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An Examination of the Effects of Psychological Stress and Anxiety on Physical Activity and Physical Fitness

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by
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ABSTRACT

In this study multiple measures of psychological stress, anxiety, physical fitness and physical activity were collected from 25 subjects in order to examine the relationships between stress, anxiety and fitness and between stress, anxiety and physical activity levels. It has long been hypothesized that levels of physical activity and physical fitness are moderators of psychological stress (Da Silva, et al., 2012). It has also been suggested that there is a bidirectional relationship between stress and physical activity and fitness levels (Da Silva, et al., 2012). This study intended to consider the ways that psychological stress may influence physical fitness and physical activity levels. It was hypothesized that increased levels of psychological stress would correspond to decreased physical fitness and lower levels of physical activity. Analysis of the data supported the hypothesis that increased stress and anxiety are related to decreased levels of activity and that elevated anxiety is related to lower fitness when measured as an estimated VO2Max but elevated stress was not related to Estimated VO2Max and was associated with lower BMI, WHR and weight.

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LIST OF ABBREVIATIONS

ACTH	Adrenocortiotropic hormone
BMI	Body Mass Index (kg/m2)
CRH	Corticotropin-releasing hormone
GAD	Generalized Anxiety Disorder
GAS	Generalized Adaptation Syndrome
HPA	Hypothalamic-Pituitary-Adrenocortical-Axis
LCUs	Life Changing Units
METs	Metabolic equivalents
PA-R	Physical Activity Rating
PFA	Perceived Functional Ability
PSS	Perceived Stress Scale
PSWQ	Penn State Worry Questionnaire
sAA	Salivary Alpha-Amylase
SAM	Sympathetic-Adrenal-Medullary System
SD	Standard Deviation
SRRS	Social Readjustment Rating Scale
STAI	State-Trait Anxiety Inventory
WHR	Waist to hip ratio

CHAPTER I: Introduction

Psychological stress affects everyone from time to time, but chronic stress can have significant and far-reaching impacts on health and well-being. Stress occurs when someone perceives situational or environmental demands to exceed their own ability to cope with the stressor (Burchfield, 1985). When stress occurs the body responds by activating very specific pathways in the neuroendocrine system to counteract the stressful situation. This system is important for day-to-day activities but, when activated chronically, the system cannot adequately carry out its protective purpose. When the chemical mediators of the stress response are elevated chronically, pathological conditions can develop like cardiovascular disease, stroke, or inability to react to another stressor (Mcewen, 2007). In humans, the glucocorticoid stress hormone cortisol is released from the adrenal glands as a part of the natural stress response; however, long-term elevations in cortisol can lead to decreased fertility, muscle atrophy, and decreased immune capacity (Barlow & Durand, 1995)

Physical activity broadly refers to any bodily movements requiring energy expenditure and includes the subcategory of exercise, which is structured and intentional physical activity for the purpose of maintaining or improving physical fitness (Caspersen, Powell, & Christenson, 1985). Exercise has been shown to reduce health risks by reducing blood pressure, LDL cholesterol levels, and body weight

(Myers, 2003). It has also been suggested that an increase in regular, unplanned physical activity may provide many of the same benefits of regular, planned exercise (Sharkey & Gaskill, 2007).

Physical activity and exercise have long been thought to impact psychological stress and the stress response. Much research has been done to demonstrate the relationship between stress and exercise and many pathways by which physical activity might moderate the stress response have been proposed. Childs and DeWit have suggested that resilience to acute stressors might occur by regularly activating the stress response through physical exercise (2014). It has also been shown that those who exercise are less likely to experience depression, anxiety, and cognitive impairment associated with aging (Cohen & Wills, Stress, Social Support, and the Buffering Hypothesis, 1985). The relationship between physical activity and stress outcomes has been well validated with research, although the specific mechanism by which they interact has not yet been determined.

It is important, however, to also consider the ways in which stress might affect levels of physical activity and fitness. Da Silva has examined the possibility of a bidirectional relationship between stress and fitness showing that while physical activity was associated with a lower incidence of depressive symptoms, the same depressive or anxious symptoms were associated with a decreased likelihood that the participant would meet the recommended levels of physical activity (Da Silva, et al., 2012). More research is necessary to examine the effects of stress on physical activity and fitness as both psychological stress and reductions in physical activity are both major concerns in public health today. A greater understanding of the ways in which psychological stress might

affect physical activity would be beneficial to creating clinical exercise plans for those who experience chronic psychological stress. This study seeks to broadly examine these relationships through analysis of psychological and physiological variables related to stress, anxiety, physical activity and physical fitness.

Purpose

The purpose of this study was to examine the effect of psychological stress and anxiety on levels of physical activity and physical fitness.

Hypothesis

The following hypotheses were tested by this study:

1. Individuals experiencing higher levels of psychological stress or anxiety will exhibit lower levels of physical fitness
2. Individuals experiencing higher levels of psychological stress or anxiety are likely to engage in less physical activity.

CHAPTER II: Literature Review

Stress

Stress can be defined in many ways and, as a result, can be complicated to understand. For the purposes of this study, stress will be defined as a state in which "environmental demands tax or exceed the adaptive capacity of an organism resulting in psychological and biological changes that may place persons at risk for disease" (Burchfield, 1985). The specification of psychological stress adds a perceptual component to the conceptualization of stress because psychological stress involves an individual's perception that environmental demands exceeding their ability to cope with said demands (Barlow & Durand, 1995). Stress also includes a biological component because under stress the body activates specific pathways in response to physical and psychological demands (Burchfield, 1985). The stress response is critical to survival through stressful situations but the inadequate or excessive functioning of systems involved in the stress response is disadvantageous to health (Mcewen, 2007). This allows differentiation between "good stress" and "bad stress"; the natural stress response of the body due to acute stressors is to release chemical mediators which create physiological changes that allow individuals to adapt to everyday demands such as waking up or climbing stairs (Mcewen, 2007). Chronic elevation of these mediators can, however, lead to systemic changes over time that ultimately result in the development of pathophysiological conditions like heart

disease or stroke and affect the ability of an organism to respond to further stressful stimuli.

Allostasis is the process of actively maintaining a dynamic equilibrium state of homeostasis (McEwen, 1998). The designations of allostatic load or overload refer to the wear and tear on the body and brain that happen as a result of deregulated stress mediators (McEwen, 1998). Two systems are often referred to in the biological discussion of stress and adaptation: the Sympathetic-Adrenal-Medullary System (SAM) and the hypothalamic-pituitary-adrenocortical axis (HPA).

Initial investigations into the SAM stress response came from Walter Cannon's early work regarding the evolutionary "fight or flight" stress response (Cohen & Syme, Social Support and Health, 1985). The SAM reacts to states of stress rapidly with an increase in the release of the catecholamines: epinephrine and norepinephrine (Cohen & Syme, Social Support and Health, 1985). The increase in production and release of these catecholamines causes very specific physical changes including increased blood pressure and heart rate, sweating, and constriction of peripheral blood vessels (Cohen & Syme, Social Support and Health, 1985). Prolonged elevation of catecholamines leads to dangerous pathology such as suppressed immune function, and the development of neurochemical imbalances (Cohen & Syme, Social Support and Health, 1985).

The HPA is responsible for the production and release of adrenocorticotropin hormone (ACTH) and subsequently the glucocorticoid cortisol in humans (Kang, 2010). The HPA involves to a slow cascade of secretory signals that ultimately culminate with the release of cortisol from the adrenal glands and inhibition of many non-emergency processes (Laurent, Powers, & Granger, 2013). Glucocorticoids, like cortisol, have many

varied effects on body systems including an influence on carbohydrate metabolism, the promotion of gluconeogenesis and glycogen storage, a reduction of glucose entry to cells, and a reduction in lipid metabolism (Newberry, Jaikins-Madden, & Gerstenberger, 1991). Generalized adaptation syndrome (GAS) can explain the various stages of response and adaptation to a stressor is useful in understanding the role of cortisol in the stress response (Burchfield, 1985). GAS involves three stages of reaction and adaptation to stressful stimuli: alarm, resistance, and exhaustion (Burchfield, 1985). In the alarm stage the anterior pituitary secretes ACTH, which activates the adrenal cortex to secrete additional corticosteroid hormone, in humans this is the glucocorticoid cortisol (Burchfield, 1985). The resistance stage follows the alarm stage when the stressor is prolonged and involves a full adaptation to the stressor that results in improvement or disappearance of the symptoms developed in the alarm stage (Burchfield, 1985). Finally the exhaustion stage occurs in the case of severe or prolonged stressors and the anterior pituitary and adrenal cortex lose the ability to adequately secrete hormones which causes the organism to become unable to adapt to the stressor at which point the symptoms which disappeared in the resistance stage reappear (Burchfield, 1985).

Evaluation of stress appraisal can be designated into primary and secondary appraisals (Cohen & Syme, Social Support and Health, 1985). Primary appraisal categorizes a stressor by the degree of possible harm or benefit that has occurred or been threatened (Newberry, Jaikins-Madden, & Gerstenberger, 1991). Stimuli are categorized as 1) Irrelevant, 2) Benign-positive, or 3) stressful (Cohen & Syme, Social Support and Health, 1985). Stimuli that fall into the third category are then further categorized to present either 1) harm or loss, 2) threat of possible future harm or loss or 3) a challenge

that presents the possibility for growth or change (Cohen & Syme, Social Support and Health, 1985). Secondary appraisal accesses the capabilities of the individual to deal with the stressor using their resources (Cohen & Syme, Social Support and Health, 1985). These resources may be personal, material or social (Newberry, Jaikins-Madden, & Gerstenberger, 1991). Over time the secondary appraisal of stressors can act through a feedback mechanism to affect primary appraisal of stressors (Cohen & Syme, Social Support and Health, 1985).

