green exercise bouts (Control: 1 ± 2; Green: 0 ± 2; P = 0.049; Figure 7).
<table>
<thead>
<tr>
<th>Measures</th>
<th>Non-Obese</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>22 ± 2</td>
<td>28 ± 5*</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.5 ± 3.9</td>
<td>179 ± 10.1</td>
</tr>
<tr>
<td>Body Mass (kg)</td>
<td>76.6 ± 8.1</td>
<td>90 ± 15.3*</td>
</tr>
<tr>
<td>% Fat from DEXA</td>
<td>12.7 ± 2.5</td>
<td>29 ± 8.6*</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>24 ± 2</td>
<td>28 ± 6*</td>
</tr>
<tr>
<td>Resting Systolic (mm Hg)</td>
<td>120 ± 11</td>
<td>122 ± 13</td>
</tr>
<tr>
<td>Resting Diastolic (mm Hg)</td>
<td>73 ± 10</td>
<td>67 ± 10</td>
</tr>
<tr>
<td>Resting MAP (mm Hg)</td>
<td>89 ± 10</td>
<td>85 ± 8</td>
</tr>
<tr>
<td>IPAQ</td>
<td>5537 ± 1777</td>
<td>5863 ± 7612*</td>
</tr>
</tbody>
</table>

Table 1
Figures

Figure 1

Mean Arterial Pressure (mm Hg)

- Non-Obese Control
- Obese Control
- Non-Obese Green Exercise
- Obese Green Exercise

Pre-Exercise 30-min Post-Exercise Post-Rest

Time
Figure 2

Main effect of condition
P = 0.006
Main effect of condition

P = 0.042

Figure 3
Figure 4

ΔMHC-SF Continuous (Post-Pre)

- Control
- Green

Main effect of group

P = 0.041
Figure 5

Main effect of group

\[ \text{P} < 0.001 \]
Figure 6

Main effect of group
P = 0.019

Obese

Non-Obese

Δ POMS Confusion-Bewilderment (Post-Pre)

Control  Green
Figure 7

Δ MHC-SF Emotional (Post-Pre)

- **Control**
- **Green**

Main effect of condition

P = 0.049
Figure 8
Figure 9

Δ Satisfaction with Life (Post-Pre)

Control  Green

Pre  Post

Time
Figure 10

A POMS Tension-Anxiety (Post-Pre)

Non-Obese

Obese

Control  Green
Figure 11

Δ POMS Depression-Dejection (Post-Pre)

Non-Obese
Obese

Control  Green
Figure 12

Δ POMS Anger-Hostility (Post-Pre)

Non-Obese

Obese

Control  Green
Figure 13

Δ POMS Vigor-Activity (Post-Pre)

Non-Obese  Obese

Control  Green
Figure 14

Δ POMS Fatigue-Inertia (Post-Pre)

Non-Obese

Obese

Control  Green
Figure 15
Figure 16 - Exercise Self-Efficacy (Post-Pre)

Non-Obese

Obese

Control

Green
Figure 17

Δ Beck's Inventory (Post-Pre)

Control  Green

Non-Obese  Obese
Chapter 5: Discussion

Green exercise has been shown to improve mood, self-esteem, anxiety and other cognitive and emotional benefits (Hug et al., 2009; Pretty et al., 2007; Mackay & Neill, 2010; Pretty et al., 2005; Barton & Pretty, 2010). However, it is unknown if green exercise has the same beneficial effects in obese individuals. The aim of the present study was to compare the physiological and psychological effects of green exercise on obese and non-obese males. Green exercise consisted of viewing pleasant rural images; no images were viewed during the control trial. Subjects walked for 30 minute at 50% HRR. Moderate intensity exercise lasting 30 min was used because that is the recommendations set forth by ACSM to reap the health benefits of exercise (Haskell et al., 2007). The acute mental effects of green exercise were examined using a variety of validated questionnaires (i.e., Adult MHC-SF, Satisfaction with Life, POMS, Exercise Self-Efficacy, and Beck’s Inventory) completed before and after each exercise. The primary finding from this study was that exercise significantly improved emotional health (e.g., improved MHC-SF Emotional scores), independent of body size.

