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# The Use of Cortisol and HbA1c as Biomarkers of Stress in University Administrators

Jacilyn Marie Olson
*University of Arkansas, Fayetteville*

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IN UNIVERSITY ADMINISTRATORS

# THE USE OF CORTISOL AND HbA1c AS BIOMARKERS OF STRESS IN UNIVERSITY ADMINISTRATORS

A dissertation proposal submitted in partial fulfillment
of the requirement for the degree of
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By

Jacilyn M. Olson
Fort Hays State University
Bachelor of Science in Health and Human Performance, 2006
Fort Hays State University
Master of Science in Health and Human Performance, 2008

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University of Arkansas

**ABSTRACT**

**PURPOSE:** The purpose of this study was to explore the impact of perceived stress and cardiorespiratory fitness on cortisol and HbA1c, biomarkers of stress, in a group of select university administrators. The impact of gender on these relationships was of special concern. **METHODS:** University administrators with job titles of Chancellor, Provost, Vice Chancellors and Vice Provosts of the university, and Deans and Associate Deans at the college level were recruited. Twenty-five administrators (15 males and 10 females) agreed to participate and completed a battery of assessments that included completion of the University Administrative Concerns Questionnaire, a finger-stick blood test for HbA1c, estimation of cardiorespiratory fitness, and analysis of salivary cortisol over the course of two days. Data were analyzed using a series of unpaired *t*-tests to examine gender differences in the variables of interest. The relationships between variables were examined separately for the genders using multiple regression analyses. **RESULTS:** The results of the gender comparisons revealed that men and women scored similarly on the variables of perceived administrative stress, $t$ (23) = 0.50 $p$ = .62, cardiorespiratory fitness, $t$ (23) = -1.28 $p$ = .21, and HbA1c, $t$ (23) = -0.57 $p$ = .57. However there was a significant difference for cortisol AUC, $t$ (23) = -3.00 $p$ = .0064, with males having significantly greater cortisol concentrations. The effect sizes for these analyses were small to moderate, except for cortisol AUC, where a large ($d$ = 1.22) effect was found. The results of the multiple regression analyses indicated that neither cortisol AUC or HbA1c were significantly predicted by perceived stress and cardiorespiratory fitness in either gender. However, prediction of HbA1c for females did account for a promising 42% of the variance, with fitness accounting for more of variability than perceived stress. Despite the lack of predictive power, the analyses revealed several gender differences in the magnitude and direction of the correlations between

variables. This indicates that despite similar mean values for stress and fitness related variables, the relationships between the variables may be different for men and women, warranting further research.

This dissertation is approved for recommendation to the Graduate Council

Dissertation Director:

______________________________________

Ro Di Brezzo, Ph.D.

Dissertation Committee:

Inza L. Fort, Ph.D.

Michelle Gray, Ph.D.

Sean Mulveneon, Ph.D.

Tyrone Washington, Ph.D.

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**DEDICATION**

To my fiancée, Greg, for his love and support throughout graduate school. Somehow you knew I would be able to accomplish this all along. Thank you for reminding me whenever I questioned this path. You mean the world to me.

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# CHAPTER ONE

## INTRODUCTION

Stress occurs any time an individual is presented with a challenge or threat, real or perceived, and is forced to adjust (Selye, 1979). The body reacts by stimulating the sympathetic nervous system ("fight or flight response"). This response prepares the body for a physical reaction, through a series of hormonal releases which increases heart rate, blood pressure, respiration rate, and available fuel sources. The stress response is designed for acute stressors, relying on recovery time for the systems to return to normal before the next stressful situation. However, recurrent or prolonged activation of the systems leads to damage, increasing the risk of future health problems (Mellner, Krantz, & Lundber, 2005). Chronically elevated stress levels have been linked to numerous serious health issues such as cardiovascular disease, stroke, hypertension, diabetes, and mental illness (World Health Organization [WHO], 1999).

There are many biomarkers used to study the physiological response to stress, these biomarkers are often studied in context to the stress an individual perceives. Two biomarkers of particular interest are glycated hemoglobin (HbA1c) and cortisol. HbA1c is of interest because the acute stress response causes an increase in blood glucose. When blood glucose is elevated, glycosylated proteins form. HbA1c is a particular type of these proteins and in the non-diabetic population may indicate when an individual has experienced frequent acute stress responses (Kawakami, Araki, Hayashi, & Masumoto, 1989; Kelly, Hertzman, & Daniels, 1997; Kudielka & Kirschbaum, 2007; McEwen & Seeman, 1999). The second biomarker of interest is cortisol, which is the major stress hormone produced during stress responses that last more than a few minutes. Elevated levels of cortisol have been linked to perceived stress in numerous populations, such as those experiencing work or relationship stress (Maina, Bovenzi, Palmas, & Larese Filon, 2009; Powell et al., 2002).

Research has shown, but not conclusively, that men and women may differ in some of these stress-related variables. In particular, it has been shown that women typically report more perceived stress but have lower levels of the stress biomarker cortisol (Hall, Chipperfield, Perry, Ruthig, & Goetz, 2006; Kirschbaum, Wust, & Hellhammer, 1992; Kudielka & Kirschbaum, 2005; Matud, 2004; McDonough & Walters, 2001; Oman & King, 2000; Ptacek, Smith, & Zanas, 1992; Tytherleigh, Jacobs, Webb, Ricketts, & Cooper, 2007; Uhart, Chong, Oswald, Lin, & Wand, 2006) . However, gender differences in HbA1c are typically not found (Corwin, McCoy, Whetzel, Ceballos, & Cousino-Klein, 2006; Meigs, Nathan, Cupples, Wilson, & Singer, 1996). Research has also found gender differences in the rates of some stress-related illnesses, for example women tend to suffer more from depression, anxiety, and autoimmune diseases, while men are more likely to develop cardiovascular disease, infectious diseases, and substance abuse (American Psychological Association [APA], 2006; Kudielka, Hellhammer, & Kirschbaum, 2000).

Fortunately, there are supported stress management strategies, such as exercise, that have been found to buffer the adverse effects of stress. Exercise has been shown to improve psychological symptoms of general and work-related stress during and after a single bout of exercise (Fox, 1999). However, more enduring stress relief and prevention of associated health problems may be achieved through regular exercise participation. In fact, physical fitness appears to have a stronger negative relationship with stress than simply exercise volume (Roth, Wiebe, Fillingim, & Shay, 1989). Gender differences are also supported in relation to cardiorespiratory fitness levels, with men generally showing higher absolute and relative fitness levels; however the meaningfulness of this difference for health and stress is debatable (Thompson, Gordon, & Pescatello, 2010; Wilmore, Costill, & Kenney, 2008).

Workplace stress is one of the leading sources of stress and is a major health concern in the U.S. It arises from a mismatch between the capabilities, resources, and needs of the individual employee and the demands of the occupation (Michailidis, 2008). High levels of stress are believed to not only adversely impact health of workers but also negatively impact job performance and satisfaction (Chalmers, 1998). University administrators are a group of employees that have a unique set of job demands that include budget management, recruitment and management of personnel, and mediation of conflict (Rasch, Hutchison, & Tollefson, 1986). Research has found this group of employees to have consistently high levels of anxiety that are greater than the anxiety levels of the general population (Karsli & Baloglu, 2006). The current cohort of high level administrators is predominately older males, many of whom are reaching retirement (Marshall, 2009). As is the trend in academics, administrators are typically promoted from within the academic hierarchy and women are entering the faculty ranks at a faster rate than men. This indicates that the retirement of older male administrators provides an opportunity for more qualified women to transition into administration (Marshall, 2009). Therefore, it is important to examine stress and its effects in both male and female administrators. The impact on the health of university administrators is of particular concern as their job performance impacts the faculty, staff, students, and community they serve (Jo, 2008).

In light of gender differences in many stress and fitness related variables and the fact that more women will occupy leadership positions in higher education it is important to explore if men and women display similar relationships between perceived stress, cardiorespiratory fitness, and biological markers of stress. This line of research is important as it may help identify general and gender-specific areas on which to focus when developing strategies to reduce perceived stress, biomarkers of stress, and potentially the rate of stress-related illness.

## Purpose of the Study

The purpose of this study was to investigate the relationships between perceived stress, fitness, and biomarkers of stress in a group of selected university administrators. Within the purpose of this study, gender differences in these relationships were also explored. Participants with job titles of include Chancellors, Provosts, Vice Chancellors and Vice Provosts of the university, and Deans and Associate Deans at the college level were recruited.

## Research Hypotheses

1. Male and female administrators will report similar levels of perceived administrator stress.
2. Male administrators will have greater levels of estimated cardiorespiratory fitness levels than female administrators.
3. HbA1C levels will not differ between the genders.
4. Cortisol secretion levels will not differ between the genders, as measured by area-under-the-curve (AUC).
5. Perceived administrator stress will have a positive correlation with cortisol AUC.
6. Cardiorespiratory fitness will have a negative correlation with cortisol AUC.
7. Perceived stress and HbA1c will be positively associated.
8. Cardiorespiratory fitness and HbA1c will be negatively correlated.

## Definition of Terms

*Chronic Stress* is stress that is constant and persists over an extended period of time. It can affect both physical and psychological well-being and is associated with a variety of health problems including heart disease, high blood pressure, weakened immunity, and depression.

*Stress* is the normal physical and psychological response to events that are perceived to be threatening or challenging.  There is a great deal of interpersonal variability in the stress response, as different people may perceive and respond to the same stressor in different manners.

*Stressors* are specific events or circumstances that cause individuals discomfort. Stressors may vary in nature, intensity, and duration.

*Glycated Hemoglobin (HbA1c)* is a form of hemoglobin used to identify the average glucose levels over the previous 2-3 months.  The higher the average blood glucose levels, the higher the HbA1c.  Glucose is released into the blood stream during the acute stress responses. Therefore, frequent activation of the stress response system is believed to increase HbA1c levels.

*Hydrocortisone (cortisol)* is a glucocorticoid produced by the adrenal gland that is released as part of the stress response.   Measurement of cortisol is a means of assessing the function of the hypothalamic-pituitary-adrenal (HPA) axis.

*Salivettes* are saliva collection devices used to measure total free cortisol.

*Select University Administrators* include Chancellors, Provosts, Vice Chancellors and Vice Provosts of the university, and Deans and Associate Deans at the college level.

**Significance of the Study**

University administrators experience a great deal of occupation related stress (Karsli & Baloglu, 2006).  The stress levels of administrators, as well as other occupations, if chronically elevated may negatively impact the health of these individuals.  Health problems often associated with stress include metabolic and cardiovascular disorders and mental illness (Agardh et al., 2003; Kivimäki et al., 2006; Peltzer, Shizana, Zuma, Van Wyk, & Zungu-Dirwayi, 2009). Promisingly, exercise and fitness may have stress buffering effects on this negative relationship (Gerber, Kellmann, Hartmann, & Puhse, 2010). Therefore, the purpose of this study was to explore the impact of fitness and stress on biomarkers of health in a group of university administrators. The impact of gender on these relationships was also explored. Gaining a better understanding of the relationships between these variables may help determine better strategies to reduce the negative health implications of the types of stress that university administrators experience.

# CHAPTER TWO

# REVIEW OF LITERATURE

Numerous studies have outlined the negative impact of general and occupational stress on the health and productivity of workers. University administrators are a group that has been found to report high levels of perceived stress. However, biological markers of stress and the impact of fitness on these variables have not been measured in this group. Therefore, the purpose of this study was to explore the impact of fitness and perceived stress on biomarkers of health in a group of university administrators. The impact of gender on these relationships was also explored. The following review of literature discusses the associations between these variables and is divided into the following sections: (a) stress and university administrators, (b) stress and health, (c) biomarkers of stress, and (d) fitness and stress.