Chronic stress has serious health implications (Barlow & Durand, 1995). Long-term elevations in cortisol due to chronic stress can cause decreased fertility, muscle atrophy, coronary hypertension and decreased immune capacity (Barlow & Durand, 1995). Psychological stress may also impair cognitive function (Cohen, 1985). Chronic stress may even impact physiology and anatomy in more direct ways; A 2010 study found that progressive increases in salivary cortisol levels over a five-year period were predictive of reduced hippocampal volume and reduced performance on hippocampal-dependent memory tasks (Juster, McEwen, & Lupien, 2010)

Anxiety

Like stress, worry is a normal evolutionary response to a threatening stimulus,. Anxiety, however, is a heightened state of worry in the absence of a real or obvious danger (Dishman, 2002). The word anxiety is believed to be derived from the Indo-German “angh” meaning, “feeling of tightness, constriction, or choking under duress” (Zeidner & Matthews, 2004). It is important to differentiate between fear and anxiety. Fear is the biologically adaptive response to an identifiable stimulus, while anxiety is a

heightened psychological state or response to an ambiguous stimulus (Zeidner & Matthews, 2004). Fear and anxiety share some notable overlapping characteristics such as the cognition and appraisal of an environmental threat, feelings of tension and worry, autonomic nervous system reactivity and various somatic manifestations (Zeidner & Matthews, 2004).

Anxiety can be divided into subcategories as state or trait. An anxiety state is an individual's introspective, verbal report of feeling anxious (Speilberger & Sarason, 1975). Trait anxiety is the general level of anxiety a person experiences on average as well as proneness to experience an anxiety state for certain situations (Speilberger & Sarason, 1975). Anxiety is expressed through cognitive, affective, and behavioral subsets within individuals.

The cognitive facet involves worry or concerns about the anticipated stimuli triggered by cues that indicate an undesirable event (Zeidner & Matthews, 2004). The cognitive facet of anxiety also relies on perception; it develops when an individual's perceived ability to cope with a task does not exceed the ability he perceives necessary to cope with said task (Zeidner & Matthews, 2004). While low levels of cognitive anxiety may facilitate mental problem solving or motivate productive behaviors; it also tends to generate a negative affect over time (Zeidner & Matthews, 2004).

The affective facet of anxiety refers to the objective and measurable symptoms of an anxiety response (Zeidner & Matthews, 2004). These symptoms are very similar to aspects of the stress response because they both involve the activation of the sympathetic nervous system. Anxiety includes strong emotional arousal that can activate the sympathetic nervous system and initiation of, the "fight or flight" response (Zeidner &

Matthews, 2004). The objective manifestations of this activation may include pupil dilation, increased blinking, decreased production of saliva, movement of blood from periphery to muscle tissue, blood vessel constriction, increased heart rate, and an increase in levels of epinephrine and norepinephrine (Zeidner & Matthews, 2004).

The third facet of anxiety is behavioral and can often be observed in individuals experiencing anxiety (Zeidner & Matthews, 2004). This component involves specific behaviors often expressed by those experiencing anxiety and can be subdivided into motor anxiety, facial anxiety, verbal anxiety and social anxiety (Zeidner & Matthews, 2004). Motor anxiety includes behaviors like nail biting and increased touching of the hair or face (Zeidner & Matthews, 2004). Facial anxiety encompasses behaviors such as lip licking, increased swallowing, sighs or grimaces (Zeidner & Matthews, 2004). Verbal anxiety includes things like inability to produce sounds or speak properly and social anxiety is distinguished by averting the gaze of others when speaking (Zeidner & Matthews, 2004).

Much like stress, everyone experiences some level of anxiety on occasion. Clinical or pathological anxiety is identified when it is so strong or disruptive that it interferes with normal everyday activity (Zeidner & Matthews, 2004). Typical disorders of anxiety include Generalized Anxiety Disorder (GAD) a heightened level of anxiety not tied to any specific event and phobias, which involve anxiety experienced in specific contexts (Zeidner & Matthews, 2004).

Measuring Stress and Anxiety

Stress responses are multidimensional involving biological and psychological processes and therefore require a multidimensional approach for measurement and analysis (Kang, 2010). Cohen discusses the measurement stress extensively and noted the importance of matching measures and designs to research questions (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). Appropriate measures of stress are dependent on the specific questions being asked and pathways by which stressors might influence the development of pathology (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). This necessitates a consideration of the temporal courses by which stress might produce measurable effects. An acute traumatic event might trigger processes contributing to the onset of a disease process while long-term chronic stress might facilitate the development of pathology during the course of exposure (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). It is also relevant to consider the importance of the interaction between the measure and the outcome, for example, the use of measures that assess overlapping or identical concepts because measures of psychological symptoms and cognitive appraisal often include similar items (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010)

The use of well-validated and reliable psychological questionnaire measures of stress is often a part of research methods and has proven useful in the assessment of psychological stress (Richardson, Rice, & Devine, 2014). The Social Readjustment Rating Scale (SRRS) is a measure of stressful events that have occurred in an individual's life within the last year. The SRRS measures the stress associated with specific events

such as change in employment, living conditions, marital status or education based on pre-assigned standardized weights measured as Life Changing Units (LCUs) based on how difficult it is to adjust to each event (Holmes & Rahe, 1967). Another notable consideration is the fact that the SRRS does not distinguish between events that caused life change in a positive or negative direction but bases LCUs solely on the absolute degree of change and adjustment required (Holmes & Rahe, 1967).

The Perceived Stress Scale (PSS) measures the degree to which an individual views situations as stressful which is significant in its acknowledgment of the cognitive appraisal component of the stress reaction (Cohen, Kamarck, & Mermelstein, A Global Measure of Percieved Stress, 1983). The PSS is an empirically established index of appraisal (Cohen, Kamarck, & Mermelstein, A Global Measure of Percieved Stress, 1983). A rich reference base is available for the PSS reaching across gender, socioeconomic status, race and age as well as other demographics (Cohen, Kamarck, & Mermelstein, A Global Measure of Percieved Stress, 1983). Further studies have demonstrated prospective associations between perceived stress measured by the PSS and health outcomes such as contraction of the common cold (Cohen, Kamarck, & Mermelstein, A Global Measure of Percieved Stress, 1983). Some limitations are important with use of the PSS such as an overlap between psychological symptoms and perceived stress as measured by the PSS but this correlation is comparable to the average found between self-report measures of depressive symptomatology (Cohen, Kamarck, & Mermelstein, A Global Measure of Percieved Stress, 1983). Overall the PSS is considered the best index of appraisal and is easily incorporated into varied research

contexts (Cohen, Kamarck, & Mermelstein, A Global Measure of Percieved Stress, 1983).

Anxiety can also be measured with self-report questionnaires like the State-Trait Anxiety Inventory (STAI) and Penn State Worry Questionnaire (PSWQ). The STAI was designed to measure anxiety levels in normal, non-clinical, adult populations (Metzger, 1976). It was created in 1970 under the assumption that state and trait anxiety are different constructs that should each be measured (Zeidner & Matthews, 2004). The STAI has been used to access outcome measures for clinical anxiety interventions, anxiety levels in stress-related disorders, and the effect of anxiety on learning and performance (Zeidner & Matthews, 2004). The STAI has been found to be highly reliable and to have the ability to discriminate between high and low stress situations (Metzger, 1976). The test is versatile and may be self administered, given individually or in groups and has no set time limits (Zeidner & Matthews, 2004). The state measure is given first and followed by the trait measure (Zeidner & Matthews, 2004). Validity for the STAI is reinforced because its measure of state anxiety is highly sensitive to environmental stressors while the measure of trait anxiety remains essentially the same (Zeidner & Matthews, 2004). Internal consistency across normative samples of high school, college, working, and military samples ranges from .89 to .95 for state and .89 to .91 for trait (Zeidner & Matthews, 2004). Test-Retest reliability ranges between .16 and .62 for state and .65 and .86 for trait, which is consistent with the expected ranges for stable trait (Zeidner & Matthews, 2004).

The Penn State Worry Questionnaire (PSWQ) is the most widely used measure of pathological worry after its development in 1990 by Meyer and colleagues (Joos, et al.,

2012). Worry has been shown to be predictive of anxious symptomatology making the PSWQ useful in analysis of anxiety and anxious behaviors (Joos, et al., 2012). It is used to assess the frequency and intensity of worry via a 16-item self-report scale (Joos, et al., 2012). The PSWQ is able to distinguish between GAD patients and those with other anxiety disorders (Joos, et al., 2012). It has been proven reliable in both clinical and non-clinical samples (Startup & Erickson, 2006). Internal consistency reliabilities range from 0.88 to 0.95 (Startup & Erickson, 2006)

Specific biomarkers can also be used to measure stress levels. Research suggests that a combination of self-report measures and objective biomarker measurement may create a more complete picture of psychological stress state (Richardson, Rice, & Devine, 2014). The activation of both the HPA and the SAM under stress can be measured through specific chemical mediators (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). The salivary concentrations of both cortisol and alpha-amylase are used as physiological measures of stress.