This study closely mirrors the structure of a study by Pretty et al. (2005). However, the main difference between the studies that may have affected the outcomes, were the subjects. Pretty et al (2005) recruited 55 females and 45 males aged 18-60 years old, of unknown body size. Although Pretty et al. (2007) found mental health improvements after green exercise to be independent of age, gender, exercise intensity and duration, it is possible that some of these factors were responsible for the differences in the physiological results between the two studies.
We specifically used subjects that were sedentary, to avoid the chronic mental and physical benefits of exercise, and their influence on the acute effects of the experimental trial.

It is well known that exercise lowers blood pressure post-exercise, and green exercise was expected to magnify this effect compared to exercise alone. Pretty et al. found that blood pressure before and after 20 minutes of exercise significantly decreased after viewing the same green exercise images as used in our study (~8 mmHg), but did not change after control exercise when no images were observed. We did not see a significant drop, possibly due to the variances in exercise intensities between the two studies. Our participants all exercised at 50% HRR (achieved by varying speeds of walking at an incline), while Pretty’s subjects selected their instructed intensity of “fairly light,” which was mostly attained by jogging with no incline. It is possible that jogging in our study would have produced a significant drop in blood pressure, especially since elevated resting blood pressure is correlated with increases in BMI above ≥25 kg/m² (Ferrannini, 1995). If resting or exercising blood pressure was greater in our obese subjects, there may have been greater room for it to come down post-exercise. Using healthy obese individuals (i.e., normotensive) may explain why our obese individuals did not have a reduction in MAP after green exercise.

Pretty et al. (2005) also found significant improvements in POMS scores after green exercise. Confusion-bewilderment, tension-anxiety, vigor-activity, and depression-dejection scores improved significantly in their study, while we only found significant improvements in confusion-bewilderment. However, the improvement we observed was dependent on subject grouping (obese experienced greater improvements) and not on exercise condition (i.e., no
difference between green and control exercise; Figure 6). Pretty offers an interesting explanation in pointing out that the difficulty in distinguishing the effects of exercise on mood state may be due to the theory that runners have either an “internal focus,” in which they concentrate on the effects of exercise on their body, while others focus externally, and concentrate on distractions. Although our subjects walked, some may have blocked out the images despite our instructions, and focused all attention on their physical state.

Independent of body size, there were two main effects of conditions regarding the physiological effects of exercise. Participants rated their perception of exertion during exercise as higher during the control, as opposed to green exercise. Average heart rate was also higher during the control trial. Since there was no difference in intensity of exercise between trials, this data suggests that green exercise is perceived psychologically and physiologically less strenuous than traditional non-green exercise. This is an appealing quality of green exercise, and may encourage obese individuals to become more active, if green exercise is perceived as more feasible option.

There were several significant main effects of body size, independent of exercise type. Obese individuals had greater well-being (as indicated by higher MHC-SF Psychological scores; Figure 5) prior to exercise, compared to non-obese participants. Thus the non-obese individuals had a greater ability or range to improve this score. This might explain why non-obese individuals showed greater improvements in this measure after exercise. In other words, the higher psychological pre-values for obese individuals made their pre-to-post exercise psychological improvements appear to be less dramatic than non-obese participants.
Tension-Anxiety was higher before the control trial versus green exercise. Individuals were aware whether they would be walking while viewing a blank screen or viewing pictures before filling out their pre-exercise questionnaires, and this knowledge may have affected this mood state. However, because of the random, balanced design, it is unclear why individuals would have slightly higher tension-anxiety scores prior to the control trial.

Non-obese individuals showed greater pre-exercise self-efficacy compared to obese participants. This may be related to higher activity levels self-reported by the non-obese participants (Table 1).

Surprisingly, there was only one significant main effect of condition, independent of body size. Control exercise improved emotional health (as indicated by MHC-SF Emotional category score; Figure 7) more than the green exercise, independent of body size. The emotional category in the MHC-SF represents the frequency with which individuals experience the items of “happy,” “interested in life,” and “satisfied.” This was anticipated, and is in accordance to previous research (Hug et al., 2009; Pretty et al., 2007; Mackay & Neill, 2010; Pretty et al., 2005; Barton & Pretty, 2010). We knew that exercise alone has positive psychological effects. It improves mental health, self-efficacy, and mood, while decreasing depression and anxiety symptoms (Nieman et al., 2000; Penedo & Dahn, 2005). This finding is especially beneficial to obese individuals, as improved mood and self-efficacy increases one’s propensity to follow an exercise program (Perri et al. 1997; Annesi & Unruh, 2008; Wadden et al., 1997).