## Stress and University Administrators

The broad definition of stress is the psychological and physiological reaction to a real or perceived threat that requires some action or resolution (Selye, 1979). It is a response that operates on cognitive, behavioral, and biological levels; the cognitive and biological responses were the focus of this study. Currently there are no widely used set criteria for classifying stressors as acute or chronic. However, chronic stress can be intuitively defined as the response to a stressor(s) over a long period of time. Acute stress on the other hand is often referred to as the short term response to a stressor that has a definitive end point.

Stress is measured in two major domains, the physical domain, where the physiologic responses to stress are of interest, and the psychological domain, where perceived or reported stress is measured. Gender differences in the physiologic response to stress will be discussed later. Research is conflicted on which gender experiences more perceived stress. A few studies report men to have higher levels of stress but there are many more studies that report women to encounter more numerous stressful situations (Hall et al., 2006; Matud, 2004; McDonough & Walters, 2001; Tytherleigh et al., 2007). Women also perceive these stressful events as more taxing than men (Ptacek et al., 1992). Additionally, women report more daily stress related to role fulfillment at home and family life (Oman & King, 2000). These findings support additional research indicating that women experience chronic stress differently than men (McDonough & Walters, 2001).

In addition to the stress related health consequences that will be discussed later, stress also has tremendous economic costs (APA, 2012). Of special concern for employers, American workers admit stress negatively impacts their productivity, with approximately half of Americans (51%) saying that stress decreased their productivity at work (APA, 2009). Additionally, the health care costs for employees with high stress levels are 46% higher than for those with lower stress levels (Goetzel et al. 1998). Taken together, Rosch (2001) estimated that occupational stress costs U.S. industries more than $300 billion a year in days of missed work, turnover, reduced productivity, and medical, legal, and insurance costs.

In addition to general stress, occupational or work related stress is one of the most impactful to one's life and has been studied extensively. A worker experiences occupational stress when job requirements do not match the capabilities, resources, and needs of the individual (Michailidis, 2008). The level and frequency of stress varies by occupation and is influenced by workplace factors, such as nature of tasks, job security, workload, and physical working (Palmer, 2004). Universities were traditionally considered to be low-stress work environments but more recent research indicates staff, faculty, and administrators experience high levels of occupational stress (Biron, Brun, & Ivers, 2008; Karsli & Baloglu, 2006; Lazaridou, Athanasoula-Reppa, & Fris, 2008; Rasch et al., 1986). University administrators specifically face many job related stressors, including budget management, recruitment and management of personnel, mediation of conflict, and balancing the demands of trustees, alumni, and governing agencies (Rasch et al., 1986).

These job responsibilities coupled with the complex nature of higher education, dealing with government funding, accelerated deregulation, shifting funding sources and incompatibility of expectations of governments, students, employers, and communities, leads many researchers to believe university administrators experience high levels of role ambiguity, conflict, stress, and other negative influences (Lazaridou et al., 2008). Such a study of 72 university administrators used the Turkish version of the State Trait Anxiety Inventory (Karsli & Baloglu, 2006). This inventory examines state anxiety, or the anxiety felt "at the moment", and trait anxiety, the anxiety felt in general (Spielberger, 2010). The mean anxiety scores for this group were found to higher than scores for other populations, indicating university administrators are more stressed than other workers. Additionally, a strong relationship between state and trait anxiety was found, this was interpreted to mean that the stress levels of university administrators remain constantly elevated over time, meaning university administrators are anxious much of the time. The level of administration was also of interest and found to be non-significant between middle, mid-upper, and upper levels. When demographic variables were also related to the anxiety levels, it was found that male and female administrators scored similarly on both state and trait anxiety. However, age or tenure as an administrator did not influence either anxiety measure (Karsli & Baloglu, 2006).

The stress of one particular type of administrator in higher education has been studied more than others—community college presidents. In absence of findings to support stress level differences based on the level of administration, the stress of this homogenous population is of interest to understanding the stress of administrators in general. Royal and Grobe (2008) studied the job-related stress of 39 North Carolina community college presidents. Using the Stress in General instrument, the stress subscales of "pressure" and "threat" were examined in relation to the size of intuition, years in presidential role, and components of sleep quality. Stress in the form of "pressure" was related to job demands, while "threats" were related to feeling of being overwhelmed. The findings indicate that community college presidents perceived more stress related to job demands than they did to feelings of being overwhelmed. However, the feelings of stress were not related to the size of institution or years as presidents and the presidents generally slept well. The authors concluded that the presidents likely used stress reduction methods, such as exercise, to help them deal with their stress (Royal & Grobe, 2008). This is the only study of university administrators to examine stress in relation to a biological variable—sleep quality.

A larger study of community college presidents investigated the relationship between reported stress levels and wellness practices (Radliff-Dawson, 2004). This study found significant differences in the stress levels of presidents based on gender and years served as president. Female presidents reported more stress than males and presidents with longer tenures were less stressed than those with fewer years. A significant negative correlation was also found between stress symptoms and wellness practices, with the physical practices of wellness being more strongly related to reducing stress than other wellness practices. It was concluded that community college presidents use wellness practices to managements stress, but efforts should continue to promote wellness in the lives of busy administrators (Radliff-Dawson, 2004).

Work-related stress is multidimensional, with many sources of stress operating in each occupation (Cooper & Marshall, 1978). However occupations vary greatly based on the sources and strength of these stressors. As a result, specific instruments have been developed for various occupations. One of the instruments developed specifically for measuring stress of university administration is called the University Administrative Concerns Questionnaire (UACQ) (Rasch et al., 1986). This instrument is based on the Administrative Stress Index (ASI), which was developed for use with primary and secondary school administrators. The ASI measures four factors of stress: role stress, task stress, conflict-mediating stress, and boundary-spanning stress (Tung, 1980). Since the ASI was designed for secondary school administrators, a few of the questions were eliminated or reworded on the UACQ. The UACQ has undergone expert review by 18 administrators for content validity and clarity. Based on the feedback of the reviewers, three items were added, resulting in the 35-item questionnaire (Rasch et al., 1986).

The 35-item version of the UACQ was then administered to 1,108 administrators and 777 of the surveys returned were usable. Factor analysis revealed a four-factor solution that aligned well with the ASI; these factors included role-based stress, task-based stress, conflict-mediating stress, and social-confidence stress. As in the ASI, the factors associated with role- and task-based stress accounted a substantial amount of the total variance (28%), while the factors of conflict-mediating stress, and boundary-spanning stress were relatively weak for both scales. Six of the 35-items did not meet the author-selected factor loading cut-off of .35 and were eliminated from the questionnaire. This resulted in a 29-item questionnaire designed to specifically measure the primary types of stress that university administrators experience (Rasch et al., 1986).

In addition to validating the UACQ, Rasch et al. (1986) analyzed the administrators' perceived scores on the four areas of stress based on level of administration and demographic information. Their sample included 186 central administrators, 241 Deans, and 350 Department Chairs. Central administrators included those with the job titles of Provost, Vice Chancellor, Vice President, Associate Vice Chancellor or Vice President, or Assistant Vice Chancellor or

Vice President. The results indicated significant differences in role-based and task-based stress as a result of administrative level. Post hoc analysis showed that department chairs reported significantly higher role-based stress than central administrators. For task-based stress, the post hoc analysis showed that there were significant differences between all three levels of administration, with department chairs experiencing the most task-based stress and central administrators experiencing the least. The authors acknowledged that all three levels complete tasks that are typically seen as stressful, but that higher level administrators typically have assistants or other support to help with these tasks. No administrative level differences were seen in conflict-mediated or social-confidence stress. Additionally, neither age nor gender were found to be significantly related to the different types of stress (Rasch et al., 1986).

The current cohort of high level administrators is predominately older males. The reviewed studies from the United States reported between 73 and 88% of respondents were male (Karsli & Baloglu, 2006; Radliff-Dawson, 2004; Rasch et al., 1986; Royal & Grobe, 2008). Unfortunately, only two of the studies reported mean age and both studies focused on community college presidents. Royal and Grobe (2008) reported the mean age for their group to be 57.5, with a range of 41 to 66 years. Ratliff-Dawnson (2004) reported a very similar mean age of 56.7, with a range of 40 to 74 years for her group.  An additional study reports that 49% of university presidents are 61 years or older (American Council on Education, 2007). This would indicate that a large percentage of these administrators will be retiring in the next decade (Marshall, 2009). As is the trend in academics, administrators are typically promoted from within the academic hierarchy, moving from faculty member to department chair and finally to college Dean or higher. Women are entering the faculty ranks at a rate that outpaces men, indicating that the retirement of these older male administrators provides an opportunity for more qualified women to transition into administration, including high level positions (Marshall, 2009). As more women occupy these leadership positions it is important to explore how the elevated stress levels of being a university administrator impact their health and well-being. Although research in this area has begun, it is typically qualitative in nature and focuses specifically on the sources of stress for female administrators, rather than comparing their stress to male administrators quantitatively (Acker & Armenti, 2004; Keim & Erickson, 1998; Summers & Steckol, 2009) .

Men and women leaders often have different approaches to their job responsibilities. Summers and Steckol (2009) contend that, in addition to being concerned about overall productivity, female administrators strive to develop and maintain cooperation within the workplace. The emotional aspects of work are typically of greater importance for females than for males (Summers & Steckol, 2009). Additional research supports this statement with findings that women perceive more stress from interpersonal conflicts than men (Iwasaki, MacKay, & Ristock, 2004). Taken together, these concepts help explain why "conflict with supervisors" is reported as the top reason women leave administrative positions in higher education (Jo, 2008).

High levels of anxiety are believed to adversely impact the general health of any worker as well as job performance and satisfaction (Chalmers, 1998). The impact of stress on health and performance is of special concern in university administrators as their daily job responsibilities impact the faculty, staff, students, and community they serve, both negatively and positively (Jo, 2008).

**Stress and Health**

Work-related stress is cited as one of the top sources of stress for Americans (APA, 2012). Stress alone does not cause illness, however it contributes to wear and tear on the body that contributes to circumstances where illnesses and diseases are more likely to develop.

Therefore, stress and stress-related illnesses and diseases are a major concern for both individuals and the organization for which they work. For the individual, high levels of stress are related to numerous chronic diseases such as, cardiovascular disease, stroke, hypertension, diabetes, and mental illness (WHO, 1999). Some researchers also contend that medically unexplainable physical problems may indicate dysregulation of the stress response systems (Mellner et al., 2005). Although it is difficult to track, researchers estimate that 75-90% of all visits to primary care physicians are because of stress related disorders (Rosch, 2001). Stress also impacts the bottom line for employers. American workers admit that stress negatively impacts their productivity, with approximately half of Americans (51%) saying that stress decreased their productivity at work (APA, 2009). Additionally, the health care costs for employees with high stress levels are 46% higher than for those with lower stress levels (Goetzel et al. 1998). Taken together, Rosch (2001) estimated that occupational stress costs U.S. industries more than $300 billion a year in days of missed work, turnover, reduced productivity, and medical, legal and insurance costs.

As mentioned above, many health problems have been associated with stress but type 2 diabetes and cardiovascular diseases have attracted a great deal of attention. Work place stress has been linked to type II diabetes in middle-aged Swedish women (Agardh et al., 2003). This study of 4,821 women provided evidence that self-reported stress factors were related to identification of type II diabetes through glucose tolerance testing (Agardh et al., 2003).

Evidence is particularly strong relating stress and cardiovascular disease. A meta-analysis of 14 studies, which included a total of 83,014 workers, determined the risk of coronary heart disease to be 1.16 times greater for individuals with high job strain compared to those with low strain. This difference was found after adjustment for age and gender. Despite great variation in the cohort studies regarding the measurement of stress and related factors, the review determined work stress to increase the risk for coronary heart disease by 50% (Kivimäki et al., 2006).

Additionally a cross-sectional study of 21,307 South African public school educators found job stress to be related to several other illnesses and risk factors for diseases. High levels of stress were identified in the group of educators. Job stress was related to six stress-related illnesses: hypertension, heart disease, stomach ulcers, asthma, mental distress, and tobacco and alcohol misuse (Peltzer et al., 2009).