HPA activity is related to concentration of corticosteroids, which are produced and secreted by the adrenal cortex at an increased quantity before and after exposure to a stressor, and cortisol is the predominant corticosteroid in human populations (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). The hypothalamus initiates the pathway with corticotropic releasing hormone (CRH), which stimulates the pituitary (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). The pituitary produces ACTH, which produces a response from the adrenal glands to produce corticosteroid release (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). During periods of increased stress more

cortisol is released from the adrenal cortex in a pulsatile fashion; Cortisol concentration displays a natural diurnal rhythm showing a peak around 8:00 AM and a low point around midnight (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). This natural rhythm typically displays 15 or more pulse releases every 24 hours (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). These natural pulses of cortisol allow for everyday activities and facilitate things like waking up. Cortisol can be collected from blood serum, urine, or saliva. Salivary cortisol collection has recently become more prevalent because it can be obtained without inducing new stress from blood collection and is a more acute measure than is urine (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). The flow rate of saliva is insignificant for cortisol measurement because the hormone is small and lipid soluble (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). The correlation between cortisol measures from blood and saliva are high, frequently reaching or exceeding 0.9 (Kirschbaum & Hellhammer, 1989). Salivary cortisol levels are also shown to increase with exposure to physical or psychological stressors making it a useful tool in laboratory measurement (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). Cortisol is especially significant in the relationship between stress and its metabolic effects (Cohen & Kessler, Measuring Stress: A Guide for Health and Social Scientists, 2010). Salivary cortisol is a well-established measure of HPA activity and of acute stress (Vineetha, Pai, Vengal, Gopalakrishna, & Narayanakurup, 2014).

Salivary alpha-amylase (sAA) is known to correlate with plasma concentrations of norepinephrine, an indicator of increased parasympathetic and SAM activity (Kang,

2010). Vineetha et al. found in a study of 50 chronically stressed subjects and 50 non-stressed subjects who were pre-tested for stress by psychometric screening that sAA activity increased in the chronically stressed group compared to the control group suggesting that sAA is a useful biomarker of chronic stress (2014). In a study of 33 college students Kang found that sAA increased in participants following an academic stressor while no change occurred in the control group (2010). Salivary hormones are a fast, non-invasive means of biomarker measurement for psychological stress (Vineetha, Pai, Vengal, Gopalakrishna, & Narayanakurup, 2014).

A multidimensional measurement of stress recognizes both biological and psychological facets of the stress response to better understand the levels of acute and chronic stress in research participants (Kang, 2010). Laurent, Powers and Granger sought to refine the multisystem view of stress by measuring self-report stress, sAA and salivary cortisol in young dating couples to observe the interconnection of these variables concerning the stress response (Laurent, Powers, & Granger, 2013). In both the men and women studied changes in cortisol predicated changes in sAA across the response trajectory. They also found that self-report stress anticipation predicted the cortisol-sAA coordination trajectory (Laurent, Powers, & Granger, 2013). Measuring stress through both self-report psychological measures and biomarkers accounts for both cognitive and physiological processes involved in the complex multidimensional human stress response.

Physical Activity, Physical Fitness, and Body Composition

Physical activity is any movement that requires the expenditure of physical energy while exercise is a subcategory of physical activity that is planned, structured, and purposeful (Caspersen, Powell, & Christenson, 1985). Exercise can be considered purposeful when it has the objective to maintain or enhance physical fitness. Unlike exercise, physical fitness refers to a set of attributes instead of actions or activities. Physical fitness can further be divided into components: cardiovascular, muscular, and flexibility (Caspersen, Powell, & Christenson, 1985). Regular exercise can reduce cardiovascular risk factors by reducing body weight, reducing blood pressure, reducing "bad" cholesterol LDL and increasing "good" cholesterol HDL (Myers, 2003). Exercise also improves aerobic capacity, which allows the body to complete activities with less fatigue (Myers, 2003)

Aerobic fitness describes the ability to take in, transport, and use oxygen to complete metabolic processes (Sharkey & Gaskill, 2007). Aerobic exercises are those that involve rhythmic sustained activation of large muscles such as walking, jogging, swimming, or cycling (Sharkey & Gaskill, 2007). Regular aerobic exercise improves aerobic fitness because the demand created by aerobic exercise increases respiration, circulation and metabolism that leads to adaptations of the systems and muscles recruited for the activity (Sharkey & Gaskill, 2007). Aerobic fitness can be evaluated with a VO2max test, which measures the peak amount of oxygen used in maximal aerobic exercise. The test requires subjects to perform aerobic activity, such as running on a treadmill, at gradually increasing intensity while their oxygen intake is measured (Sharkey & Gaskill, 2007). The test ends when the oxygen intake levels stop increasing

with intensity or when the subject can no longer continue, the maximum volume of oxygen intake is the recorded VO2max score (Sharkey & Gaskill, 2007). Typical scores range between three and four Liters per minute while endurance athletes may have higher scores between five and six liters per minute (Sharkey & Gaskill, 2007). Because it is a measure of volume, VO2max is related to body size and larger people have higher scores. This can be controlled for by dividing the score, initially in Liters per minute of Oxygen, by body mass in kg to get a score referred to as aerobic power (L/kg*min) (Sharkey & Gaskill, 2007). Average aerobic power for men 18-25 is between 42 and 45 milliliters per kilogram minute and women in the same age group average 39 to 41 milliliters per kilogram minute (Sharkey & Gaskill, 2007). Body composition influences aerobic fitness, as body fat increases aerobic fitness declines (Sharkey & Gaskill, 2007).

There are many ways to measure body composition, the three used in this study were Body Mass Index (BMI), waist to hip ratio (WHR), and body fat percentage. BMI evaluates body composition based on measures of height and weight (Sharkey & Gaskill, 2007). The BMI scale has specifically defined normal values within a range to gauge whether a person is under or over weight (Sharkey & Gaskill, 2007). BMI has several limitations in measuring and reporting body compositions especially as a component of physical fitness because it does not account for muscle mass or body type (Sharkey & Gaskill, 2007). In general, however, BMI is considered to be an effective way to broadly predict health risk based on body composition (Sharkey & Gaskill, 2007). WHR is another measure of body composition that is calculated as the circumference of the narrowest part of the waist divided by the circumference of the widest part of the hips (Wells & Fewtrell, 2005). Like BMI, WHR has a defined normal range where overweight

is considered to be a WHR greater than .9 for men or greater than .85 for women (Wells & Fewtrell, 2005). Centralized abdominal fat is considered more dangerous to health outcomes than adiposity that is centralized in other areas such as the hips or thighs (Sallis & Owen, 1999). For this reason WHR is considered an effective measure of health risk since it is closely related to central adiposity. Standardized equations can be used to predict body fat from measurements of skin fold thickness at various standard sites (Brodie, Moscrip, & Hutcheon, 1998). This method can estimate general fatness and the distribution of subcutaneous adipose (Brodie, Moscrip, & Hutcheon, 1998). This measurement technique operates on the assumption that subcutaneous adipose tissue is representative of total body fat (Brodie, Moscrip, & Hutcheon, 1998). When measuring skinfolds the folds are grasped between the thumb and forefinger and calipers are applied and moved in as deep as the skinfold is wide (Sharkey & Gaskill, 2007). In the three-site method of skinfold thickness measurement the measurements are taken at the chest, abdomen, and thigh for men and the triceps, thigh, and suprailiac for women (Sharkey & Gaskill, 2007).

Body composition is closely related to cardiovascular health and its associated risks and is therefore considered an important measure of health and cardiovascular fitness. Death rates begin to rise as BMI scores progress above 30 (Sharkey & Gaskill, 2007). Increases in aerobic fitness are associated with improvements in many health outcomes. It is now thought that overall physical activity levels are more important than the result of physical exercise. People who partake in regular, moderate physical activity receive many of the benefits associated with exercise (Sharkey & Gaskill, 2007). An increase in physical activity provides protection against heart disease, hypertension,

adult-onset diabetes, depression and premature aging (Sharkey & Gaskill, 2007). Physical activity also improves cardiovascular function by increasing fat oxidation, arterial elasticity, cardiac efficiency, the efficiency of systemic blood distribution and return, blood oxygen content, and stress tolerance (Sharkey & Gaskill, 2007). In a study of Harvard alumnae that groups of alumnae with the lowest levels of physical activity had 78.8 cardiovascular deaths per 10,000 participants per year compared to 43.0 deaths for the most active groups, this showed a 46% lower risk of cardiovascular related death for active alumnae (Paffenbarger, Hyde, Wing, & Hsieh, 1986)

Stress and Physical Activity

Exercise has long been suggested to impact psychological outcomes in many ways. Those who exercise are less likely to experience depression, anxiety and cognitive impairment with age (Stults-Kolehmainen & Sinha, 2014). Exercise has also been suggested to reduce negative emotions and stress hormone concentrations (Sallis & Owen, 1999). Regular physical activity is associated with improved emotional well being as well as a decreased risk of mortality (Sharkey & Gaskill, 2007). Multiple pathways have been suggested through which exercise might moderate stress and anxiety. Some of these suggested pathways are the creation of increased feelings of control, providing a distraction from stress, the creation of greater resilience to stress, as well as biochemical pathways like reducing stress hormones or the release of endorphins induced by physical activity (Sallis & Owen, 1999).