There were multiple significant main effects of body size (i.e., independent of group) in post-pre-exercise psychological health. Non-obese individuals showed greater improvements in
psychological health, as well as overall mental health, as demonstrated by the MHC-SF Continuous category (i.e., the sum of all social, psychological, and emotional health scores). It appears that non-obese participants received the greater mental benefits from exercise in general, compared to obese individuals. Confusion-bewilderment was also decreased to a greater extent in non-obese versus obese individuals (Figure 6). Previous research has shown that green exercise is more restorative than non-green exercise (Hug et al., 2009), specifically meaning it renews focus and attention, or decreases confusion and bewilderment. Pretty at al. (2005) found green exercise to positively improve POMS Confusion-Bewilderment scores. However, our study achieved such significant improvements in non-obese individuals, independent of green or control exercise.

Future Research

The results of this study suggest that green exercise was responsible for several mental health improvements. Further research is necessary to establish the effects of green exercise on body size more clearly. Although Pretty et al. (2007) found mental health improvements after green exercise independent of age, gender, exercise intensity and duration, a smaller age gap should be used in future investigations. The current study evaluated obese individuals with a body composition range from 19 to 49% body fat. It is possible that differences exist within the obese classification [i.e., low range (~20% body fat) versus high range (~45% body fat)]. Due to a small sample size we cannot statistically make comparisons within the obese category, however future studies should make this comparison.
Viewing images of nature is only the first level of engagement. (Pretty et al., 2005). Future studies should increase the depth of engagement, which may produce heightened positive mental effects. Specifically, this study should be repeated in the presence of nature, which is considered the second level. Additionally, this study used a greater number of psychological questionnaires than Pretty (2005), which instigated complaints of boredom by our participants, and may have resulted in less accurate questionnaire responses. Greater involvement with nature, as well as a condensed version of the questionnaires might decrease the tedium of the study, improve participant morale, and increase the likelihood of greater effort in answering all questionnaires thoughtfully and genuinely.

Conclusion

The findings of this study suggest that green exercise can positively affect mental health in both obese and non-obese individuals. The primary finding from this study was that green exercise can lower RPE and HR in obese and non-obese individuals. Exercise also improved emotional health to a greater extent in non-obese individuals. Further research is required to investigate whether green exercise benefits obese individuals more than non-obese individuals. An increase in the level of “greenness,” or greater interaction with nature in the study should help heighten the benefits of green exercise.

References

Andersen RE, TA Wadden, SJ Bartlett, B Zemel, TJ Verde, SC Franckowiak. Effects of lifestyle


Fletcher GF, G Balady, SN Blair, J Blumenthal, C Casperson, B Chaitman, S Epstein, ESS Froelicher, VF Froelicher, IL Pina, ML Pollock. Statement on exercise: Benefits and recommendations for physical activity programs for all Americans. *A Statement for Health Professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association.*


INVITATION TO PARTICIPATE

You are invited to participate in a research study about how exercise effects your mood state. You are being asked to participate in this study because you are a healthy male between the ages of 18 and 39.

WHAT YOU SHOULD KNOW ABOUT THE RESEARCH STUDY

Who is the Principal Researcher?
Alexandra LaChance; aalacha@uark.edu

Who is the Faculty Advisor?
Matthew S. Ganio, Ph.D.; msganio@uark.edu; 479-575-5309

What is the purpose of this research study?
The purpose of this study is to examine the effects of exercise on mood state in individuals with varying body sizes.

Who will participate in this study?
There will be 30 males participating. The individuals will be between 18 and 39 years of age. They will be a mix of University of Arkansas students and non-students.

What am I being asked to do?

You will be asked to report to the Human Performance Laboratory on 3 occasions. The first visit will take approximately 1 hour. The other 2 visits will take approximately 1.5 hours. Twenty four hours prior to each visit, we ask that you refrain from the consumption of alcohol, caffeine, and over-the-counter drugs. To aid in comfort during exercise, two hours prior to arrival, please refrain from eating food. Prior to each visit, please consume an additional ~16 oz. (2 cups) of water the night before your arrival and 2-3 hours prior to arrival.