Research regarding gender differences in stress-related illnesses is very interesting. More women report stress to have a negative impact on their health and visit the doctor more often for stress-related complaints. However, men are more likely to die of these same diseases (APA, 2006). There are likely many contributing factors to these differences, with gender differences in perceived stress and physiological responses to stress being of primary importance.

**Biomarkers of Stress**

The human body may respond differently to various types of stressors, but there remains a general pattern of physiological stress response. The stress response is initiated when the central nervous system identifies a stressor. The signal is sent through the thalamus to the hypothalamus activating the autonomic nervous system. The sympathetic nervous system then causes the release of the epinephrine and norepinephrine. These hormones increase heart rate, blood pressure, and respiration rate, dilate the pulmonary system, and inhibit digestive function. This system also increases circulating levels of cholesterol and free fatty acids. This initial response is often referred to as the "fight or flight response" and is proficient for stressors lasting less than 10 minutes.

However, if the stressor continues another stress system in sparked, the hypothalamic-pituitary adrenal (HPA) axis. This system also begins at the hypothalamus. The anterior part of the hypothalamus releases corticotrophin releasing factor which stimulates secretion of adrenocorticotropic hormone (ACTH). ACTH stimulates the adrenal-cortex to produce corticosteroids, especially cortisol. Cortisol's main impacts in the normal stress response are suppression of the immune system and mobilization of energy sources. The HPA axis responds to the affective aspects of the stress, such as loss of control, anxiety, and distress. This acute response effect has a protective effect if it is followed by rest. However, recurrent or prolonged activation of the stress response systems leads to accumulated damage, increasing the risk of future health problems as discussed earlier (Mellner et al., 2005).

Release of epinephrine is one of the immediate aspects of the stress response by the sympathetic nervous system. Epinephrine causes a temporary increase in blood glucose levels. However, if the stress response is repeatedly stimulated, epinephrine and glucose are repeatedly released, leading to a time-average increase in blood glucose levels (Kelly et al., 1997). When blood glucose is consistently elevated, as in diabetics, glycosylated proteins form. This occurs when glucose binds non-enzymatically with proteins and this process cannot be reversed. This binding inhibits the protein from functioning properly, therefore glycosylation of protein is detrimental as it deactivates enzymes, inhibits binding of regulatory molecules, causes inappropriate cross-linking between proteins, and slows removal of abnormal proteins (Masoro, Katz, & McMahan, 1989).

Glycosylated hemoglobin (HbA1c) is a particular form of glycosylated proteins formed by a reaction between glucose and hemoglobin A1 in the red blood cell. As this reaction is irreversible, HbA1c is stable for the remaining life of the red blood cells (2-3 months). HbA1c levels are consistent over time (years) at 4-6% for individuals with normal blood glucose levels (Meigs et al., 1996). However the levels in diabetics may be three times greater and proportional to their time-averaged blood glucose levels over the previous 1-2 months. Due to this relationship, HbA1c is used to monitor the blood glucose levels of diabetics over time (Folling, 1990).

Multiple studies have examined this potential relationship between stress and elevated HbA1c levels. Kawakami et al. (1989) found a significant correlation between job dissatisfaction and HbA1c levels in male white-collar workers, even after accounting for confounding variables such as age, obesity, alcohol consumption, smoking, and job-overload. Another study linking job stress to elevated HbA1c levels was conducted by Netterstrøm and Sjøl (1991). This study examined objective and subjective job strain, as measured by job title and subject responses to work related questions, respectively. HbA1c levels were significantly elevated in those with objective job strain (Netterstrøm & Sjøl, 1991). A third study also found significant correlations between two components of work-related stress, as measured by effort-rewards imbalance model, and HbA1c levels, but only in female workers. However, no correlations were found for male workers (Xu et al., 2012). Evidence for a correlation between HbA1c and stress is supported enough that it is included in the widely used stress model of allostatic load (Kudielka & Kirschbaum, 2007; McEwen & Seeman, 1999). The original version of this model had 10 factors and the extended version has 17; HbA1c was included in both models.

Not all studies find meaningful associations between work stress and HbA1c, a study of occupational stress in female Japanese nurses found correlations between various job stressors and HbA1c to range from -.074 to .125, with no correlations found to be significant (Kawaguchi et al., 2007). Gender differences in HbA1c levels are typically not found (Corwin et al., 2006). Therefore, guidelines for normal HbA1c levels are the same for men and women, 4-6% (Meigs et al., 1996).

As mentioned above, the second system that contributes to the stress response is the hypothalamic-pituitary-adrenocortical (HPA) axis. When this system is activated, it secretes cortisol. Cortisol has effects on nearly all levels in the human body, especially an important role in lipid and glucose metabolism.

In addition to being released during stress, cortisol is released at varying levels throughout the course of a day. The typical diurnal cortisol pattern is characterized by high and varying measures in the morning and by late afternoon/evening. Eating also tends to cause a brisk increase in cortisol. Cortisol may be measured in three forms; bound, free, and total. Bound cortisol accounts of 90% of total cortisol and may be bound to either serum cortisol-binding-globulin (CBG) or serum albumin; free cortisol comprises the remaining 10% (Heyns, van Baelen, & de Moor, 1967). Collection of salivary cortisol is only a means of assessing free cortisol. Although all three means of measuring cortisol have valid uses in assessing HPA axis health, free cortisol is the measure of interest in this study because it is the biologically active form. It is also a better measure of HPA axis function because changes in levels of bound and total cortisol may be masked by changes in concentrations of binding proteins, especially CGB (le Roux et al., 2003). Additionally, measurement of bound and total cortisol requires venous blood samples, which may induce stress in some individuals (Kirschbaum & Hellhammer, 1994). Therefore, collection of salivary cortisol is an ideal means of measuring HPA axis function while increasing individual’s comfort with the measurement, lessening the risk of inducing stress during the process.

There are numerous protocols for assessing HPA axis function using salivary cortisol. The protocol for this project is based on recommendations from a panel of experts organized by the MacArthur Research Network on Socioeconomic Status and Health. In 1999, this group of well-known investigators in the field of stress met to discuss research supported protocols for collecting and analyzing salivary cortisol measures (The MacArthur Research Network on SES and Health, 1999). The recommendations stated that for normal populations, such as administrators, determining area-under-the-curve is an appropriate summary measurement. This is in contrast to determining rhythm profiles, which is more appropriate for examining underlying health conditions. In order to calculate an accurate area-under-the-curve a minimum of four samples per day are needed. Finally, since cortisol concentrations vary day-to-day, measurements should be taken over several days. In the case of determining area-under-the-curve, three or four days of measurements are preferable, in order to get a reliable assessment of "typical" daily concentration for each individual (The MacArthur Research Network on SES and Health, 1999).

The protocol focuses on morning and evening samples, which have been shown to be more different between high stress and low stress individuals than samples taken during the middle of the day (Adam & Gunnar, 2001; Ockenfels et al., 1995; Steptoe, Cropley, & Kirschbaum, 2000). This finding highlights the importance of the timing of stressors which may make samples taken at certain times of the day more important. For example, those with job strain may experience more stress in the mornings as they prepare for and arrive at work. Similarly individuals with stressful home lives may experience more stress outside of work hours (Powell et al., 2002). The timing of the stressors is of importance in this study as university administrators experience stressors during regular working hours, but also have many obligations outside of normal hours that may be an additional source of stress. In addition to carefully considering the times of day the saliva samples are taken, attention must be paid to which days of the week stress is measured. Research indicates that stress varies throughout the week, with greater stress reported Monday through Thursday than on Friday, Saturday, and Sunday (Schneider, Ainbinder, & Csikszentmihalyi, 2004). As a result data collection days should be considered in context of the research question.

Research studies linking cortisol release to stress are numerous; one such study examined the relationship between two job stress models and salivary cortisol in 104 call-center operators (Maina et al., 2009). In addition to providing demographic data, subjects completed two questionnaires, one aimed at the job demand-control model of stress and the other aimed at the effort-reward imbalance model, and provided three days of cortisol samples. Seven cortisol samples were self-collected on each of two non-consecutive working days and one day off. Samples were taken upon awakening, 30 and 60 minutes after wakening, at the start of the work day, and every three hours until bed. The first three samples of the day were used to assess cortisol AUC for the awakening response and the final four samples were used to determine AUC for the rest of the day. The researchers found the cortisol concentrations during the two work days to be stable; therefore the AUC values were averaged across the two days for statistical analysis. The results indicated that the awakening AUC was positively associated with job strain as measured by the job demand-control model of stress, while high stress scores on the effort-reward imbalance model were associated with both lower awakening AUC and AUC for the rest of the day. Gender and proper adherence to the saliva sampling protocol were also found to significantly influence cortisol concentrations in the morning. The apparent contrasts in the direction of relationships between the two job stress models and cortisol concentrations indicated that high stress work environments impacted HPA axis regulation but that the two work stress models impacted cortisol secretion differently (Maina et al., 2009).

Occupational stress is not the only form of stress to impact cortisol excretion; relationship stress has also been related to cortisol secretion. Powell et al. (2002) found that women experiencing relationship stress, in the form of anticipating or undergoing a separation or divorce, reported more psychosocial distress and secreted more cortisol than demographically matched women without relationship stress. This study did not use AUC for comparisons but rather compared the groups at each of eight time points over the course of the day. The cortisol secretion levels of the stress and non-stressed women were more different in the evenings that in the mornings (Powell et al., 2002). The authors believed the larger differences in the evening cortisol levels were related to the stress the separated women felt coming home to an empty house, when they had once come home to a significant other.

The above article mentioned a gender difference in cortisol secretion and in fact, gender is the most thoroughly researched demographic factor in relation to stress (Maina et al., 2009). However, the relationship is not completely clear. Research indicates that males and females have similar physiological responses to physical stress, such as exercise (Kraemer, Blair, Kraemer, & Castracane, 1989). However, the results are not as clear about psychological stress, with some studies finding no differences (Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004; Kurina, Schneider, & Waite, 2004) and others finding a stronger physiologic response by males (Kirschbaum et al., 1992; Kudielka & Kirschbaum, 2005; Uhart et al., 2006). Explanations for gender differences in cortisol secretion typically follow two lines of reasoning. The first reason, which is more typical in older research, is that gender differences in how the stress was perceived influenced cortisol secretion (Kirschbaum et al., 1992). The second, found in newer research, talks about the influence of estrogen on cortisol secretion. This is especially supported by research by Kudielka and Kirschbaum (2005), where it was found that women in the luteal phase, when estrogen levels are low, have similar cortisol responses to stress as men. However, women in the follicular phase or on oral contraceptives, when estrogen levels are higher, have suppressed cortisol secretion compared to men (Kudielka & Kirschbaum, 2005). Research into the impact of the sex hormones on cortisol secretion is in its infancy. As this research continues, the conflicting results about gender differences in cortisol secretion may be explained.

**Fitness and Stress**

Work places have taken notice of the impact of stress on worker health as well as workplace productivity and health care costs. This interest is demonstrated by the implementation of many workplace stress management programs. These programs, as well as the U.S. Prevention Services Task Force and many healthcare providers, promote exercise because it has been shown to reduce stress and the risk of many diseases linked to chronic stress (APA, 2007; Traustadóttir, Bosch, & Matt, 2005). In fact, the roles of stress, exercise, and fitness have been explored to determine if exercise and fitness have a "stress buffering" effect (Gerber et al., 2010). Often this possible buffering effect is studied in occupations seen as inherently stressful such as police officers, firefighters, and emergency response officers. Despite the popular assumption that the stress of these occupations comes from the dangerous and physically demanding aspects of their work, most of the stress associated with these occupations comes from dealing with administration and other psychologically distressing aspects of the job, such as feelings that their work is intruding on their home life (Violanti & Aron, 1993). Therefore, perhaps the stresses of emergency responders and university administrators are more similar than one might think.