Childs and DeWit proposed a mechanism of creating resilience or resistance to stress by regularly activating the body's natural stress systems with physical activity

(Childs & De Wit, 2014). They suggested that regular, intentional activation of stress systems might cause beneficial adaptation to allow the body to respond more effectively to acute stress (Childs & De Wit, 2014). In the study they measured heart rate, blood pressure, and cortisol levels of participants who were categorized by their self-reported activity levels as either regular exercisers or sedentary (Childs & De Wit, 2014). They found that during stress heart rate was significantly lower among regularly exercisers and that participant's emotional responses to tasks differed by group (Childs & De Wit, 2014). Regular exercisers exhibited a smaller decline in positive affect after stress than participants in the sedentary group, which suggested that individuals who exercise regularly might be more resistant to acute stress (Childs & De Wit, 2014).

The effect of stress on physical activity and physical fitness cannot be examined without considering the determinants of physical activity and fitness. Da Silva hypothesized a bidirectional relationship between stress and fitness (Da Silva, et al., 2012). In a study controlled physical activity was associated with a reduced likelihood of depressive symptoms, but a converse analysis showed that exposure to anxious or depressive symptoms was associated with an increased probability that participants would not meet the recommended levels of physical activity at a follow up visit (Da Silva, et al., 2012).

A novel study in 2014 by Stults-Kolehmainen & Sinha sought to investigate the influence of stress on indicators of physical activity and exercise through a comprehensive review of the existing literature on the subject. 168 studies were collected from their search which varied in the stress constructs they measured include perceived stress, distress, life events, job strain, role strain, and work-family conflict but none

included a measure of cumulative lifetime adversity. The purpose of their study was to amass the pertinent literature on the topic of stress and physical activity and identify factors that might moderate that relationship. The majority (76.4%) of these studies indicated that psychological stress was associated with less physical activity and/or exercise; these inverse relationships appeared to be stronger in studies that focused on populations of adults over the age of 50. Some studies, however, showed a positive relationship between stress and physical activity, which was cited as indication that for some populations exercise is a commonly practiced coping mechanism for dealing with psychological stress. Previous explorations of this relationship have focused on improving psychological outcomes with exercise. Examining the relationship from the opposite direction seeks to understand whether stress is detrimental towards the adoption and maintenance of exercise behaviors. It is important to examine this relationship from both directions because of the bi-directional nature of the relationship that likely exists. This review included studies which found that stress could account for a substantial proportion of variance in collective health behaviors. Lutz et al. found that the relationship was stronger from the perspective of the effects of stress on physical activity and exercise, which is less often studied (Lutz, Lochbaum, & Lanning, 2007). Of the studies included in this review only 2 included biological measures of stress one which measured salivary cortisol and one which measured urinary catecholamines and only 2 included an activity measure of pedometer readings as opposed to self-reported activity measures or activity journals (Stults-Kolehmainen & Sinha, 2014).

The purpose of this study was to examine the relationship of stress and anxiety with physical activity and physical fitness. Because of the complex, multidimensional

nature of psychological variables they were measured both through participant responses to tested psychological self-report measures as well as through the salivary concentration of the stress hormone cortisol. Physical fitness was measured both as a function of body composition as BMI, WHR, overall weight, and body composition as well as through the estimation of VO2Max. Lastly, physical activity was measured both directly through the use of FitBit personal activity monitors and indirectly through participant responses to various standard activity questionnaires. By measuring stress, fitness and activity in multiple ways this study hoped to broadly examine the relationship between psychological factors and physical fitness and activity and to test the hypotheses that higher levels of psychological stress and anxiety are associated with lower levels of fitness and lower levels of physical activity.

CHAPTER III: Methods

Recruitment

25 participants were recruited, ages 21 to 45 with a range of physical activity and stress levels. A baseline medical history was gathered from participants by interview to record their demographics (gender and race); medication history (including prescriptions, over the counter medication and dietary supplements); any medical issues, specifically any history of pulmonary, cardiovascular, metabolic, autoimmune or malignant disease; Family history of allergic, autoimmune, or malignant disease; and physical activity history (typical time and type of physical activity each week). Participants were recruited by flyers posted on approved boards within a 25-mile radius of UMMC and by advertisements on the UMMC webpage, with local running clubs, on craigslist and on social media platforms (Facebook, Twitter, blogs). The flyer contained a brief description of the study and contact information. Participants were screened using the screening form; ineligible participant's screening forms were shredded within one week. Eligible participants were instructed to wear loose-fitting athletic clothing and athletic shoes to their scheduled study visits.

Inclusion/exclusion criteria

In order to participate in the study participants were required to meet the following criteria:

1. Between the ages of 18 and 45
2. Generally healthy for his/her age and not taking medication that could affect stress responses or immune parameters
3. No history of hematologic, autoimmune, malignant, metabolic, or cardiovascular disease
4. No history of defined sleep disturbance
5. Any allergic disease must be well controlled with topical medications and/or antihistamines and no systemic immunosuppressive for previous 30 days

Participants were excluded if any of the following were true:

1. Any history of psychological of psychiatric illness that may limit participant cooperation or compromise the integrity of self-reported clinical or psychological data
2. Taking or have taken medication (prescription or supplements) within the past 30 days that is likely to affect immune profiles
3. Presence of an underlying systemic illness which could interfere with immunological profiles
4. Pregnant women

Study Design

Data was collected in three distinct categories: health/fitness, psychosocial, and immune. The immune measures were not used for the purposes of this project. Samples were collected at the UMMC Allergy and Immunology Clinic or the UMMC Laboratory of Behavioral Immunology Research. Data were collected over the course of 7 days including two visits to the study site. At the first visit, participants were given an activity monitor (FitBit) to wear on their wrist for 7-8 days. At the second visit, which occurred 7-8 days after the first, participants returned the activity monitor and participated in data collection. Collection included anthropomorphic measurements; saliva collection; blood collection; answering of short questionnaires about their fitness and psychological stress levels; and a 6-minute walk test to determine exercise capacity. The methods used for data collection are outlined below.

Anthropomorphic: Each participant's height, weight, waist circumference, and hip circumference was measured and recorded. Height and weight were measured with a measuring tape and digital scale and were used to calculate participant BMI. Waist and hip circumference were measured using a measuring tape and were used to calculate a waist-to-hip ratio.

Body composition: Body fat percentage was measured using calipers to measure the thickness of skinfolds at standardized sites: chest, abdomen and thigh for men; triceps, suprailiac, and thigh for women. All measurements were taken on the right side of the body. To measure thickness, skinfolds were grasped between the thumb and index finger and pulled away from the participants body, calipers were then placed perpendicular to

the skinfold and pressure was released from the grip, measurement from the calipers was then recorded. Body density was calculated using the following equations:

Men:

$$Density = 1.097 - 0.0008267(sum\ of\ all\ 3\ skin\ folds) + 0.0000016(sum\ of\ all\ 3\ skin\ folds)^2 - 0.000244(age)$$

Women:

$$Density = 1.099421 - 0.0009929(sum\ of\ all\ 3\ skin\ folds) + 0.0000023\ (sum\ of\ all\ 3\ skin\ folds)^2 - 0.0001392\ (age)$$

Body density was then converted to body fat using the following equation:

$$\%Body\ Fat = \frac{457}{Density - 414.2}$$

Exercise Capacity: The 6-min walk test was used to measure participant exercise capacity. Participants walked on a flat surface in a thermo-neutral environment and were instructed to walk as far as they could in 6 minutes. The total distance walked was used as a measure of exercise capacity.

Self-Report fitness questionnaires: Cardiovascular fitness (VO2max) was estimated from participant's responses to the Physical Activity Rating (PA-R) and Perceived Functional Ability (PFA) questionnaires. Scores from both the PA-R and PFA can be used to estimate VO2max using the following equation

$$VO2\ \max\left(\frac{ml}{kg/_{min}}\right) = 48.0730 + (6.179 \times Gender; women = 0, men = 1) - (0.2463 \times age) - (0.6186 \times BMI) + (0.7115 \times PFA) + (0.6709 \times PA - R)$$

The short form of the International Physical Activity Questionnaire (IPAQ) was also used to determine the training load of each participant over the previous 7 seven days in metabolic equivalents (MET)-min/week. Several sub scores can be obtained from the IPAQ short form, walking is measured with the IPAQ-Walk subscore (3.3 METs), moderate intensity activities (4.0 METs) are represented with the IPAQ-Mod sub score and vigorous activity (8.0 METs) is measured with the IPAQ-Vig sub score, the sum of these three sub scores yields the measure IPAQ-Total. Amount of time spent sitting is also recorded with the score IPAQ-Sit. IPAQ scores were also reported categorically (IPAQ-Cat) in three groups: High (IPAQCat = 3), moderate (2) or low (1). The high group is defined as individuals with vigorous activity on at least 3 occasions summing to a minimum of 1500 MET-minutes/week or 7 or more days of any combination of activity with a total of at least 3000 MET-minutes/week. The moderate category is defined as 3 or more days of vigorous activity for at least 20 minutes per day or 5 or more days of moderate activity or walking for at least 30 minutes per day. The low category includes scores that do not fall into either of the other two categories.