Familiarization visit (visit 1: ~2 hrs)
You will first fill out questionnaires regarding your medical history, physical activity level, and what you have done over the last 24 hours. We will then measure your height and weight. We will then measure your body composition with a dual energy x-ray absorptiometry machine (DEXA). This involves you laying quietly for ~10 min while the machine moves over you. The amount of radiation used by the DEXA machine is about one tenth of the amount you would receive from a chest x-ray (see below for details).
We will then measure your heart rate and blood pressure. You will then practice walking on a treadmill for ~10 min at an intensity equivalent to ~55% of maximal effort.
We will then familiarize with you a variety of questionnaires that ask about your mood.

Experimental Trials (visit 2 and 3: ~1.5 hrs each)

Upon arrivial for an experimental trial, you will be asked to void your bladder while providing a small urine sample. We will look at the concentration of the urine to determine if you are hydrated. You will then walk for 30 min on a treadmill at an intensity equivalent to 55% maximal effort. Throughout exercise, we will adjust the treadmill speed to maintain the required intensity. A fan producing an air speed of 3.5 m/s will be directed at you throughout exercise. While exercising you will view images projected onto a screen. Each experimental trial will consist of a different set of images. The set of images presented on the first trial will be randomly assigned. The only difference between trials is the types of images presented during exercise.

Before, during and after exercise we will measure HR and blood pressure and ask your effort level. Before and after exercise, you will fill out the questionnaires regarding mood state.
What are the possible risks or discomforts?

There are no apparent psychological, social, legal, or economic risks to you. The discomforts (i.e., muscular and systemic) due to exercise will be no greater than when you exercise in daily living. The DEXA exposes you to a small amount of ionizing radiation. The amount received during a DEXA test is about the same as four (4) days of normal background radiation in Northwest Arkansas.

What are the possible benefits of this study?

Individually you will benefit by the physical conditioning received during exercise. You will be eligible to receive, at random, one of two $50 gift cards.

As a society, this research will benefit clinicians and practitioners by clarifying the effect of exercise on mood state. This has implications for the prescription of exercise to all individuals.

How long will the study last?

You will be asked to report to the Human Performance Laboratory on 3 occasions. The first visit will take approximately 1 hour. The other visits will take approximately 1.5 hours. Each visit will be separated by a minimum of 48 hours. Depending on your availability you may be enrolled in this study for ~2-3 months.

Will I receive compensation for my time and inconvenience if I choose to participate in this study?

You will be eligible to receive, at random, one of two $50 gift cards.

Will I have to pay for anything?

No. There are no costs associated with you being a participant.

What are the options if I do not want to be in the study?
If you do not want to be in this study, you may refuse to participate. Also, you may refuse to participate at any time during the study. Your job, class grades, relationship with the University, etc. will not be affected in any way if you refuse to participate.

*How will my confidentiality be protected?*

All information will be kept confidential to the extent allowed by applicable State and Federal law.

You will be assigned a code number. This code will be used during data entry and all computer programs used for analysis. All data will be locked and stored in the Human Performance Laboratory. The results of all tests will be strictly confidential. Your results will not be shared with anyone except the investigators present at the time of the experiments. You will not be identified in any publication or presentation of this study.

*Will I know the results of the study?*

At the conclusion of the study you will have the right to request feedback about the results. You may contact the faculty advisor, Matthew S. Ganio (msganio@uark.edu) or Principal Researcher, Alexandra LaChance (aalacha@uark.edu). You will receive a copy of this form for your files.

*What do I do if I have questions about the research study?*

You have the right to contact the Principal Researcher or Faculty Advisor as listed below for any concerns that you may have.

Alexandra LaChance: [Contact Information]

Matthew S. Ganio, Ph.D.; msganio@uark.edu; 479-575-5309

You may also contact the University of Arkansas Research Compliance office listed below if you have questions about your rights as a participant, or to discuss any concerns about, or problems with the research.
Ro Windwalker, CIP
Institutional Review Board Coordinator
Research Compliance
University of Arkansas
120 Ozark Hall
Fayetteville, AR  72701-1201
479-575-2208
irb@uark.edu

I have read the above statement and have been able to ask questions and express concerns, which have been satisfactorily responded to by the investigator. I understand the purpose of the study as well as the potential benefits and risks that are involved. I understand that participation is voluntary. I understand that significant new findings developed during this research will be shared with the participant. I understand that no rights have been waived by signing the consent form. I have been given a copy of the consent form.
Appendix B: Flyer for Posting

The Human Performance Laboratory, University of Arkansas is seeking:

Males for a Laboratory Study
Effect of Exercise on Mood State.