Research shows potential regarding exercise and fitness as stress buffers. More researchers focus on exercise as the primary buffer, although the two variables are often measured together. The focus on exercise is because of its effect on improving state and trait anxiety as well as mental well-being (Fox, 1999). Exercise has also been shown to alleviate psychological symptoms when individuals suffer from general or occupational stress (Ensel & Lin, 2004). The variables of stress and vigorous exercise have been found to account for 33% of the variation in psychological complaints in a study of 533 Swiss police and emergency response personnel, after accounting for demographics and social background (Gerber et al., 2010). Brown (1991) measured exercise and fitness together and found active and fit individuals to report better health and fewer health center visits when stressed than inactive or lower fitness individuals. These studies indicate that increased fitness and exercise are related to the well-being of individuals and help them cope with stress (Gerber et al., 2010). The positive psychological impact of exercise undoubtedly helps individuals feel less anxious; however, results concerning the validity of self-reported exercise participation are questionable. Therefore fitness may better reflect the actual frequency and intensity of an individual's exercise habits over time. This may be one reason stronger relationships are found between fitness and stress than between exercise and stress (Roth et al., 1989).

The research regarding exercise, fitness, and stress is not unanimous, with some studies finding no relationships between the variables. Young (1994) found no relationship between fitness and general or job-related stress on blood pressure and cholesterol, both common risk factors for coronary artery disease. Likewise, self-perceived fitness and exercise were not found to moderate stress related illnesses (Roth et al., 1989). The relationship between occupational stress and health was also found to be independent of exercise level in male managers in Hong

Kong (Siu, Cooper, & Leung, 2000). Although a few studies have found no relationship between exercise and stress, no study has found exercise to exacerbate the negative health impacts of stress (Gerber et al., 2010). Therefore, based on the supportive literature, exercise should continue to be studied as a stress reduction method.

In contrast to the other variables of interest in this study, gender differences in maximal oxygen uptake are more universally accepted. These differences are most evident in the normative values that have been established for each validated laboratory and field test of cardiorespiratory fitness. Men have higher absolute and relative oxygen uptakes at any given fitness level (Thompson et al., 2010). These differences are primarily related to differences in body size, as women have smaller hearts and lower blood volumes. To compensate, women typically have higher heart rates at any given work load to maintain cardiac output. Women also have lower hemoglobin content which reduces the amount of oxygen delivered to the active muscles (Wilmore et al., 2008). Based on these facts, gender is an important factor to consider when examining the relationship between cardiorespiratory fitness and stress.

**Summary**

In summary, chronic workplace stress is a major concern for individuals and their employers, especially in light of the high health and productivity costs. The reviewed research indicates that university administrators experience a great deal of occupation related stress (Karsli & Baloglu, 2006). If chronically elevated, the stress levels of administrators, as well as other occupations may damage the health of these individuals. Health problems often associated with stress include metabolic disorders, cardiovascular disease, and mental illness (Agardh et al., 2003; Kivimäki et al., 2006; Peltzer et al., 2009). However, the current body of literature does not relate the perceived levels of administrator stress to biological measures. In order to fully understand the impact of stress, perceived stress is studied in context of the biological pathways make up the stress response. Two biomarkers are particularly helpful in understanding the acute and chronic stress responses, HbA1c and cortisol (Kelly et al., 1997). Finally, exercise and fitness may have stress buffering effects on this negative relationship (Gerber et al., 2010). Therefore, the purpose of this investigation was to explore the impact of perceived stress and fitness on cortisol and HbA1c, biomarkers of stress, in a group of university administrators, the impact of gender on these relationships was also of interest. It was hypothesized individuals with higher stress would display a more negative biomarker profile, higher values of cortisol and HbA1c. Fitness was hypothesized to positively influence the biomarkers, resulting in lower values. Men were hypothesized to have higher values of cardiorespiratory fitness but gender was not hypothesized to impact the two biomarkers or the relationships between stress, fitness, and the biomarkers.

## CHAPTER THREE

## METHODOLOGY

This study was designed to examine the impact of fitness and stress on HbA1c and salivary cortisol in a group of select university administrators. HbA1c and salivary cortisol are two biomarkers of health that are used to measure the responses of the sympathetic nervous system and HPA axis, respectively. The sympathetic nervous system is the first system to respond in stressful situations while the HPA axis is responsible for the long-term adaptations to stress. These systems are of interest in university administrators as this group experiences consistently high levels of job-related stress (Karsli & Baloglu, 2006; Lazaridou et al., 2008; Rasch et al., 1986). Gender differences in the absolute values of and the relationships between the stress and fitness variables were also explored.

### Participants

Select university administrators were recruited from a mid-sized university located in the Midwest with approximately 23,000 students. It offers nearly 200 academic programs. This institution has achieved the highest Carnegie Classification, based on the number and diversity of doctoral degrees awarded and research grants received.

Participants were recruited by sending letters to all select level administrators with job titles of Chancellor, Provost, Vice Chancellors and Vice Provosts of the university, and Deans and Associate Deans at the college level. The letter included detailed information about the purpose of the study, testing protocol, and time commitments (Appendix A). Letters were sent by campus mail to 42 administrators with the selected job titles; nine administrators agreed to participate following this initial invitation. A follow-up email was sent to administrators who did not reply within 10 business days. An additional 16 administrators agreed to participate following the email, bringing the total number to 25. Administrators formally agreed to participate by providing informed consent (Appendix B). The Institutional Review Board (IRB) and Institutional Biosafety Committee (IBC) approved all aspects of the project (Appendices C and D).

**Testing Procedures**

After an administrator agreed to participate, a testing time was scheduled and a packet of information sent to the participant. This packet included a health history questionnaire, the University Administrative Concerns Questionnaire (UACQ), and detailed instructions to prepare them for the laboratory testing (Appendices E-G). The packet was sent to the administrator no more than seven days prior to their laboratory appointment to limit the time between completion of the questionnaires and physical testing.

**University Administrative Concerns Questionnaire**. Perceived Stress was measured using the UACQ. This 29-item scale measures four different types of stress university administrators experience: role-based, task-based, conflict-mediating, and social-confidence stress. This instrument was originally developed to identify and measure the primary types of stress experienced by university administrators (Rasch et al., 1986). For the purpose of this study, total stress (sum of all 29 items) was used for analysis. Responses were based on a 5-point Likert-type scale for how often the administrators were bothered by different work-related situations. Therefore, the questionnaire has a minimum score of 29 and a maximum score of 145. Participants were instructed to complete this questionnaire at their leisure during the week leading up to their physical testing.

**Health History Questionnaire.** Participants were asked to complete a questionnaire about their health history, including health conditions that they currently have, ones they have had in the past and family history of conditions. This form also asked about any over-the-counter or prescription medications the participants took. This information was important to determine their risk stratification for exercise testing and to identify any medical conditions or current medications that would impact the biomarkers of interest.

**HbA1c.** HbA1c is a form of hemoglobin that has been exposed to glucose causing glycosylation of the protein. This reaction occurs in proportion to the amount of glucose present; more hemoglobin becomes glycated when blood glucose levels are high. Therefore HbA1c serves as a marker for blood glucose levels over the previous 2-3 months. HbA1c was measured using the A1CNow+® system. The A1CNow+® system is a point-of-care (POC) instrument which provides a capillary blood HbA1c measurement. Research has shown this POC test to be well correlated to laboratory testing of venous blood draws, with correlations ranging from $r$ = .893 to .918 (Arrendale, Cherian, Zineh, Chirico, & Taylor, 2008; Leal & Soto-Rowen, 2009).This testing method required a 5uL sample of blood from a finger prick. The participant did not need to fast prior to testing. The blood was collected in a pipette and then expelled into an analysis cartridge. The cartridge was processed by the A1CNow+® system; results were available in approximately five minutes. The used cartridge and all other supplies used to process the sample were then disposed of in the appropriate biohazard containers.

**YMCA Cycle Ergometry Test.** Cardiorespiratory fitness of the participants was estimated using the YMCA Cycle Ergometry test. This test is a commonly used submaximal test from which maximal cardiorespiratory fitness can be estimated. This protocol was selected for the project because it is appropriate for individuals of various fitness levels and subjects typically feel less anxious about cycle tests than they do about treadmill tests (Thompson et al., 2010).

The protocol for this test consists of two to four stages of continuous cycling at 60 revolutions per minute. The stages were generally three minutes in duration and heart rate was taken during the final 30-seconds of the second and third minutes. If these two heart rates vary by greater than five beats per minute (bpm), a fourth minute is added to the stage for the heart rate to stabilize. The first or warm-up stage of the test is the same for all participants at 180 kgm/min. The resistance for stage two is determined by the participant's heart rate during stage one. If the participant has a heart rate of less than 80 bpm during the first stage, the resistance for stage two is set at 900 kgm/min. If the stage one heart rate is between 80 and 90 beats bpm, the resistance is set at 720 kgm/min. Resistance is set at 540 kgm/min if the stage one heart rate is 90 to 100 bpm. Finally, resistance is set at 360 kgm/min if the heart rate is 100 bpm or greater. Resistances for stages three and four are set at 180 and 360 kgm/min greater than stage two, respectively (Appendix H).

The test is concluded when the participant completes four stages, or achieves a measured heart rate of 110 beats per minute or greater for two consecutive stages. Maximal oxygen consumption is estimated by plotting the participant's heart rate at the end of each stage against the ergometer's workload settings for each stage completed. A regression line is then added to the plot and the intersection of this line with the participant's age-predicted maximal heart rate estimates the workload at which the participant would reach their age-predicted maximal heart rate. Maximal oxygen consumption is the estimated using the formula for determining metabolic calculations for cycling (Thompson et al., 2010).

The test is terminated if the participant requests to stop, or shows signs and/or symptoms that indicate the test should be stopped. These signs and symptoms include, but are not limited to, shortness of breath, dizziness, nausea, abnormal changes in blood pressure, or noticeable changes in heart rhythm (Thompson et al., 2010).

One participant was unable to complete the YMCA protocol for health reasons, so a regression formula was used to estimate cardiorespiratory fitness based on physical activity level (PA), age, body fat percentage (BF), and gender, Equation 1. This formula has been found to accurately estimate cardiorespiratory fitness (Nieman, 2010).

$$VO_{2max} = 50.513 + (1.589 \times PA) – (0.289 \times Age) – (0.552 \times BF) + (5.863 \times Gender) \quad (1)$$

Where male=1 and female=0

**Salivary Cortisol.** Cortisol is the primary hormone measured to examine the status of the HPA axis. This axis serves as the primary communication between the central nervous system and the endocrine system during times of stress (Kirschbaum & Hellhammer, 1989). Although cortisol levels may be assessed through blood samples, saliva samples are an ideal method of assessing cortisol because saliva contains the biologically active form of cortisol (unbound cortisol) and allows samples to be collected easily during the course of the day, rather than arranging for blood samples to be taken.

Saliva samples were collected using Salivettes by the participants on a Monday and Tuesday at specific intervals while executing their normal daily activities. The collection times selected are based on the work of Powell et al. (2002), who examined the cortisol patterns of middle-aged women. The testing times were upon waking, 20 minutes after waking, 12:00 pm, 6:00 pm, and 9:00 pm. The first two collections varied based on the waking time of the individual. Previous research has shown that the awakening cortisol response is similar regardless of the wake time (Pruessner, Hellhammer, Prussner, & Lupien, 2003). Mondays and Tuesdays were select for data collection because research indicates stress for working individuals to be higher Monday through Thursday than on the Fridays and the weekend (Schneider et al., 2004). Additionally, collection of saliva samples was scheduled for days when the administrators were not traveling. Although the stress of traveling is a regular aspect of administrators' duties, this was done to increase adherence to the collection time protocol and to allow for timely pick-up and proper storage by the investigator. Participants were given specific instructions on collection of the samples and were asked to set alarms on a personal electronic device to remind them of collection times (Appendix G).