Activity Monitors: Each participant was given a physical activity monitor to directly measure physical activity. The device (FitBit) was worn around the wrist between the first and second study visits to determine the number of steps the participant takes per day. Participants were instructed to wear the FitBit 24 hours a day. The FitBit measured number of steps taken, distance covered, and number of active minutes each day. The active minutes are further divided into categories based on the estimated metabolic equivalents (METs) of the activity. Activities that use 6 or more METs are categorized as "very active minutes" those that use between 3 and 6 METs are categorized as "fairly

active minutes" and those which use between 1 and 3 METs are categorized as "lightly active minutes". Sedentary minutes were calculated by subtracting the sum of all active minutes each day from the total number of minutes in a day. The usefulness of personal activity monitors to measure activity levels has recently been studied widely (Stackpool, Porcari, Mikat, Gillette, & Foster, 2014) , (Takacks, Pollock, Guenther, Bahar, Napier, & Hunt, 2014), (Lee, Kim, & Welk, Validtity of Consumer-Based Physical Activity Monitors, 2014).

Saliva Collection: Saliva was collected using the Salimetrics Oral Swab. The participants held the swap under the front of their tongue for three minutes and the swab was then placed in a Salimetrics Swab storage tube. Salivary cortisol was measured in each sample using an ELISA kit according to directions provided by the manufacturer.

Social Readjustment Rating Scale (SRRS): The SRRS is used to measure chronic stress. It provides a measure of the impact of a wide variety of stressors that commonly occur. The participant is asked to circle events they have experienced in the last 12 months from a list of 43 choices. The scale is based on the assumption that changes, whether positive or negative, create some degree of stress. Each event is assigned a value in "life changing units" which implies the amount of stress it likely to cause. The score is determined by adding together all of the "life changing units" for events that have occurred in the past 12 months.

The Perceived Stress Scale (PSS): is an assessment of the degree to which situations are considered to be stressful. Participants rate house often they have felt or thought a certain way over the past month. Participants assigned values to each item from 0 (never) to 5 (very often).

The State-Trait Anxiety Inventory (STAI): The STAI assesses an individual's level of both trait and state anxiety. It consists of 40 items that the subject rates on a 4 point Likert scale (1 = not at all 4 = very much so).

Penn State Worry Questionnaire (PSWQ): Participants ranked 16 items from 1 (not at all typical of me) to 5 (very typical of me). Scores are summed at range from 16-80. The PSWQ measures generality, excessiveness, and uncontrollability of worry. The PSWQ shows good internal consistency ($\alpha = .93$).

Statistical Analyses

Treatment of missing observations: Every measure was not recorded for every participant in this study and therefore for measures that were used in data analysis that were missing observations linear regression models were used to predict the missing values based upon known correlates. A missing PA-R score was replaced with a value predicted by the linear regression model of the measures PFA, IPAQ-Vig, IPAQ-Mod and IPAQ-Total and the measure in question, PA-R. A missing value for the measure Steps per day was replaced with the value predicted by a linear regression model of the variable IPAQ-Total and the measure in question, Steps per day. A missing observation for the variable IPAQ-Sit was replaced with a value predicted by a linear regression model of the measures PFA, IPAQ-Total and Steps per day along with the measure in question, IPAQ-Sit. Missing observations for the variable very active minutes were replaced with the value predicted by a linear regression model between the measures IPAQ-Total and IPAQ-Vig, and very active minutes, fairly active minutes were modeled with IPAQ-Total, IPAQ-Mod, IPAQ-Walk and fairly active minutes, and lightly active minutes were modeled

with IPAQ-Total, IPAQ-Walk and lightly active minutes. The missing value for distance was replaced with a value predicted by the linear regression model between Steps per day and distance. In the analyses concerning cortisol and estimated VO2Max the subject missing both measurements was ignored from analysis (n=24).

Correlational Analysis: Calculation of Pearson's correlation (r) was performed between each stress or anxiety measure (PSS, STAI-T, STAI-S, Cortisol, SRRS, PSWQ) and each fitness and activity measure (LBM, BC, FM, BMI, WHR, Steps per day, PFA, PA-R, IPAQ-Total, estimated VO2Max, Weight, very active minutes, fairly active minutes, lightly active minutes, sedentary minutes, distance, IPAQ-Vig, IPAQ-Sit, IPAQ-Walk, calories and IPAQ-Mod). For each analysis both a slope (r) and significance (p) were reported. Because of the small sample size in this study p values that were less than 0.10 were considered significant when assessing the relationships between stress measures and measures of physical activity and physical fitness with p values less than .05 considered to be highly significant.

CHAPTER IV: Results

Participant Characteristics

Anthropomorphic/ physical fitness: The participants ranged from 21 to 45 years of age (mean= 30.92, median=31). Of the 25 participants 12 were female and 13 were male. Two participants identified themselves as Asian and two participants identified themselves as African-American or black, the remaining 21 participants identified themselves as white or Caucasian. Mean (SD) height was 64.14 (2.35) inches for women and 70.5 (2.0) inches for men. Mean BMI (SD) was 26.49 (8.00) for women and 27.91 (4.44) for men. Mean WHR was 0.797 (.085) for women and 0.84 (0.065) for men. The mean Estimated VO2 Max was 39.64 (10.044). Percent body fat had a mean value of 29.35 (7.51)% for women and 19.2 (6.48)% for men. Anthropomorphic and fitness data is summarized in Table 1.

Physical Activity: The mean number of participant steps per day was 9,340.7 (2562.7). Self report PFA scores ranged from 3 to 24 (mean= 14.16, SD= 5.77) and PA-R scores from 1 to 9 (4.08, 1.85). Of the 25 subjects 10 placed in the high IPAQ category, 10 in the moderate IPAQ category and 5 in the low IPAQ category. Self reported physical activity data can be found summarized in Table 3 and physical activity data from the activity monitors is summarized in Table 4.

Stress/ anxiety: The mean measured cortisol level was 0.332 (0.228). PSS scores ranged from 2 to 25 (13.64, 5.52) and PSWQ scores ranged from 20 to 65 (41.84, 14.29). SRRS scores ranged from 25 to 403 (175, 103.22). STAI-S scores had a range from 21 to 65

(35.16, 10.25) and STAI-T scores ranged from 21 to 49 (34.76, 8.709). Stress and anxiety data is summarized in Table 2.

Relationships between stress measures and both physical activity and physical fitness

Significant associations were found between multiple measures of stress and measures of both physical activity and physical fitness. Cortisol was found to be inversely associated with LBM (r=-0.367, p=0.078); BMI (r=-0.421, p=0.040); WHR (r=-0.452, p= 0.027); and overall weight (r=-0.368, p=0.033). SRRS score was found to be inversely associated with number of steps per day (r=-0.368, p=0.077) and positively associated with sedentary minutes (r=0.398, p=0.054).

Relationship between anxiety measures and both physical activity and physical fitness

STAI-T scores were inversely associated with IPAQ-Sit (r=-0.440, p=0.028) and IPAQ-Mod scores (r=-0.362, p=0.076). STAI-S scores also showed significant inverse association with IPAQ-Sit (r=-0.418, p=0.076) and IPAQ-Mod scores (r=-0.489, p=0.013). PSWQ scores showed significant associations with PFA score (r=-0.429, p=0.036), IPAQ-Mod score (r=-0.466, p=0.019) and estimated VO2 Max (r=-0.359, p= 0.085). Correlational statistics for all variables are reported in Table 5.

CHAPTER V: Discussion

There is much room to improve our understanding of the relationships between psychological stress, physical fitness and physical activity. This study sought to examine those relationships through the collection and analysis of multiple measures in all three categories. Much of the work done in this field seeks to understand how physical activity, exercise, or overall physical fitness might affect psychological stress, in this study we sought to make connections from the other direction to understand how psychological stress might affect one's fitness or levels of physical activity.

Two of the three stress measures showed significant relationships with measures of physical activity and fitness. The physiological measure of stress, salivary cortisol, was inversely associated with multiple anthropomorphic measures: higher cortisol levels were associated with a lower WHR, BMI and overall weight as well as less lean body mass the metabolic pathways through which cortisol acts in the short term to quickly create useable energy from stored fat can explain this inverse relationship because of the acute nature of the measurement of stress with salivary cortisol. Higher scores of the SRRS were associated inversely with activity as recorded by the activity monitors in the form of fewer steps per day, and positively associated with the number of minutes spent sedentary.

Measures of anxiety and worry were associated with both physical fitness and activity. Higher scores for both state and trait anxiety were associated with lower IPAQ-

Mod sub scores but also with lower IPAQ-Sit sub scores. Higher scores on the PSWQ were associated with lower PFA scores, lower IPAQ-Mod scores and lower estimated VO2 Max.

These results were consistent with hypothesis 1 that those with higher levels of psychological anxiety exhibit lower levels of fitness on the basis of estimated VO2Max but no significant association was found between levels of psychological stress and estimated VO2Max and higher levels of salivary cortisol were actually associated with a lower BMI and WHR. Results are consistent, as well, with hypothesis 2 that those with higher levels of psychological stress or anxiety are likely to engage in less physical activity. Higher levels of psychological stress were associated with lower levels of physical activity as recorded by the activity monitor but not with self report measures of activity, higher levels of anxiety were associated with lower self reported physical activity scores but not with physical activity as recorded by the activity monitor.

It is relevant to note that the correlational analysis here could have been affected by the methods used to replace missing values in the data sets. Measures of correlation and significance were also likely affected by the small sample size here, which could be reconciled by increasing the sample size in further research.