If you are an 18 – 39 year old male and have no medical illness, please inquire.

This study will involve 3 visits (2 involve exercise).
Participants will be eligible to receive, at random, one of two $50 gift cards.

Contact:
Alexandra LaChance at [redacted]
Appendix C: Flyer for Electronic Communication

Male participants wanted for a research study to evaluate the effects of exercise on mood state.

**Seeking:** 30 men, 18-39 years old; no chronic illness or injury; should be able to tolerate light/moderate treadmill walking (30 minutes).

**Benefits of participating in study:** physical conditioning received during exercises and results of body composition free.

**Compensation for participating in study:** eligibility to receive, at random, one of two $50 gift cards.

**This study will involve:** 3 visits to the Human Performance Laboratory (approximately 60-90 minutes per visit); light/moderate treadmill walking (30 minutes) on two occasions; heart rate and blood pressure monitoring.

For details: telephone Alexandra LaChance at [redacted] or aalacha@uark.edu

The principal investigator is Matthew Ganio, Ph.D. This study has been approved by the University of Arkansas, Institutional Review Board for Human Studies, Fayetteville, AR.
Appendix D: Familiarization Visit Data Sheet

ID:

Time/ Date:

Familiarization Trial Data Sheet

1. Brief Explanation of Study
2. Par-Q, IPAQ, Personality Questionnaire, Informed Consent
3. Height: __________ Weight: __________ Arm Circumference: __________ cm
4. Body Mass (DEXA) ________________.
5. □ Obese (BMI ≥ 30 kg/m²) □ Non-obese (BMI 18.5-24.9 kg/m², DEXA 8-19%)
6. 10 min quiet rest on DEXA bed
7. Measure BPrest ________________.
8. Sit up and fit with heart rate monitor (wet back w/ distilled)
9. Lay for 2 min.
10. Measure HRrest ________________.
11. Calculate HRmax =208 - 0.7 x age ________________.
12. HRR = HRmax - HRrest = ________________.
13. HR/(HRmax - HRrest ) x 100 = 50% HRR ________________.
14. Calculate MAP (1/3 systolic) + (2/3 diastolic) = ________________.
15. Explain Borg’s 6-20point rating of perceived exertion (RPE) scale w/ sheet.
16. Practice treadmill walk ~10 min @ ~50% HRR ________________.
17. Review Experimental Trial Protocol
   a. Wear exercise clothes and sneakers
   b. Drink 500 ml (2 cups) of water the night before, and 2-3 hours before experimental trial.
   c. Refrain from caffeine, alcohol, OTC drugs
18. Schedule last 2 trials
Appendix E: International Physical Activity Questionnaire

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

☐ No vigorous physical activities ➞ Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

☐ No moderate physical activities ➞ Skip to question 5

4. How much time did you usually spend doing moderate physical activities on one of those days?
Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

____ days per week

☐ No walking ➞ Skip to question 7

6. How much time did you usually spend walking on one of those days?

____ hours per day

____ minutes per day

☐ Don’t know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a week day?

____ hours per day

____ minutes per day

☐ Don’t know/Not sure

This is the end of the questionnaire, thank you for participating.
Appendix F: Experimental Trial Data Sheet

ID: ________________  Control

Time/Date: ________________  Rural Pleasant

Arm Circumference: __________

HRmax: ________________

HRrest: ________________

50% HRR: ________________

Treadmill Speed: ________________

Treadmill Incline: ________________

1. Complete 24-hr history questionnaire
2. Urine sample ________________, Euhydration = < 1.030
3. Fit with HR monitor
4. Sit quietly: fill out psychological questionnaires:
   - Adult MHC-SF, Satisfaction with Life Scale, Psychological Well-Being Scale, POMS, Exercise Self-Efficacy, Beck's Inventory
5. BP measured on treadmill __________ mmHg
6. Walk 30 min on treadmill ~50% HRR
   - HR measured every 5 min, RPE every 10 min
5: HR: __________ bpm
10: HR: ______ bpm, RPE: ______
15: HR: __________ bpm
20: HR: ______ bpm, RPE: ______
25: HR: __________ bpm (Put cuff on)
30: HR: ______ bpm, RPE: ______, BP: ______ mmHg