***Transportation and storage.*** Saliva samples were picked up daily from the participants. The samples were transported in airtight containers separate from any unused Salivettes to the laboratory for storage. Saliva samples were stored in a refrigerator away from unused Salivettes and any hazardous materials. Away from the laboratory, the samples were stored in the same manner, but not refrigerated. Salivary cortisol is stable at room temperature for up to three weeks, but may begin to mold after four days. For this reason, samples were refrigerated when returned to the laboratory and frozen prior to analysis.

***Laboratory analysis.*** The saliva samples were analyzed using an enzyme immunoassay kit while following all provided instructions, outlined below (Salimetrics, LLC, State College, PA). To prepare for the analyses, the saliva samples were thawed and all reagents and the 96-well microtitre plate were brought to room temperature. Then the samples were centrifuged in an Allegra 6R centrifuge at 1500 × g (2500 rpm) for 20 minutes (Beckman Coulter, Inc., Fullerton, CA). The resulting supernatant was used for analysis of salivary cortisol.

Prior to the analysis, the layout of the plate was established. This included determining placement of the seven known standards, high and low controls, and unknown salivary cortisol samples. Duplicate wells were used for all solutions. Two non-specific binding wells and two wells that contained only assay diluent (zero wells) were also included in the plate.

After determining the layout, 25 µl of each standard, control, and salivary supernatant were pipetted into the designated wells. Next, a 1:1600 dilution of the cortisol enzyme conjugate was mixed using 15µl of the conjugate and 24 mL of the assay diluent. Using a multichannel pipette, 200 µl of the diluent was then added to each well. The plate was then mixed on a mini-orbital shaker (Bellco Biotechnology, Vineland, NJ) for 5 minutes and incubated at room temperature for 55 minutes. Then, the plate was washed five times using a phosphate buffer solution and a microplate strip washer (ELP-40 Bio-Tek Instruments, Inc., Winooski, VT). After the wash, 200 µl of the substrate tetramethylbenzidine was added to each well. The plate was then mixed on the plate rotator (Bellco Biotechnology, Vineland, NJ) for an additional 5 minutes and incubated in a dark room for 25 minutes. The final addition was 50 µl of 3M sulfuric acid stop solution before a final mixing on a plate rotator (Bellco Biotechnology, Vineland, NJ) for 3 minutes. The plate was read within 10 minutes on a Victor-3 V 1420 multilabel counter at 490 nm (Perkin-Elmer Lifesciences, Wellesley, MA). This reading gave the optical density of each well. Duplicate wells that did not have consistent optical density readings were reanalyzed.

Cortisol concentrations were then determined through a series of calculations. The first calculation was to determine the average optical density for each set of duplicate wells. This average was calculated for each standard, control, salivary cortisol sample, non-specific binding and zero well. Next, the average optical density of the non-specific binding wells was subtracted from the average optical density for each standard, control, and saliva sample. Then the percentage bound for each standard, control and unknown was determined by dividing the average optical densities by the average optical density of the zero wells. Finally the concentrations of controls and saliva samples were determined by fitting them to a standard curve using equations provided by the manufacturer of the enzyme immunoassay kits (Salimetrics, LLC, State College, PA).

***Determination of area-under-the-curve.*** For each day of cortisol collection, area-under-the-curve (AUC) was determined based the work of Pruessner, Kirschbaum, Meinlschmid, and Hellhammer, (2003). This method involves graphing the diurnal curves of the measurements and then determining the AUC under the line connecting the first two consecutive cortisol measures. The formula used to determine the AUC is derived from the formula used to calculate the area of a trapezoid. This process was repeated with the next two consecutive measurements and the next two, until the area between each set of consecutive measurements was determined. The total AUC for the day was the sum of each of these AUC values (Pruessner et al., 2003). This method is considered the area-under-the-curve with respect to ground ($AUC_G$) and is useful because it considers both the difference between sets of consecutive measurements (sensitivity) and the distance of these measurements from zero (intensity) (Fekedulegn et al., 2007).

**Statistical Analysis.**

Data were analyzed using SAS 9.2 (SAS Institute, Inc., Cary, NC). Three steps were taken prior to hypothesis testing, to screen the data and to ensure proper statistical measures were used. First, data were screened for normality and outliers using Shaprio-Wilk's test for normality and z-scores for potential outliers. A z-score greater than 2.5 standard deviations was considered significant. Second, the correlation matrix for all variables of interest was examined to determine if gender differences should be examined univariately or multivariately. Finally, variance-covariance matrices for the variables of interest were developed for each gender. The purpose of these matrices was to determine if the relationships between variables should be studied for the entire group or separately for each gender.

Based on these preliminary analyses, it was determined that eight analyses were needed to test the eight research hypotheses. This included four unpaired *t*-tests and four multiple regression analyses. The overall alpha level was set at $\alpha = .05$, with corrections made based on the number of analyses.

**Hypotheses one, two, three, and four.** A series of four unpaired *t* tests were conducted to compare males and females on the variables of perceived stress, cardiorespiratory fitness, HbA1c and cortisol AUC. The alpha level for each of these analyses was set at $\alpha = .01$, according to Bonferoni's correction for multiple analyses.

**Hypotheses five and six.** Two multiple regression analyses, one each for males and females, were used to regress perceived administrator stress, and cardiorespiratory fitness on cortisol AUC. When appropriate, individual predictors were examined using *t*-scores. The alpha level for the multiple regression models and individual predictors was set at $\alpha = .05$.

**Hypotheses seven and eight.** Two multiple regression analyses, one for males and one for females, were used to regress perceived administrator stress, and cardiorespiratory fitness on HbA1C level. T-scores were again used to judge the significance of the individual predictors. The alpha level for all analyses was set at $\alpha = .05$.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

The purpose of this study was to investigate the relationships between perceived stress, fitness, and biomarkers of stress in a group of select level university administrators. Gender differences in the variables and relationships between the variables were also of interest. Participants with job titles of Chancellors, Provosts, Vice Chancellors and Vice Provosts of the university, and Deans and Associate Deans at the college level were recruited.

## Results

Forty-two administrators with the selected job titles were recruited to participate in this study, nine administrators agreed to participate following the initial invitation and an additional 16 administrators agreed to participate following a second invitation. The final group of 25 included 15 men and 10 women. All administrators were accepted into the study based on their responses on the Health History Questionnaire. Twenty-four of the participants were able to complete all assessments, while one participant had a medical condition that prevented completion of the YMCA Cycle Ergometer test for estimation of cardiorespiratory fitness. A regression equation was used to estimate cardiorespiratory fitness for this individual. Descriptive statistics for the subjects are presented in Table 1.

Although electronic timers were used to help remind the participants to take their saliva samples at the necessary times, a few of the samples were missed. One participant missed the entire first day of samples, resulting in five missed samples. Another participant missed the first two samples of day one, making calculation of AUC to be inaccurate because the awakening peak was missed. Two days of samples were collected because a reliable “typical” AUC concentration cannot be obtained from only one day of measurements (Kudielka, Gierens,

Table 1

*Descriptive Statistics*

| | M ± SD | Minimum | Maximum |
|---|---|---|---|
| Age | 56.41 ± 7.90 | 37.10 | 67.70 |
| Perceived Stress Score | 67.92 ± 12.00 | 46.00 | 99.00 |
| $VO_2$ [a] | 29.82 ± 5.98 | 17.35 | 40.00 |
| HbA1C [b] | 5.66 ± 0.55 | 5.66 | 7.90 |
| AUC Cortisol [c] | 2.56 ± 1.22 | 0.65 | 5.00 |

[a] Measured in ml/kg/min. [b] Measured in percentage. [c] Measured in µg/dL.

Hellhammer, Wust, & Schlotz, 2012). However, in this group of administrators, cortisol AUC was found to be significantly correlated between the two days of testing, $r = .611$, $p < .01$. Therefore, the values for cortisol AUC for the two days were averaged to obtain a summary measure for the purposes of data analysis. Figure 1 displays the average cortisol levels for over the course of the two days for males and females.

Individual results for estimated cardiorespiratory fitness and HbA1C were compared to normative values. Results of the cardiorespiratory endurance test indicated a wide range of fitness levels in the participants, ranging from 17.35 to 40.00 mL/kg/min. However, based on the age and gender of the participants the results were more homogenous, two participants were classified as having fair fitness levels, 12 had average fitness levels, and 11 had good fitness levels. No participants were classified as having low, high, or very high fitness levels, the classifications at the extremes of the fitness continuum. This lack of participants with a low fitness level may be a result of two factors. First, this finding is in line with research that indicates that those with high levels of education tend to be more aerobically fit (Barnes, Yaffe, Satariano, & Tager, 2003). Second, it may be an indication of self-selection. The administrators knew that fitness was a key component of the study; therefore it is likely that the administrators who volunteered already had an interest in exercise and fitness and may have had higher fitness levels than the administrators who chose not to participate.

Normal HbA1c levels range from 4.0 to 6.0% for non-diabetic individuals. Twenty-four of the subjects were non-diabetic and all had HbA1c levels within the normal range. One participant was diabetic and had an HbA1c level outside of the normal range.

Prior to hypothesis testing, the variables were analyzed for normality and outliers. The Shaprio-Wilk's test for normality indicated total perceived stress, estimated cardiorespiratory

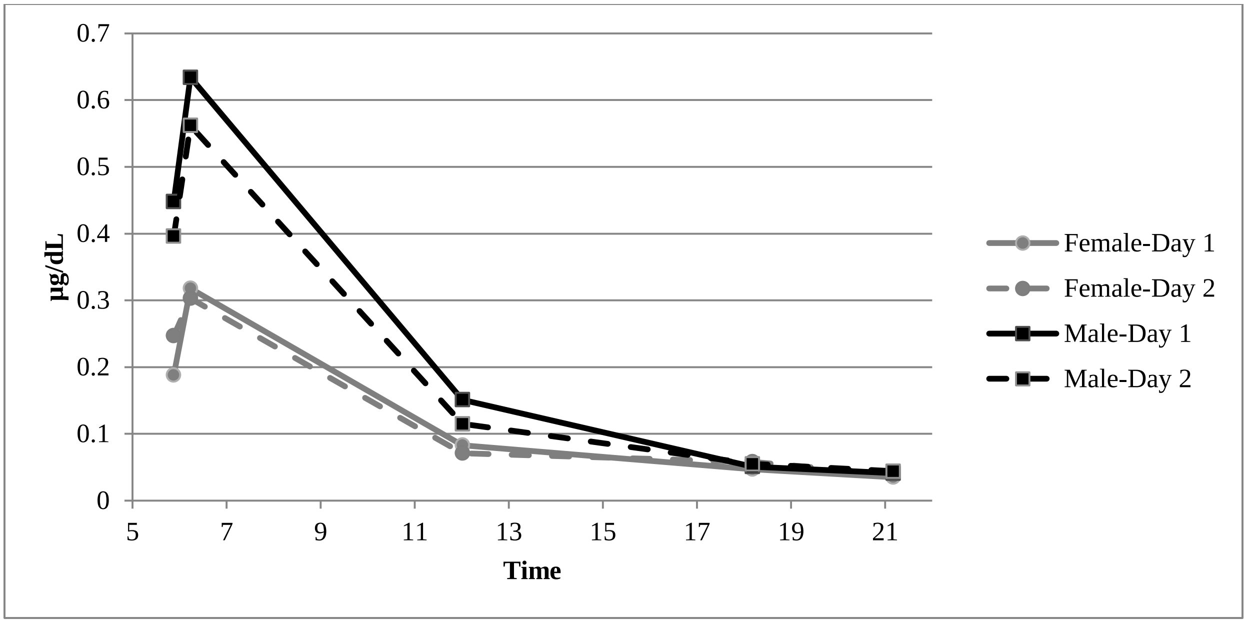


Figure 1. *Daily Cortisol Concentrations for Males and Females*

endurance, HbA1c, and cortisol AUC to all be normally distributed. Two outliers were also identified during this testing. One total perceived stress score was found to be an outlier, with a z-score of 2.59 standard deviations above the mean. This perceived stress score was examined and determined to be calculated correctly, the data point remained in the analysis because it accurately represented the subject's reporting of their administrative stress level. The second outlier was the HbA1c value for the diabetic subject, with a z-score of 4.05 standard deviations above the mean. This data point was removed from the data set because of the strong impact that diabetes has on HbA1c levels, which would supersede any impact of stress may have on the value.