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APPENDICES

APPENDIX I: Data Dictionary

	Participant ID
Age	age, years
Gender	0=male, 1=female
Race	1=asian, 2=black, 3=white, 4=hispanic, 5=more than 1 race, 6=other
Height	Height, in
Weight	Weight, lbs
BMI	Body Mass Index, kg/m2
Waist	Waist circumference, cm
Hips	Hip circumference, cm
WHR	Waist to hip ratio
BC	Body Composition (% fat)
LBM	Lean body mass, lbs
FM	Fat mass, lbs
Stepperday	Avg steps walked per day
VActMin	Very Active Minutes/day (>6 METs)
FActMin	Fairly Active Minutes/day (3-6 METs)
LActMin	Lightly Active Minutes/day (<3 METs)
SedMin	Sedentary Minutes/day
Distance	Distance (miles)/day
Calories	Calories burned/day
PSS	Perceived Stress Scale
STAI-S	State-Trait Anxiety Inventory - State
STAI-T	State-Trait Anxiety Inventory - Trait
PSWQ	Penn State Worry Questionnaire
SRRS	Social Readjustment Rating Scale
PFA	Perceived Functional Ability
PAR	Physical Activity Rating
IPAQ-Vig	Vigorous Intensity, MET-min/wk
IPAQ-Mod	Moderate Intensity, MET-min/wk
IPAQ-Walk	Walking, MET-min/wk
IPAQ-Tot	Total IPAQ score, MET-min/wk
IPAQ-Cat	1=Low, 2=Moderate, 3=High
IPAQ-Sit	time spent sitting, h/weekday
EstVO2M	Estimated VO2max
Cortisol	Cortisol (ug/dl)

APPENDIX II: Tables and Figures

	Weight	Height	BMI	WHR	BC	FM	LBM	Estimated VO2 Max
Maximum	260	73.5	43.5	0.968	43.7	201.5	107.4	56.12
Mean	176.74	67.45	27.228	0.82012	24.0736	133.156	43.596	39.46
SD	44.168	3.878	6.305	0.0770	8.582	32.376	22.067	10.22
Median	179	68	25.7	0.819	22.9	135.8	38.3	41.7

Table 1. Summary of Anthropomorphic/fitness measures

	PSS	STAI-T	STAI-S	PSWQ	SRRS	Cortisol
Minimum	2	21	21	20	25	0.057
Maximum	25	65	49	65	403	1.046
Mean	13.640	35.160	34.760	41.840	175.000	0.332
SD	5.522	10.254	8.710	14.288	103.228	0.233
Median	14	34	35	39	155	0.306

Table 2. Summary of stress and anxiety measures

	Step/day	Very Active Minutes	Fairly active minutes	Lightly active minutes	Sedentary minutes	Distance	Calories
Minimum	6327	2.3	68	121	1017	2.5	1817
Maximum	16623	52	175	274	1230	8.1	4183
Mean	9340.727	18.304	109.800	185.560	1129.280	4.203	2543.920
SD	2562.789	11.330	30.170	41.378	63.782	1.304	539.664
Median	8985	15.3	105	184	1140	4.1	2484

Table 3. Summary of physical activity from FitBit

	PFA	PA-R	IPAQ-Vig	IPAQ-Mod	IPAQ-Walk	IPAQ-Total	IPAQ-Sit
Minimum	3	1	0	0	0	20	1.5
Maximum	24	9	4320	1200	3564	4815	12
Mean	14.160	4.080	758.400	243.200	858.920	1860.52	6.370
SD	5.771	1.847	963.568	304.449	881.570	1247.807306	2.940
Median	16	4	720	120	495	1588	6

Table 4. Summary of self-report physical activity

	PSS		STAI-T		STAI-S		Cortisol		SRRS		PSWQ	
	r	p	r	p	r	p	r	p	r	p	r	p
LBM	-0.118	0.575	-0.225	0.279	-0.173	0.408	-0.367	0.078	0.077	0.716	-0.162	0.439
BC	0.208	0.319	0.201	0.336	0.216	0.300	-0.105	0.624	0.170	0.416	0.257	0.215
FM	0.126	0.548	0.124	0.554	0.132	0.530	-0.337	0.107	0.143	0.497	0.182	0.383
BMI	0.079	0.708	0.064	0.761	0.104	0.622	-0.421	0.040	0.106	0.613	0.129	0.540
WHR	-0.046	0.827	0.066	0.752	-0.059	0.779	-0.452	0.027	-0.170	0.415	-0.027	0.900
Steps per day	-0.022	0.919	0.113	0.590	0.000	1.000	-0.214	0.316	-0.364	0.074	0.042	0.842
PFA	-0.176	0.400	-0.332	0.105	-0.258	0.213	0.117	0.587	-0.003	0.987	-0.429	0.032
PA-R	-0.254	0.220	-0.240	0.248	-0.302	0.142	0.008	0.972	-0.139	0.508	-0.232	0.265
IPAQ-Total	-0.259	0.211	-0.165	0.430	-0.303	0.141	-0.064	0.766	-0.066	0.753	-0.188	0.368
Estimated VO2M	-0.190	0.373	-0.290	0.169	-0.240	0.259	0.197	0.357	-0.088	0.682	-0.359	0.085
Weight	-0.023	0.913	-0.103	0.625	-0.061	0.773	-0.435	0.033	0.127	0.544	-0.028	0.895
Very active minutes	-0.012	0.953	-0.013	0.949	0.007	0.973	-0.033	0.879	-0.239	0.250	-0.056	0.790
Fairly active minutes	0.038	0.858	0.178	0.394	0.000	1.000	-0.282	0.183	-0.294	0.153	0.157	0.454
Lightly active minutes	-0.017	0.937	0.307	0.136	0.077	0.714	-0.246	0.246	-0.298	0.148	0.313	0.128
Sedentary minutes	-0.003	0.989	-0.274	0.185	-0.057	0.787	0.281	0.184	0.348	0.088	-0.267	0.198
Distance	-0.049	0.815	0.020	0.924	-0.051	0.808	-0.236	0.267	-0.304	0.139	-0.022	0.918
IPAQ-Vig	-0.041	0.844	0.024	0.910	-0.094	0.654	0.145	0.500	-0.146	0.485	-0.176	0.401
IPAQ-Sit	-0.259	0.211	-0.440	0.028	-0.418	0.038	-0.221	0.300	0.199	0.339	-0.263	0.204
IPAQ Category	-0.348	0.088	-0.199	0.340	-0.409	0.043	-0.126	0.559	-0.249	0.230	-0.257	0.216
IPAQ-Walk	-0.229	0.271	-0.135	0.520	-0.157	0.453	-0.300	0.154	0.061	0.771	0.086	0.681
Calories	0.016	0.940	-0.059	0.778	-0.023	0.913	-0.343	0.101	-0.008	0.970	0.007	0.973
IPAQ-Mod	-0.268	0.194	-0.362	0.076	-0.489	0.013	-0.034	0.876	0.015	0.944	-0.466	0.019

Table 5. Correlations between stress measures and measures of physical activity and physical fitness

ID	Age	Gender	Race	Height	Weight	BMI	Waist	Hips	WHR	BC	LBM	FM	Step/day	VActMin	FActMin
CR021	41	0	3	69.5	228	33.2	109	117	0.932	26.6	167.4	60.6	11272	11.7	168
CR022	27	1	3	65.5	140.8	23.1	67	99	0.677	28.3	101	39.8	6550	17	91
CR023	41	0	3	68	207	31.5	105	108.5	0.968	28.8	147.4	59.6			
CR024	45	1	3	66	184.6	29.8	92.5	109.5	0.845	32.5	124.6	60	7655	11.7	94
CR025	29	1	3	63	196	34.7	105.5	112	0.942	32.8	132	64	7173	11.5	89
CR026	28	0	3	70	161.5	23.2	76.5	101.5	0.754	9.1	146.9	14.7	13191	32	144
CR027	24	0	3	73.5	224.8	29.7	94	111.5	0.843	22.9	173.3	51.5	8985	23	99
CR028	34	1	2	61.5	198.8	37	103	117	0.88	41.3	117	82	6699	8	82
CR029	31	0	1	69	230	34	94	120	0.783	26.1	170	60	9586	15	122
CR030	29	0	3	72.5	188.2	25.2	88	106	0.83	17.2	155.8	32.4	7490	15.3	88
CR031	28	0	3	70	179	25.7	83	103.5	0.802	15.2	151.8	27.2	6484	13	76
CR032	26	0	1	70	140	20.7	68.5	89.5	0.765	7.5	129.5	10.5	10983	23	143
CR033	44	1	2	63	245.8	43.5	115	130	0.885	43.7	138.4	107.4	8313	9	108
CR034	25	0	3	70	199.4	28.6	88	108	0.815	19.1	161.3	38.1	11388	30	
CR035	32	0	3	73.5	222.4	29.3	95	109	0.872	21.3	175	47.4	10505	20	128
CR036	34	1	3	65.5	124.4	20.4	74	96	0.771	25	93.3	31.1	6763	4.8	85
CR037	31	0	3	67	167	26.2	86.5	99	0.874	18.7	135.8	31.2	6668	9	88
CR038	34	1	3	63.5	116.2	20.3	73	87	0.839	25.6	86.5	29.7	12327	18.8	147
CR039	31	1	3	68.25	142.4	21.5	73.5	96	0.766	22.4	110.5	31.9	7626	14	86
CR040	34	1	3	62	104.2	19.1	68	83	0.819	20.4	82.9	21.3	11481	24	126
CR041	24	1	3	60	124.6	24.3	72	97.5	0.738	30.74	86.3	38.3	6327	14.5	68
CR042	21	0	3	72	260	33.4	108	120	0.9	22.5	201.5	58.5	16623	52	175
CR043	24	1	3	65.5	117.4	19.2	62	91	0.681	20.1	93.8	23.6	10963	42.7	72
CR044	24	1	3	66	155	25	76	105.5	0.72	29.4	109.4	45.6	9582	20	109
CR045	32	0	3	71.5	161	22.1	77	96	0.802	14.6	137.5	23.5	10009	2.3	147