BP on treadmill: ________ mmHg

BP after 5 min of seated rest: ________ mmHg
Appendix G: Rating of Perceived Exertion Scale

Rating of Perceived Exertion Scale

6
7 Very, Very Light
8
9 Very Light
10
11 Fairly Light
12
13 Somewhat Hard
14
15 Hard
16
17 Very Hard
18
19 Very, Very Hard
20
Appendix H: 24 Hour History Questionnaire

24-Hour History

ID __________

Treatment ________    Treatment # ________

Date ________    Time ________

USG ________ (not to be >1.030)    Temp. ________ (not to be >37.8°C)

1. How many hours of sleep did you get last night? (please circle one)
   1 2 3 4 5 6 7 8 9 10 11 12 >12

2. How many hours of sleep do you normally get? (please circle one)
   1 2 3 4 5 6 7 8 9 10 11 12 >12

3. How many hours has it been since your last meal or snack? (please circle one)
   1 2 3 4 5 6 7 8 9 10 11 12 13 >14

List the items below:

4. When did you last have:
   · a cup of coffee or tea?
· cigarettes?
· drugs (including aspirin)?
· alcohol?
· herbal or dietary supplements?

5. How many 8 oz. glasses of water or other beverages have you consumed in the last 24 hours?
1 2 3 4 5 6 7 8 9 10 11 12 13 14

6. When did you last consume water or another beverage?
_____________ How much? ________ (glasses)

7. What sort of physical activity did you perform yesterday?

8. What sort of physical activity have you performed today?

9. Describe how you feel right now by checking one of the following:

______excellent
_______very bad
______very, very good
_______very, very bad
______very good
_______terrible
______good
_______neither good nor bad
______bad
Appendix I: Green Exercise Images
Appendix J: Adult MHC-SF

**Adult MHC-SF**

Please answer the following questions are about how you feel right now. Indicate to what extent you feel this way right now, that is, at the present moment.

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. interested in life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. satisfied with life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. that you had something important to contribute to society</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5. that you belonged to a community (like a social group, or your neighborhood)</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6. that our society is a good place, or is becoming a better place, for all people</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. that people are basically good</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. that the way our society works makes sense to you</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>---</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>that you liked most parts of your personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>good at managing the responsibilities of your daily life</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>that you had warm and trusting relationships with others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>that you had experiences that challenged you to grow and become a better person</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>confident to think or express your own ideas and opinions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>that your life has a sense of direction or meaning to it</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix K: Satisfaction with Life

**Satisfaction with Life Scale**

Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

- 7 - Strongly agree
- 6 - Agree
- 5 - Slightly agree
- 4 - Neither agree nor disagree
- 3 - Slightly disagree
- 2 - Disagree
- 1 - Strongly disagree

____ In most ways my life is close to my ideal.
____ The conditions of my life are excellent.
____ I am satisfied with my life.
____ So far I have gotten the important things I want in life.
____ If I could live my life over, I would change almost nothing.
Appendix L: Profile of Mood States

**PROFILE OF MOOD STATES**

<table>
<thead>
<tr>
<th>Subject Number</th>
<th>Date: __________</th>
</tr>
</thead>
</table>

Below is a list of words that describe feelings people have. Please read each one carefully, then mark ONE circle under the answer to the right which best describes *HOW YOU FEEL RIGHT NOW.* The numbers refer to these phrases:

0 = Not at all  
1 = A little  
2 = Moderately  
3 = Quite a bit  
4 = Extremely

<table>
<thead>
<tr>
<th>Friendly</th>
<th>Uaworthy</th>
<th>Desperate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4</td>
<td>0 1 2 3 4</td>
<td>0 1 2 3 4</td>
</tr>
<tr>
<td>Tense</td>
<td>Spateful</td>
<td>Sluggish</td>
</tr>
<tr>
<td>Angry</td>
<td>Sympathetic</td>
<td>Rebellious</td>
</tr>
<tr>
<td>Worn out</td>
<td>Uneasy</td>
<td>Helpless</td>
</tr>
<tr>
<td>Unhappy</td>
<td>Ruthless</td>
<td>Weary</td>
</tr>
<tr>
<td>Cleared</td>
<td>Unable to concentrate</td>
<td>Bewildered</td>
</tr>
<tr>
<td>Lively</td>
<td>Fatigued</td>
<td>Alert</td>
</tr>
<tr>
<td>Confused</td>
<td>Helpful</td>
<td>Deceived</td>
</tr>
<tr>
<td>Sorry for things done</td>
<td>Annoyed</td>
<td>Furious</td>
</tr>
<tr>
<td>Shaky</td>
<td>Discouraged</td>
<td>Efficient</td>
</tr>
<tr>
<td>Listless</td>
<td>Resentful</td>
<td>Trusting</td>
</tr>
<tr>
<td>Peeved</td>
<td>Nervous</td>
<td>Full of pep</td>
</tr>
<tr>
<td>Considerate</td>
<td>Lonely</td>
<td>Bad-tempered</td>
</tr>
<tr>
<td>Sad</td>
<td>Miserable</td>
<td>Worthless</td>
</tr>
<tr>
<td>Active</td>
<td>Muddled</td>
<td>Forgetful</td>
</tr>
<tr>
<td>On edge</td>
<td>Cheerful</td>
<td>Carefree</td>
</tr>
<tr>
<td>Grouchy</td>
<td>Bitter</td>
<td>Terrified</td>
</tr>
<tr>
<td>Blue</td>
<td>Exhausted</td>
<td>Guilty</td>
</tr>
<tr>
<td>Energetic</td>
<td>Anxious</td>
<td>Vigorous</td>
</tr>
<tr>
<td>Pummley</td>
<td>Ready to fight</td>
<td>Uncertain about things</td>
</tr>
<tr>
<td>Hopeless</td>
<td>Good natured</td>
<td>Bushed</td>
</tr>
<tr>
<td>Relax</td>
<td>Gloomy</td>
<td></td>
</tr>
</tbody>
</table>

*This means you are ready to get in a physical fight*

**MAKE SURE YOU HAVE ANSWERED EVERY ITEM**

<table>
<thead>
<tr>
<th>Subject Number</th>
<th>TEST</th>
<th>GROUP</th>
</tr>
</thead>
</table>

**MARKING INSTRUCTIONS**

- Use a No. 2 pencil only.  
- Do not use ink, ballpoint, or felt tip pens.  
- Make solid marks that fill the response completely.  
- Erase cleanly any marks you wish to change.  
- Make no stray marks on this form.
Appendix M: Exercise Self-Efficacy

**Exercise Self Efficacy Questionnaire**

*This five-item self-efficacy questionnaire was designed to measure confidence in one’s ability to persist with exercising in various situations.*

Using the scales listed below, please indicate how confident you are that you would participate in regular exercise under the various circumstances by circling the appropriate number.

Please answer honestly and accurately. There are no right or wrong answers.

1 indicates “not at all confident” and 11 indicates “very confident.”

<table>
<thead>
<tr>
<th></th>
<th>Not at all confident</th>
<th>Neutral</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I am confident I can participate in regular exercise when I am tired.</td>
<td>1 2 3 4 5 6 7 8 9 10 11</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I am confident I can participate in regular exercise when I am in a bad mood.</td>
<td>1 2 3 4 5 6 7 8 9 10 11</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>I am confident I can participate in regular exercise when I feel I don’t have the time.</td>
<td>1 2 3 4 5 6 7 8 9 10 11</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>I am confident I can participate in regular exercise when I am on vacation.</td>
<td>1 2 3 4 5 6 7 8 9 10 11</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>I am confident I can participate in regular exercise when it is raining or snowing.</td>
<td>1 2 3 4 5 6 7 8 9 10 11</td>
<td></td>
</tr>
</tbody>
</table>
Appendix N: Beck’s Depression Inventory

Beck's Inventory

For each question, please select one item for how you feel right now.

1. 0  I do not feel sad.
    1  I feel sad
    2  I am sad all the time and I can’t snap out of it.
    3  I am so sad and unhappy that I can’t stand it.