In addition to testing for normality and outliers, correlations between the variables were examined to determine if gender differences should be examined univariately or multivariately. A multivariate analysis is appropriate when the variables of interest are correlated, while univariate analyses are used when the variables are not. The results of the correlation matrix indicated no significant correlations between variables to be compared for males and females. Therefore, a univariate approach was determined to be appropriate. The correlations between the variables can be found in Table 2.

Variance-covariance matrices for the variables of interest were also developed for each gender. The purpose of these matrices was to determine if the relationships between variables should be studied separately for the genders. The results of the matrices indicated that some of the relationships differed in magnitude and/or direction for men and women. Therefore, all subsequent analyses were conducted separately for men and women. Tables 3 and 4 display the variance-covariance matrices for males and females, respectively.

Table 2

*Pearson Correlation Coefficients*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Perceived Stress | 1.000 | .074 | -.084 | .154 |
| $VO_2$ | | 1.000 | -.369 | .287 |
| HbA1C | | | 1.000 | -.021 |
| Cortisol AUC | | | | 1.000 |

Table 3

*Variance Covariance Matrix for Males*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Perceived Stress Score | 163.210 | 37.696 | -1.101 | 5.225 |
| $VO_2$ | | 26.276 | -0.468 | 2.012 |
| HbA1C | | | 0.110 | -0.047 |
| Cortisol AUC | | | | 1.471 |

Table 4

*Variance Covariance Matrix for Females*

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Perceived Stress Score | 125.378 | -39.408 | 0.891 | -0.010 |
| $VO_2$ | | 48.033 | -1.215 | -0.213 |
| HbA1C | | | 0.073 | -0.016 |
| Cortisol AUC | | | | 0.553 |

Based on the preliminary analyses, it was determined that eight analyses were needed to test the eight research hypotheses. This included four unpaired *t*-tests and four multiple regression analyses. The overall alpha level was set at $\alpha = .05$, with corrections made based on the number of analyses. Hypotheses one through four were assessed with four *t*-tests to compare males and females on the variables of interest, perceived stress, cardiorespiratory fitness, HbA1c and cortisol AUC. *T*-tests were chosen over a multivariate analysis because the variables to be examined were not significantly correlated. Two multiple regression analyses were used to determine if perceived administrator stress and cardiorespiratory fitness were significant predictors of cortisol AUC for males and females. Finally, two more multiple regression analyses determined if perceived administrators stress and cardiorespiratory fitness were significant predictors of HbA1c levels in males and females.

***Hypotheses one, two, three, and four*.** A series of four unpaired *t* tests were conducted to compare males and females on the variables of perceived stress, cardiorespiratory fitness, HbA1c, and cortisol AUC. The alpha level for each of these analyses was set at $\alpha = .01$, according to Bonferoni's correction for multiple analyses.

The results indicated that three of the variables did not significantly differ between males and females; perceived administrative stress, $t\ (23) = 0.50$ $p = .62$, cardiorespiratory fitness, $t\ (23) = -1.28$ $p = .21$, and HbA1c, $t\ (23) = -0.57$ $p = .57$. Cortisol AUC, was determined to be significantly different between the genders, $t\ (23) = -3.00$ $p = .0064$. Males had significantly higher average cortisol AUC levels than did females, at 3.08 and 1.78 µg/dL, respectively. Table 5 displays the results of the series of *t*-tests.

Effect sizes were also calculated using Cohen's *d* for each of the gender comparisons. Small effect sizes were found for perceived administrative stress, $d = 0.13$, and HbA1c, $d = 0.24$.

Table 5

*Gender Comparisons*

| | Men | Women | *p* value |
|---|---|---|---|
| Age | 57.23 ± 8.64 | 55.19 ± 6.89 | .54 |
| Perceived Stress Score | 66.93 ± 12.78 | 69.40 ± 11.20 | .62 |
| $VO_2$ [a] | 31.05 ± 5.13 | 27.97 ± 6.93 | .21 |
| HbA1C [b] | 5.59 ± 0.33 | 5.52 ± 0.27 | .57 |
| AUC Cortisol [c] | 3.08 ± 1.21 | 1.78 ± 0.74 | .01 |

[a] Measured in ml/kg/min. [b] Measured in percentage. [c] Measured in µg/dL.

A moderate effect was found for the non-significant cardiorespiratory fitness comparison, $d$ = 0.52, and a large effect was found for the significant difference for cortisol AUC, $d$ = 1.22. The large effect size for cortisol AUC indicates a substantial difference in cortisol secretion for male and female administrators. The moderate effect size for cardiorespiratory fitness raises the possibility that meaningful gender differences may exist, but this study did not have sufficient power to detect the difference because of the small sample size.

***Hypotheses five and six.*** Two multiple regression analyses, one each for males and females, were used to regress perceived administrator stress, and cardiorespiratory fitness on cortisol AUC. The result of the overall model for males was non-significant, $F$ (2, 14) = 0.97, $p$ = .41. Perceived stress and cardiorespiratory fitness accounted for 14% of the variance in cortisol AUC. The results of the analysis for females also indicated that perceived stress and cardiorespiratory fitness are very poor predictors of cortisol AUC, $F$ (2, 9) = 0.01, $p$ = .99, accounting for none of the variance. Since neither of the models were significant, the individual predictors were not examined for significance, however, correlations were examined f the directions of the relationships between variables for each gender. Table 6 displays a summary of the regression analyses.

***Hypotheses seven and eight.*** Two multiple regression analyses, one for males and one for females, were used to regress perceived administrator stress, and cardiorespiratory fitness on HbA1C levels. The result of the analysis for males was non-significant, $F$ (2, 13) = 0.58, $p$ = .58, with the predictors accounting for only 9% of the variance. The results of the analysis for females was also found to be non-significant, $F$ (2, 9) = 2.57, $p$ = .15. However, the predictors accounted for approximately 42% of the variance in HbA1c. Once again t-scores were not examined for individual predictors but correlations were examined for direction of relationships.

Table 7 displays a summary of the regression analyses.

Table 6

*Summary of Regression Analyses for Variables Predicting Cortisol AUC*

| Variable | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|
| | *b* | *SE b* | β | *p* | *b* | *SE b* | β | *p* |
| Intercept | 0.22 | 2.11 | 0 | .91 | 2.09 | 2.93 | 0 | .50 |
| Perceived Stress | 0.02 | 0.03 | 0.23 | .50 | -0.00 | 0.03 | -0.03 | .94 |
| $VO_2$ | 0.05 | 0.08 | 0.19 | .57 | -0.01 | 0.05 | -0.06 | .90 |

*Note*. $R^2$ = .14 for men and .00 for women.

Table 7

*Summary of Regression Analyses for Variables Predicting HbA1c*

| Variable | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|
| | *b* | *SE b* | β | *p* | *b* | *SE b* | β | *p* |
| Intercept | 6.27 | 0.64 | 0 | < .01 | 6.33 | 0.81 | 0 | < .01 |
| Perceived Stress | -0.00 | 0.01 | -0.16 | .65 | -0.00 | 0.01 | -0.05 | .89 |
| $VO_2$ | -0.01 | 0.02 | -0.19 | .58 | -0.03 | 0.01 | -0.67 | .08 |

*Note*. $R^2$ = .09 for men and .42 for women.

**Discussion**

The mean total perceived stress score for the current group of administrators (67.64 ± 12.16) was similar to that found in the Rasch et al. (1986) study for central administrators and Deans (64.78 ± 16.54). This appears to indicate that administrators at this institution do not feel considerably more stress than those 25 years ago. However, the roles of university administrators will continue to evolve with changes in higher education, so research concerning stress and stress management in this group will continue to be important for helping them preserve their health and serve the university community.

The result of the gender comparison for perceived stress, cardiorespiratory fitness, HbA1c, and cortisol AUC, are mixed in regards to agreement with the reviewed literature. First, in this study, male and female administrators reported very similar levels of perceived stress, with the average score for males to be 66.93 and females to be 69.40. The minimum possible score was 29 and maximum score was 145.  The effect size for this comparison was very small, $d = 0.13$, indicating the likelihood of a meaningful gender difference to be very low. This finding is in agreement with Rasch et al. (1986) who also studied administrators with similar job titles and found no gender difference in stress using the UACQ. In contrast, a study of community college presidents, found female presidents to be significantly more stressed than males using a questionnaire specifically aimed at the types of stress that community college president experience (Radliff-Dawson, 2004).This contrast in findings may be a result of the use of different administrative stress instruments or differences in the type of administrators surveyed; administrators of various titles versus community college presidents only.

Although male and female administrators reported similar levels of perceived administrator stress, male administrators were found to have significantly higher levels of cortisol AUC than female administrators. The large effect size found for this comparison indicated a meaningful difference in cortisol levels. The reviewed literature is mixed on if cortisol secretion varies by gender. Studies by Maina et al. (2009) and Kirschbaum, Kudielka, Gaab, Schommer, and Hellhammer (1999) have found men to have significantly higher levels of cortisol secretion, while others have found no differences in levels (Kunz-Ebrecht et al., 2004; Kurina et al., 2004). Additionally, men have even been found to have greater cortisol response while anticipating a laboratory stressor (Kirschbaum et al., 1992). Part of the difficulty in interpreting gender differences in cortisol secretion is that some research has found the phases of the menstrual cycle to influence levels (Kirschbaum et al., 1999). That particular study found men and women in the luteal phase to have similar levels, while women in the follicular phase or on oral contraceptives to have lower levels. This group attributed cortisol concentration differences during the different cycles to the varying levels of estrogen present. In the current study, menstrual cycle was not controlled for, as only two of female participants were premenopausal, while the remaining eight were post-menopausal. The two premenopausal females had cortisol AUC values that were very similar to the values for those who were postmenopausal, therefore menstrual cycle phase likely played a small role the gender difference found in cortisol AUC. However the role of estrogen cannot be determined since it was not measured.

Despite the fact that men appear to have greater cortisol responses to acute and anticipated stressors, females have been found to have equal or greater cortisol increases to hormonal stimulation of the HPA axis (Uhart et al., 2006). This finding indicates that lower cortisol secretion by females during real-life stressors is not a result of low responsiveness of the system. Taken together, these results support a disconnect between perceived stress and cortisol secretion.

A gender difference was not found in HbA1c level, which is in agreement with limited research regarding HbA1c levels in healthy adults (Corwin et al., 2006). This finding is also supported by the fact that guidelines for normal HbA1c levels do not differ for men and women (Meigs et al., 1996).

The finding of no significant difference in cardiorespiratory fitness between male and female administrators was surprising but the presence of a moderate effect size raises the possibility that a substantial difference exists, but this study did not have sufficient power to detect the difference because of the small sample size. In fact, all of the widely used normality data for classifying cardiorespiratory fitness show men to have higher absolute and relative oxygen uptakes than females at any given fitness level (Thompson et al., 2010). Based on this fact, although cardiorespiratory fitness was not found to be different in males and females in this study, gender should still be considered when examining the relationship between cardiorespiratory fitness and stress in future studies.

The results of the variance covariance matrices and regression analyses indicate that the relationships between perceived stress, fitness, and biomarkers of stress differ between male and female university administrators. Based on this observation, multiple regression analyses were conducted separately for men and women to predict the biomarkers of cortisol AUC and HbA1c.