Table 6. Raw data

ID	SedMin	Dist	Calories	PSS	STAI-S	STAI-T	PSWQ	SRRS	PFA	PAR	LActMin
CR021	1043	5.2	3212	21	34	34	31	272	14	3	218
CR022	1155	2.8	2094	15	35	36	62	259	10	3	177
CR023				2	21	30	34	54	4	2	
CR024	1165	3.3	2228	12	22	24	22	319	11	3	184
CR025	1203	3	2285	16	41	38	49	62	9	3	172
CR026	1075	6.3	2663	5	23	22	25	96	24	9	189
CR027	1176	4.4	3102	11	22	23	23	200	20	5	142
CR028	1163	2.7	2207	10	30	30	43	283	6	3	187
CR029	1140	4.4	3033	17	36	38	53	155	7	3	164
CR030	1186	3.6	2723	5	24	21	20	78	17	2	150
CR031	1230	3	2518	9	28	27	29	316	20	6	121
CR032	1139	5.1	2574	14	36	39	37	78	23	5	135
CR033	1083	3.4	2718	17	51	49	60	129	3	1	240
CR034		5.3	3035	14	41	35	33	198	18	4	
CR035	1129	5	3140	12	34	33	39	403	21	5	164
CR036	1148	2.9	1828	20	42	28	30	155	12	3	202
CR037	1200	3.1	2393	19	40	39	54	108	17	5	143
CR038	1023	5.1	2091	11	30	41	43	40	16	7	270
CR039	1151	3.4	2109	17	34	48	42	237	12	3	190
CR040	1036	4.6	1905	16	42	48	56	25	16	5	254
CR041	1222	2.5	1817	25	65	49	63	300	10	2	135
CR042	1023	8.1	4183	21	49	44	63	70	16	5	191
CR043	1169	5.1	2132	13	32	29	33	197	20	7	156
CR044	1099	4.1	2329	8	28	26	37	137	16	4	213
CR045	1017	4.7	2795	11	39	38	65	204	12		274

Table 6. (continued)

ID	IPAQ-Vig	IPAQ-Mod	IPAQ-Walk	IPAQ-Tot	IPAQ-Cat	IPAQ-Sit	EstVO2M	Cortisol
CR021	1440	720	792	2952	3	7.75	35.6	0.109
CR022	1200	0	66	1266	2	8	36.3	0.566
CR023	0	480	729	1209	2	10	28.9	0.134
CR024	0	400	1188	1588	2	6	28.4	0.136
CR025	0	0	2079	2079	2	7	27.9	0.211
CR026	960	600	396	1956	3	6	56.1	0.164
CR027	960	1200	1188	3348	3	10	47.6	0.505
CR028	0	0	1188	1188	1	12	23.1	0.144
CR029	0	240	693	933	2	11	32.6	0.352
CR030	1080	560	247.5	1887.5	3	10	45.0	0.138
CR031	1200	0	2772	3972	3	5	49.7	0.328
CR032	4320	0	495	4815	3	4	54.8	0.4
CR033	0	40	33	73	1	3	13.1	0.138
CR034	1080	40	297	1417	2	7	45.9	0.332
CR035	1440	480	198	2118	2	8	46.5	0.686
CR036	0	0	198	198	1	5	37.6	0.284
CR037	480	160	0	640	1	10	45.8	0.191
CR038	1200	120	462	1782	3	1.5	43.2	0.423
CR039	0	300	462	762	2	6	37.7	0.604
CR040	1920	480	1039.5	3439.5	3	2	42.6	0.493
CR041	0	0	20	20	1		35.6	1.046
CR042	720	120	1386	2226	3	4	43.2	0.057
CR043	960	0	495	1455	2	3.5	49.2	0.373
CR044	0	20	1485	1505	2	5	40.8	0.144
CR045	0	120	3564	3684	3	4		

Table 6. (continued)

ID	Age	Gender	Race	Height	Weight	BMI	Waist	Hips	WHR	BC	LBM	FM	Step/day	VActMin	FActMin
CR021	41	0	3	69.5	228	33.2	109	117	0.932	26.6	167.4	60.6	11272	11.7	168
CR022	27	1	3	65.5	140.8	23.1	67	99	0.677	28.3	101	39.8	6550	17	91
CR023	41	0	3	68	207	31.5	105	108.5	0.968	28.8	147.4	59.6	8875.	15.3	105
CR024	45	1	3	66	184.6	29.8	92.5	109.5	0.845	32.5	124.6	60	7655	11.7	94
CR025	29	1	3	63	196	34.7	105.5	112	0.942	32.8	132	64	7173	11.5	89
CR026	28	0	3	70	161.5	23.2	76.5	101.5	0.754	9.1	146.9	14.7	13191	32	144
CR027	24	0	3	73.5	224.8	29.7	94	111.5	0.843	22.9	173.3	51.5	8985	23	99
CR028	34	1	2	61.5	198.8	37	103	117	0.88	41.3	117	82	6699	8	82
CR029	31	0	1	69	230	34	94	120	0.783	26.1	170	60	9586	15	122
CR030	29	0	3	72.5	188.2	25.2	88	106	0.83	17.2	155.8	32.4	7490	15.3	88
CR031	28	0	3	70	179	25.7	83	103.5	0.802	15.2	151.8	27.2	6484	13	76
CR032	26	0	1	70	140	20.7	68.5	89.5	0.765	7.5	129.5	10.5	10983	23	143
CR033	44	1	2	63	245.8	43.5	115	130	0.885	43.7	138.4	107.4	8313	9	108
CR034	25	0	3	70	199.4	28.6	88	108	0.815	19.1	161.3	38.1	11388	30	105
CR035	32	0	3	73.5	222.4	29.3	95	109	0.872	21.3	175	47.4	10505	20	128
CR036	34	1	3	65.5	124.4	20.4	74	96	0.771	25	93.3	31.1	6763	4.8	85
CR037	31	0	3	67	167	26.2	86.5	99	0.874	18.7	135.8	31.2	6668	9	88
CR038	34	1	3	63.5	116.2	20.3	73	87	0.839	25.6	86.5	29.7	12327	18.8	147
CR039	31	1	3	68.25	142.4	21.5	73.5	96	0.766	22.4	110.5	31.9	7626	14	86
CR040	34	1	3	62	104.2	19.1	68	83	0.819	20.4	82.9	21.3	11481	24	126
CR041	24	1	3	60	124.6	24.3	72	97.5	0.738	30.74	86.3	38.3	6327	14.5	68
CR042	21	0	3	72	260	33.4	108	120	0.9	22.5	201.5	58.5	16623	52	175
CR043	24	1	3	65.5	117.4	19.2	62	91	0.681	20.1	93.8	23.6	10963	42.7	72
CR044	24	1	3	66	155	25	76	105.5	0.72	29.4	109.4	45.6	9582	20	109
CR045	32	0	3	71.5	161	22.1	77	96	0.802	14.6	137.5	23.5	10009	2.3	147

Table 7. Data with missing values replaced

ID	Lightly Active Minutes	Sedentary Minutes	Distance	Calories	PSS	STAI-S	STAI-T	PSWQ	SRRS	PFA	PAR
CR021	218	1043	5.2	3212	21	34	34	31	272	14	3
CR022	177	1155	2.8	2094	15	35	36	62	259	10	3
CR023	188	1132	3.97	2484	2	21	30	34	54	4	2
CR024	184	1165	3.3	2228	12	22	24	22	319	11	3
CR025	172	1203	3	2285	16	41	38	49	62	9	3
CR026	189	1075	6.3	2663	5	23	22	25	96	24	9
CR027	142	1176	4.4	3102	11	22	23	23	200	20	5
CR028	187	1163	2.7	2207	10	30	30	43	283	6	3
CR029	164	1140	4.4	3033	17	36	38	53	155	7	3
CR030	150	1186	3.6	2723	5	24	21	20	78	17	2
CR031	121	1230	3	2518	9	28	27	29	316	20	6
CR032	135	1139	5.1	2574	14	36	39	37	78	23	5
CR033	240	1083	3.4	2718	17	51	49	60	129	3	1
CR034	180	1125	5.3	3035	14	41	35	33	198	18	4
CR035	164	1129	5	3140	12	34	33	39	403	21	5
CR036	202	1148	2.9	1828	20	42	28	30	155	12	3
CR037	143	1200	3.1	2393	19	40	39	54	108	17	5
CR038	270	1023	5.1	2091	11	30	41	43	40	16	7
CR039	190	1151	3.4	2109	17	34	48	42	237	12	3
CR040	254	1036	4.6	1905	16	42	48	56	25	16	5
CR041	135	1222	2.5	1817	25	65	49	63	300	10	2
CR042	191	1023	8.1	4183	21	49	44	63	70	16	5
CR043	156	1169	5.1	2132	13	32	29	33	197	20	7
CR044	213	1099	4.1	2329	8	28	26	37	137	16	4
CR045	274	1017	4.7	2795	11	39	38	65	204	12	4