2. 0  I am not particularly discouraged about the future.
    1  I feel discouraged about the future.
    2  I feel I have nothing to look forward to.
    3  I feel the future is hopeless and that things cannot improve.

3. 0  I do not feel like a failure.
    1  I feel I have failed more than the average person.
    2  As I look back on my life, all I can see is a lot of failures.
    3  I feel I am a complete failure as a person.

4. 0  I get as much satisfaction out of things as I used to.
    1  I don’t enjoy things the way I used to.
    2  I don’t get real satisfaction out of anything anymore.
    3  I am dissatisfied or bored with everything.

5. 0  I don’t feel particularly guilty
    1  I feel guilty a good part of the time.
    2  I feel quite guilty most of the time.
    3  I feel guilty all of the time.

6. 0  I don’t feel I am being punished.
    1  I feel I may be punished.
    2  I expect to be punished.
    3  I feel I am being punished.

7. 0  I don’t feel disappointed in myself.
    1  I am disappointed in myself.
    2  I am disgusted with myself.
    3  I hate myself.

8. 0  I don’t feel I am any worse than anybody else.
    1  I am critical of myself for my weaknesses or mistakes.
    2  I blame myself all the time for my faults.
    3  I blame myself for everything bad that happens.

9. 0  I don’t have any thoughts of killing myself.
    1  I have thoughts of killing myself, but I would not carry them out.
    2  I would like to kill myself.
    3  I would kill myself if I had the chance.

10. 0  I don’t cry any more than usual.
     1  I cry more now than I used to.
     2  I cry all the time now.
     3  I used to be able to cry, but now I can’t cry even though I want to.

11. 0  I am no more irritated by things than I ever was.
1. I am slightly more irritated now than usual.
2. I am quite annoyed or irritated a good deal of the time.
3. I feel irritated all the time.
12. I have not lost interest in other people.
1. I am less interested in other people than I used to be.
2. I have lost most of my interest in other people.
3. I have lost all of my interest in other people.
13. I make decisions about as well as I ever could.
1. I put off making decisions more than I used to.
2. I have greater difficulty in making decisions more than I used to.
3. I can't make decisions at all anymore.
14. I don't feel that I look any worse than I used to.
1. I am worried that I am looking old or unattractive.
2. I feel there are permanent changes in my appearance that make me look unattractive.
3. I believe that I look ugly.
15. I can work about as well as before.
1. It takes an extra effort to get started at doing something.
2. I have to push myself very hard to do anything.
3. I can't do any work at all.
16. I can sleep as well as usual.
1. I don't sleep as well as I used to.
2. I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3. I wake up several hours earlier than I used to and cannot get back to sleep.
17. I don't get more tired than usual.
1. I get tired more easily than I used to.
2. I get tired from doing almost anything.
3. I am too tired to do anything.
18. My appetite is no worse than usual.
1. My appetite is not as good as it used to be.
2. My appetite is much worse now.
3. I have no appetite at all anymore.
19. I haven't lost much weight, if any, lately.
1. I have lost more than five pounds.
2. I have lost more than ten pounds.
3. I have lost more than fifteen pounds.
20. I am no more worried about my health than usual.
1. I am worried about physical problems like aches, pains, upset stomach, or constipation.
2. I am very worried about physical problems and it's hard to think of much else.
3. I am so worried about my physical problems that I cannot think of anything else.
21. I have not noticed any recent change in my interest in sex.
1. I am less interested in sex than I used to be.
2. I have almost no interest in sex.
3. I have lost interest in sex completely.
Appendix O: IRB Approval

December 16, 2011

MEMORANDUM

TO: Alexandra LaChance
    Jon David Adams
    Kathleen Paulsen
    Megan Jackson
    Charles Matthews
    Ro DiBrezzo
    Arie Greenleaf
    Matthew Ganio

FROM: Ro Windwalker
    IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 11-12-329

Protocol Title: Effect of Body Size and Exercise on Mood State

Review Type: ☐ EXEMPT    ☐ EXPEDITED    ☒ FULL IRB

Approved Project Period: Start Date: 12/15/2011 Expiration Date: 12/08/2012

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form Continuing Review for IRB Approved Projects, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (http://vpred.uark.edu/210.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 60 participants. If you wish to make any modifications in the approved protocol, including enrolling more than this number, you must seek approval prior to implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.