The model predicting cortisol AUC from perceived stress and fitness for female administrators was found to be particularly poor, accounting for none of the variability in cortisol AUC. In fact, the correlation between both perceived stress and cardiorespiratory fitness and cortisol AUC was essentially zero. This finding indicates that for female administrators factors other than administrator stress and fitness determine variability in cortisol secretion. This finding was consistent with other research that found no relationship between cortisol secretion and reported stress in a variety of populations (Kurina et al., 2004; Ockenfels et al., 1995; Rose, Jenkins, Hurst, Herd, & Hall, 1982; Rose, Jenkins, Hurst, Livingston, & Hall, 1982). The authors of some of these studies contented that individuals adapt to repeated stressors readily and that HPA axis activation occurs only in response to new stressors (Kurina et al., 2004).

The findings for predictive power of perceived administrator's stress and cardiorespiratory fitness of cortisol AUC in male administrators was similar to females with a small, non-significant proportion of the variability accounted for, 14%. However, the simple correlation between perceived stress and cortisol AUC ($r = .34$) trended in the hypothesized direction. This finding is in agreement with other studies that have found links between perceived stress and increased cortisol levels (Luecken et al., 1997; Powell et al., 2002). The sources of stress for these studies included work-related as well as personal stress.

The positive correlation between cardiorespiratory fitness and cortisol AUC ($r = .32$) was opposite to the hypothesized direction, indicating that male administrators with higher fitness levels also showed greater cortisol secretion. This hypothesis was based on limited research that indicated individuals with higher fitness levels were found to have lower morning cortisol levels and less of a cortisol response to an acute stressor than lower fitness individuals (Bosco, Tihanyit, & Viru, 1996; Rimmele et al., 2007; Traustadóttir et al., 2005). Other studies have found no relationship between cardiorespiratory fitness levels and cortisol secretion (Ritvanen, Louhevaara, Helin, Halonen, & Hanninen, 2007). However, this seems to be the first study to have found a trend towards a positive relationship between the two factors.  This positive relationship may be a function of the personality types that pursue careers in administration. Typically these individuals function at a very level in many areas of the lives. Therefore, they may see exercise as a priority but also feel pressure to perform this too at a very proficient level, but they may not make enough time to do so.

A second potential reason for the lack of significant associations between perceived stress and cortisol AUC is related to noise within the model. Although cortisol AUC was significantly correlated between the two days of sampling, $r = .61$, there was still a great deal of intra-individual variability. A number of factors have been found to influence cortisol secretion, including previous physical activity, sleep quality, and acute illness to name a few (Hill, Zack, Battaglini, Viru, & Hackney, 2008; Kudielka et al., 2012; Ritvanen et al., 2007). Although alterations in these factors are sometimes related to stress, they may also occur organically. Therefore, stress-related changes in cortisol secretion may be masked by variations caused by other influential factors.

Another source of error when examining perceived stress is reporting bias. Reporting a high stress level, by someone in a position of authority such as an administrator, may be seen as socially undesirable (Gerber et al., 2010). As a result, the university administrators may have reported their perceived stress to be lower than it actually was because of the stigma associated high stress. Therefore, the correlations between the UACQ and biomarkers may have been influenced by under-reporting of stress.

The overall model predicting HbA1c for females was found to be non-significant, however the model accounted for 42% of the variance. In particular, there was a strong negative relationship between fitness and HbA1c levels ($r = -.65$). This finding is consistent with other cross-sectional studies that have shown healthy adults with high HbA1c (>7%) to have significantly greater odds of being categorized as having poor cardiovascular fitness than individuals with lower HbA1c levels (<5%) (Agarwal, Kumar, & Kapadia, 2012). Associations between these variables have also been found in longitudinal studies. For example, an exercise intervention for type 2 diabetics improved both cardiovascular fitness and HbA1c levels. Furthermore, the changes in maximal cardiovascular fitness and HbA1c were found to be significantly correlated. Although this does not infer causation, the authors attributed the improvements in HbA1c to improvements in glucose control achieved through the aerobic exercise (Larose et al., 2011).

Although a negative relationship between cardiorespiratory fitness and HbA1c levels was hypothesized, the strength of the relationship ($r = -.65$) is surprising in female administrators. In contrast to the studies mentioned above with similar results, the female administrators in the current study all had values of cardiovascular fitness and HbA1c within the healthy range. The strength of association was surprisingly strong because when the range of a particular variable is restricted, as in this case, the correlation is lower than for the entire population. Therefore, the association for the larger population of female administrators is likely greater because of entire range of fitness and HbA1c levels would be examined. It should be noted that a negative correlation was also found between cardiorespiratory fitness and HbA1c levels in males, but the association was considerably weaker, $r = -.28$. Therefore, the benefits for aerobic exercise related to glucose control may be beneficial not only for diabetics but also individuals with normal HbA1c levels.

The most prominent gender discrepancy found in this study was in the relationships between perceived stress and HbA1c. In female administrators, this relationship was found to be positive, the hypothesized direction, with a correlation of $r = .29$. In males, this correlation was $r = -.26$. A positive relationship was hypothesized because of reviewed literature that has indicated a correlation between job dissatisfaction and stress to elevated HbA1c levels in studies including a variety of populations (Kawakami et al., 1989; Netterstrøm & Sjøl, 1991; Xu et al., 2012). In fact, HbA1c has been linked strongly enough to stress that it is included in the allostatic load model used by many researchers to study stress (Kudielka & Kirschbaum, 2007; McEwen & Seeman, 1999). However, this study is not the only study to find gender differences in the relationship between perceived stress and factors related to HbA1c. A study by Heraclides, Chandola, Witte, and Brunner (2009) found that job strain was related to the risk of type 2 diabetes in women but not men. The authors attributed the difference they found to fewer females reaching the higher levels of employment, exposing them to greater job strain. Employment level was not a factor in the current study, as all subjects were upper level administrators. However, the authors also mentioned, but did not believe it was a factor in their study, that men were more likely to underreport perceived work-related stress, which would influence the relationship between it and HbA1c (Heraclides et al., 2009). In the current study, male administrators reported slightly less stress than females, which makes it plausible that males may have underreported.

Another interesting observation for this group of administrators was that the relationship between perceived stress and estimated cardiorespiratory fitness was very different in men and women. In men, there was a significant positive correlation between the two variables, $r = .58$, $p = .02$, meaning that men with higher fitness levels also have higher perceived stress. However, in women there was a trend towards a negative relationship between fitness and perceived stress, $r = -.51$, $p = .13$. Women with higher fitness levels reported lower administrator stress. The literature typically reports a negative relationship between these variables, similar to the trend for women (Ensel & Lin, 2004; Fox, 1999; Gerber et al., 2010). This trend for men may be a reflection that they engage in physical activity for stress reduction and that activity may improve their aerobic fitness but has little impact on the stress they perceive.

In conclusion, the results of this study indicate male and female administrators report similar levels of administrative stress and have similar cardiorespiratory fitness and HbA1c levels. However, differences in cortisol secretion levels and the direction and magnitude of the relationships between the fitness and stress related variables indicate gender differences in the ways that perceived stress, fitness, and biomarkers of stress interact in males and females.

Additionally, the generalizability of the results of this study is limited to upper level university administrators at institutions such as this. Other university administrators, such as department chairs, and program directors, experience different kinds and levels of stress that were not explored in this study. Furthermore, administrators at higher educational institutions with different focuses face different levels of stress that were not explored in the current study.

# CHAPTER FIVE

## Summary

The goal of the current study was to investigate the relationships between perceived stress, fitness, and biomarkers of stress in a group of selected university administrators, with special interest in how these variables interacted for each gender.

A total of 25 university administrators, 15 males and 10 females, agreed to serve as subjects. All of the subjects were accepted into the study based on their health history questionnaires. Subjects were asked to complete the UACQ to assess perceived job related stress, provide two days of saliva samples to assess cortisol levels, undergo a finger-stick blood test of HbA1c, and performance of the YMCA Cycle Ergometer test to estimate cardiorespiratory fitness. Twenty-four of the participants were able to complete all assessments, while a regression equation was used to estimate the cardiorespiratory fitness of one subject who could not complete the YMCA Cycle Ergometer test because of a health condition.

The results of this study indicate some gender similarities and differences in the absolute values of and relationships between perceived stress, cardiorespiratory fitness, and biomarkers of stress. Male and female administrators had similar levels of perceived stress, cardiorespiratory fitness, and HbA1c. The relationship between cardiorespiratory fitness and HbA1c was also negative for both genders, as hypothesized. This negative relationship indicates that those with higher fitness levels have better glycemic control. This finding is supportive of the importance of aerobic activities in maintaining desirable blood glucose levels in health adults, not just diabetics.

Gender differences in the results included that the males secreted significantly more cortisol and some of the relationships between the fitness- and stress-related variables were in opposite directions for males and females. In particular, male and female administrators exhibited opposite trends in the relationship between perceived stress and HbA1c levels. In females, the direction of the relationship was as hypothesized, positive; those with higher stress levels also had higher HbA1c levels. In males, this relationship was negative. Another interesting gender difference was in the relationships between perceived stress or cardiorespiratory fitness and cortisol AUC. In females, the correlations for both of these relationships were nearly zero, while in males, non-significant but positive relationships were found between both perceived stress and cardiorespiratory fitness and cortisol AUC. The positive relationship between perceived stress and cortisol AUC in males was as hypothesized, while a negative relationship was hypothesized between cardiorespiratory fitness and cortisol but the results indicated a positive relationship.

**Conclusions**

University administrators have very complex job responsibilities that lead them to experience a great deal of occupation-related stress (Karsli & Baloglu, 2006). The stress levels of administrators, as well as other occupations, if chronically elevated may negatively impact the health of these individuals (Agardh et al., 2003; Kivimäki et al., 2006; Peltzer et al., 2009). However, exercise and fitness have been promoted to buffer the negative health effects of stress (Gerber et al., 2010).

The findings of this study demonstrate that despite similarities in the mean values of many of the variables of interest, the associations between perceived stress, fitness, and biomarkers of stress were different for male and female administrators. This indicates that simple mean comparisons cannot tell the whole story in regards to gender differences in perceived stress, fitness, and biomarkers of stress; rather the relationships between the variables should be examined separately for each gender before looking at overall trends for combined groups.

In addition to demonstrating that the variables of interest interact differently in men and women, this study is unique because university administrator stress has been studied almost exclusively using qualitative means to date. This is especially true in regards to the stress that female administrators experience. Researchers have typically interviewed female administrators to identify and explain their sources of stress. However in these studies, male administrators are not interviewed to provide comparative information. Additionally, only one other study has been found that looks at a physical measures of stress, sleep quality, in connection to perceived stress.

**Recommendations**

Since this was an observational study, causality of the correlations found cannot be determined. Therefore, exercise interventions should be conducted for university administrators and others in high-stress occupations to explore the impact of changes in cardiorespiratory fitness on the biomarkers of stress. A few such studies have been conducted for older adults or individuals with specific medical conditions, but the focus has typically been on perceived stress, rather than biomarkers. The results look promising in regards to improving perceived stress but as the current study and others have shown, perceived stress and biomarkers of the physiological stress response are often weakly correlated. Therefore, it is important to better understand how both perceived stress and biomarkers of stress are impacted by improvement in cardiorespiratory fitness.

The results of this study contradicted the limited research regarding the relationship between fitness and cortisol secretion. The reviewed literature showed either a negative or no relationship between the factors (Bosco et al., 1996; Rimmele et al., 2007; Ritvanen et al., 2007;

Traustadóttir et al., 2005). A study similar to the current one, with a positive relationship between fitness and cortisol AUC, could not be found. Therefore, this is an area for further study. Understanding this underlying relationship between fitness and cortisol secretion is important to better understanding the relationship between perceived stress and exercise and fitness.