Table 7. (continued)

ID	IPAQ-Vig	IPAQ-Mod	IPAQ-Walk	IPAQ-Total	IPAQ Category	IPAQ-Sit	Estimated VO2Max	Salivary Cortisol
CR021	1440	720	792	2952	3	7.75	35.58878	0.109
CR022	1200	0	66	1266	2	8	36.3	0.566
CR023	0	480	729	1209	2	10	28.8545	0.134
CR024	0	400	1188	1588	2	6	28.39442	0.136
CR025	0	0	2079	2079	2	7	27.88108	0.211
CR026	960	600	396	1956	3	6	56.11708	0.164
CR027	960	1200	1188	3348	3	10	47.55178	0.505
CR028	0	0	1188	1188	1	12	23.0923	0.144
CR029	0	240	693	933	2	11	32.5764	0.352
CR030	1080	560	247.5	1887.5	3	10	44.95678	0.138
CR031	1200	0	2772	3972	3	5	49.71188	0.328
CR032	4320	0	495	4815	3	4	54.76108	0.4
CR033	0	40	33	73	1	3	13.1321	0.138
CR034	1080	40	297	1417	2	7	45.89204	0.332
CR035	1440	480	198	2118	2	8	46.5	0.686
CR036	0	0	198	198	1	5	37.6	0.284
CR037	480	160	0	640	1	10	45.8	0.191
CR038	1200	120	462	1782	3	1.5	43.22152	0.423
CR039	0	300	462	762	2	6	37.6885	0.604
CR040	1920	480	1039.5	3439.5	3	2	42.6	0.493
CR041	0	0	20	20	1	3.5	35.58662	1.046
CR042	720	120	1386	2226	3	4	43.2	0.057
CR043	960	0	495	1455	2	3.5	49.2	0.373
CR044	0	20	1485	1505	2	5	40.8	0.144
CR045	0	120	3564	3684	3	4		

Table 7. (continued)

APPENDIX III: Participant Consent Forms

CONSENT TO PARTICIPATE IN RESEARCH

The University of Mississippi Medical Center

Study Title: Physical activity levels, psychological stress levels, and immune variables

Principal Investigator: Kristina E. Rehm, PhD

Introduction
You are being invited to be in this experimental research study because you are 18-45 years old with no known diseases. Please ask us about anything that you do not understand in this document or that we discuss.

Purpose
We are doing this study to see if the level of stress in life and physical activity levels are associated with differences in the immune system.

Procedures
If you agree to participate, a study team member will ask you questions about your medical, surgical, and medication history. If you qualify for the study, your participation will involve 2 visits, where information will be collected. The first visit may last up to 20 minutes and the second visit may last for up to an hour. All visits will take place at the UMMC Allergy and Immunology Clinic on Lakeland Drive or in the UMMC Laboratory of Behavioral Immunology in the School of Medicine (N416).

At the first study visit we will perform the following:
You will be given a physical activity monitor (a device that will count the number of steps that you take each day). You should wear this device on your wrist 24 hours a day for 7-8 days. At the end of the 7-8 days, you will return to the study site to drop the monitor off to our staff and for the remainder of the study procedures.
At the second study visit we will perform the following:

- We will collect the activity monitor from you.
- We will measure your blood pressure, heart rate, height, weight, waist circumference (around your waist), and hip circumference (around your hips). We will also measure your body fat by gently pinching several sections of skin.
- You will be asked to collect a saliva sample by inserting an oral swab under your tongue for about 3 minutes. We will check your saliva for levels of stress hormones (a chemical in your body) and IgA (a chemical in your body that is part of your immune system).
- We will draw about 2 tablespoons of blood to measure specific cells of your immune system.

- You will be given 12 questionnaires to answer to determine your physical activity, depression, stress, anxiety, and worry levels which may take about 10-15 minutes to complete.
- You will be asked to walk on a flat surface for about 6 minutes. We will record how far you can walk in those 6 minutes.

Risks

Measurement of Height, Weight, Waist/Hip Circumference, Body Fat Percentage
You may feel uncomfortable or embarrassed when being weighed and measured. You do not have to have these measurements taken if you do not want to.

Blood Pressure and Heart Rate
You may experience some discomfort when measuring your blood pressure and heart rate.

Questionnaires
Some of the questions may make you feel uncomfortable or embarrassed. You do not have to answer any questions that you do not want to answer.

Blood Draw
The risks of drawing blood are pain, bruising or infection at the site where the needle is placed in your arm. On occasion, persons have been known to faint when having their blood drawn. All precautions will be taken to prevent these things from happening.

Saliva Collection
You may experience some discomfort from collection of the saliva.

6 minute walk test
You may start to breathe heavy and sweat while walking. Your heart rate may also increase. You can stop walking if you feel too uncomfortable.

Physical Activity Monitor
You may be embarrassed to wear the physical activity monitor and have your activity recorded. You do not have to wear the monitor if you do want to.

Pregnancy
Pregnant women may not take part in this study because the immune system of a woman who is pregnant responds differently than someone who is not pregnant. We will ask you if you are pregnant and if you are pregnant you may not participate in this study.

Benefits

You will not receive a direct benefit from being in this study. We hope to learn information that will help others in the study.

Alternatives
You do not have to participate in this study.

Costs
There will be no additional costs to you for participating in this study.

Research-related injury
In the case of injury or illness resulting from your participation in this study, medical treatment is available to you at the University of Mississippi Medical Center. You will be charged the usual and customary charges for any such treatment you receive.

Compensation
You will receive a $10 Walmart gift card for each of the 2 study visits.

Voluntary Participation
Your participation is voluntary. If you decide not to participate in this study, you will not suffer a penalty or loss of benefits to which you are otherwise entitled. If you decide to participate in this study, you may discontinue at any time, without penalty, loss of benefits, or effect on the quality of your medical care.

Withdrawal
You may choose to stop your participation in this study and withdraw at any time. If you decide to withdraw, the information already collected about you may still be used in this study. Your decision to stop participating will have no effect on your quality of medical care.

Confidentiality
Every effort will be made to keep the information we learn about you private. Dr. Rehm, the study personnel, the Food and Drug Administration (FDA), the Office for Human Research Protections (OHRP), and the University of Mississippi Medical Center's Institutional Review Board (IRB) and Office of Integrity and Compliance may review the study records. If study results are published, your name will not be identified.

Protected Health Information
Protected health information is any personal health information through which you can be identified. The data collected in this study includes your name, date of birth, phone number, address,, and medical history. A decision to participate in this research means that you agree to the use of your health information for the study described in this form. This information will not be released beyond the purposes of conducting this study. The information collected for this study will be kept for up to 6 years after the study ends.

While this study is ongoing you may not have access to the research information, but you may request the information once the study is complete.

Number of Participants
We expect up to 100 participants to enroll in this study.

Questions
If you have questions about this study or need to report any problems, please call Dr. Rehm during office hours from 8 a.m.-5 p.m. at 601-815-5527, or through the 24-hour answering service, at (601) 815-1078.

You may discuss your right as a research participant with the Chairman of the University of Mississippi Medical Center's Institutional Review Board, 2500 North State Street, Jackson, Mississippi 39216; telephone, (601) 984-2815; facsimile, (601) 984-2961. The Institutional Review Board is a group of people not involved with this study who have reviewed the study to protect your rights.

Statement of Participation

I have been told about this study and the possible risks and benefits. My participation is voluntary and I may withdraw at any time without any penalty or loss of benefits to which I am entitled, including medical care at the University of Mississippi Medical Center.

By signing this form I am not giving up any legal rights I may have.

_____
Printed Name of Participant

_____ _____
Signature of Participant Date

_____
Printed Name of Person Obtaining Consent

_____ _____
Signature of Person Obtaining Consent Date

I acknowledge that the participant identified above has been entered into this study with properly obtained informed consent.

_____
Signature of Principal Investigator: Kristina E. Rehm, PhD Date

ADDENDUM

CONSENT FOR STORAGE AND FUTURE USE OF SAMPLES

We would like to keep and store left over samples of your blood to use in future research. The samples of blood will be coded and stored in a locked cabinet. That is your name will not be on the sample but a separate list will be created with your name and an identification code which is placed on the sample. The list of names and codes will be kept in a separate, locked cabinet that is only accessible by the researchers.

We may use the samples to help us:

- Learn more about your immune system.
- Learn more about how stress affects the immune system.
- Future stress hormone research that may include DNA research. DNA is the material in cells that contain information that determine such things as hair color, skin color, eye color and other characteristics, and is inherited from parents.

It is your choice. You do not have to let us do this and there will be no penalty if you do not let us keep the left over samples. This part of the study is **optional** and you can be in the study no matter what you decide.

_____ You may keep, store, and use samples of my blood for future research studies to learn more allergic rhinitis, asthma and stress hormone system.

_____ You may keep, store, and use samples of my blood for future research studies. The studies do not have to be related to my immune and stress hormone systems.

_____ You may not keep, store, and use samples of my blood for any future research studies.

_____
Printed Name of Participant

_____ _____
Signature of Participant Date

Future Studies: We may be doing more research studies like this one in the future. If we do, may we contact you to see if you want to participate? Please initial below.

_____ Yes _____ No
Phone number: _____ Email address: _____