As higher education continues to evolve, university administrators will continue to experience high levels of occupational stress; therefore it is imperative for each administrator to find a means of dealing with his or her stress. Although there are many well-promoted stress relief activities, exercise is one of the most common (APA, 2007; Traustadóttir et al., 2005). The results of this study demonstrate that fitness is beneficially associated with the biomarkers of stress, HbA1c, while the relationship between fitness and cortisol AUC is less clear. Based on these promising results and the fact that exercise has been linked to many other benefits not directly related to stress-relief, it should continue to be promoted to those in high-stress occupations.

The lives of university administrators are very busy, with numerous meeting and social obligations; therefore, they may initially find it difficult or intimidating to meet the current ACSM recommendation for 150 minutes of aerobic exercise each week. Although it can be met through 30-60 minutes of moderate activity five days per week or 20-60 minutes of vigorous activity three days per week (Thompson et al., 2010). Therefore, administrators just beginning an exercise program should strive to accumulate physical activity in the acceptable 10 minute bouts, gradually increasing in duration and frequency until meeting the recommendation.

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# APPENDICES

**Appendix A: Recruitment Letter**

February 20, 2012

Dear _________,

I am a doctoral candidate in Exercise Science; Dr. Ro Di Brezzo is my advisor. My dissertation research project is entitled "The Use of Cortisol and HbA1c as Biomarkers of Stress in University Administrators" and I am currently recruiting administrators, such as you, to participate.

The goal of this study is to explore the relationships between perceived stress, fitness levels, and biomarkers of stress in university administrators. I hope to contribute to the understanding of the relationships between the occupational demands of being an administrator and health/fitness.

Undoubtedly, one of your major concerns about participating in research projects is the time commitment. Participating in this study will involve three key components. First you will complete two questionnaires, at your leisure, during the week prior to a physical testing session. The questionnaires require approximately 30 minutes to complete. Second, you will collect your own saliva samples throughout the course of two weekdays (Monday and Tuesday) at eight specific times of the day. Collection of each samples takes approximately 2-5 minutes and can be done while completing other tasks (i.e. driving, answering emails, household chores). Finally you will complete four physical measurements at the Human Performance Lab in the HPER building.

The physical testing includes measures of body composition, glycated hemoglobin, and cardiorespiratory fitness. Two measurements of body composition will be used; seven-site skinfolds and a dual energy X-ray absorptiometry (DEXA) scan. Measurement of glycated hemoglobin requires a finger prick blood test but no fasting is required. Cardiorespiratory fitness will be assessed using a stationary bicycle test that takes approximately 12 minutes. The total testing time will be approximately 45 to 60 minutes.

I hope you will consider participating. If you wish to participate or have any questions, please contact me at your convenience by email or phone. Thank you in advance for considering this research project.

Sincerely,

Jacilyn Olson

Jacilyn Olson

**Appendix B: Informed Consent**

## INFORMED CONSENT

*Title:* The Use of Cortisol and HbA1c as Biomarkers of Stress in University Administrators

*Investigators:*

Jacilyn Olson
Ro Di Brezzo, Ph.D., Faculty Advisor
Human Performance Laboratory
College of Education and Health Professions
Dept. of Health, Kinesiology, Recreation, and Dance
155 Stadium Drive - HPER 321
479-575-7390

Ro Windwalker
Research & Sponsored Programs
Compliance Coordinator
University of Arkansas
120 Ozark Hall

Fayetteville, AR 72701
479-575-2208
irb@uark.edu

*Purpose:* The purpose of this study is to examine the effects of being an administrator in higher education on perceived stress and biomarkers of stress. The relationship of these factors to fitness will also be examined. This study consists of a series of measurements.

*Procedures:* You will complete a Health History Questionnaire and the University Administrative Concerns Questionnaire at your leisure during the week prior to your physical testing. On the Monday and Tuesday prior to your physical testing, you will also be asked to provide saliva samples at eight specific times per day. To obtain these samples you will chew on a small cotton swab until it is saturate with saliva. These saliva samples will be used to determine your pattern of cortisol (a stress hormone) secretion.

At the beginning of the physical testing height and weight will be recorded in a private setting. Your body composition will then be measured by series of skinfolds at seven specific anatomical locations. Two measurements will be taken at each location. Body composition, as well as bone density, will also be assessed with dual energy x-ray absorptiometry (DEXA). For this test, you will be asked to lie still on the DEXA table while the DEXA machine moves over you. This painless procedure takes about 5 minutes to complete. The amount of radiation used by the DEXA machine is about one tenth of the amount you would receive from a chest x-ray.

Your glycated hemoglobin will be measured using the finger stick method. This is a measure of your blood glucose levels over the last 2-3 months. Your finger will be disinfected and then pricked to induce bleeding, 5 µL of blood will be collected. The blood sample will then be analyzed using an automated system. Results will be ready in approximately five minutes.

Fitness will be assessed using the YMCA Cycle Ergometry Protocol. This six to twelve minute test consists of a series of stages. You will likely be able to complete the first stage easily and then the stages will advance depending on your fitness level. The test may be terminated by the attending laboratory personnel at any time because of signs of fatigue. In addition, you may stop when you wish because of personal feeling of fatigue or discomfort. Information you possess about your health status or previous experiences of unusual feelings with physical effort may affect the safety and value of your exercise test. Your prompt reporting of such feelings during the exercise test is of great importance. You are responsible to fully disclose such information when requested by the testing staff.

*Risks and Benefits:* You will not be exposed to more than minimal risk while participating in this study. However, there exists the possibility of certain changes during the exercise test, including abnormal blood pressure, fainting, disorder of the heartbeat, and in rare instances, heart attack, stroke, or even death. Every effort will be made to minimize these risks by evaluation of preliminary information relating to your health and fitness and by observation during the test. Personnel trained in CPR will be available to deal with unusual situations that may arise.

Risks associated with the use of the DEXA machine include the following: Exposure 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. If you have an intact uterus and ovaries and there is a chance you may be pregnant (unprotected intercourse within the last 60 days), you may not participate in this testing at this time. Radiation may be harmful to a fetus. The results obtained from this test will help with screening for osteoporosis associated with low bone density levels and other disease states associated with body composition.

Participating in the research will provide valuable information about your current health status. Upon completion of the study, you will receive a report detailing your test results. Participation in all activities in the HPER Building, on the Intermural Fields, or any program sponsored by the College of Education and Health Professions or University Recreation Department, regardless of location, is voluntary on behalf of all participants. All participants acknowledge and agree that the University of Arkansas does not provide insurance for any of its activities and shall not be liable for any injuries that occur at any of these locations or nay of its programs.

*Voluntary Participation:* Participation in the testing protocol is voluntary. You are free to deny or withdraw from testing at any time if you so desire. Withdrawing from the study or not participating will have no repercussions.

*Removal from the Research Project:* The investigator may also remove you from the project at any time and for any reason. Based on the assessment of the study principle investigator, some of the reasons that you might be removed from the project are, but are not limited to the following:

- If you are not following instructions of the principle investigator or his/her assistants,
- If the study is terminated, or
- For any reason at the discretion of the investigator

If you are removed from the project for any reason, the principle investigator will ask you to have a final evaluation. This evaluation could include any of the assessments/tests previously mentioned in this document and any other procedures that the project principle investigator feels are medically necessary. You may also be asked questions about your experience with the project.

*Right to Withdraw:* You are free to refuse to participate in the study and to withdraw at any time. Your decision to withdraw will bring no penalty to you.

*Confidentiality:* You will be assigned a code number and this will be the only information used for tracking purposes. Your testing information will be kept confidential to the extent allowed by law and University policy.

*Informed Consent:* I, _______________________________________________, have read the description of this program, including the purpose of the program, the procedures to be used, the potential risks and side effects, the confidentiality, as well as the option to withdraw from the program at any time. The investigator has explained each of these items to me. The investigator has answered all of my questions regarding the program, and I understand what is involved. My signature below indicates that I freely agree to participate in this program and that I have received a copy of this agreement if desired from the investigator.

Participant:_________________________________________ Date:____________________

Witness:____________________________________________Date:____________________

## Appendix C: IRB Approval

February 17, 2012

MEMORANDUM

| | |
|---|---|
| TO: | Jacilyn Olson<br>Ro DiBrezzo |
| FROM: | Ro Windwalker<br>IRB Coordinator |
| RE: | New Protocol Approval |
| IRB Protocol #: | 12-02-453 |
| Protocol Title: | *The Use of Cortisol and HbA1c as Biomarkers of Stress in University Administrators* |
| Review Type: | ☐ EXEMPT ☐ EXPEDITED ☒ FULL IRB |
| Approved Project Period: | Start Date: 02/16/2012 Expiration Date: 02/09/2013 |

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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 30 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.

## Appendix D: IBC Approval

UNIVERSITY OF ARKANSAS

Research Support and Sponsored Programs

June 22, 2010

MEMORANDUM

| | |
|---|---|
| TO: | Dr. Ro Di Brezzo |
| FROM: | W. Roy Penney<br>Institutional BioSafety Committee |
| RE: | IBC Protocol Approval |
| IBC Protocol #: | 10030 |
| Protocol Title: | "Stress-Saliva" |
| Approved Project Period: | Start Date: June 7, 2010<br>Expiration Date: June 6, 2013 |

The Institutional Biosafety Committee (IBC) has approved Protocol 10030, "Stress-Saliva". You may begin your study.

If further modifications are made to the protocol during the study, please submit a written request to the IBC for review and approval before initiating any changes.

The IBC appreciates your assistance and cooperation in complying with University and Federal guidelines for research involving hazardous biological materials.

**Appendix E: University Administrative Concerns Questionnaire**

Please indicate your level of concern for each item by circling “1” (never bothers me), “2” (rarely bothers me), “3” (occasionally bothers me), “4” (frequently bothers me), or “5” (usually bothers me).

| | | Never | Rarely | Occasionally | Frequently | Usually |
|---|---|---|---|---|---|---|
| 1 | Being interrupted frequently by telephone calls | 1 | 2 | 3 | 4 | 5 |
| 2 | Feeling staff members or colleagues do not understand my goals and expectations | 1 | 2 | 3 | 4 | 5 |
| 3 | Feeling that I am not fully qualified to handle my job | 1 | 2 | 3 | 4 | 5 |
| 4 | Thinking that I will not be able to satisfy the conflicting demands of the person(s) who has the authority over me | 1 | 2 | 3 | 4 | 5 |
| 5 | Feeling not enough is expected of me by my superior(s) | 1 | 2 | 3 | 4 | 5 |
| 6 | Having my work frequently interrupted by staff members who want to talk | 1 | 2 | 3 | 4 | 5 |
| 7 | Imposing excessively high demands on myself | 1 | 2 | 3 | 4 | 5 |
| 8 | Writing memos, letters, and other communication | 1 | 2 | 3 | 4 | 5 |
| 9 | Trying to resolve differences with my superior(s) | 1 | 2 | 3 | 4 | 5 |
| 10 | Speaking in front of groups | 1 | 2 | 3 | 4 | 5 |
| 11 | Attempting to meet social expectations | 1 | 2 | 3 | 4 | 5 |
| 12 | Not knowing what my superior thinks of me or how he/she evaluates my performance | 1 | 2 | 3 | 4 | 5 |
| 13 | Feeling that much of the paperwork required by others in not utilized after I complete it | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14 | Feeling that I have too much responsibility delegated to me by my superior | 1 | 2 | 3 | 4 | 5 |
| 15 | Preparing budget proposals and allocating budget resources | 1 | 2 | 3 | 4 | 5 |
| 16 | Trying to resolve parent/institution conflicts | 1 | 2 | 3 | 4 | 5 |
| 17 | Feeling I have to participate in university activities outside of the normal working hours at the expense of my personal time | 1 | 2 | 3 | 4 | 5 |
| 18 | Feeling that I have too little authority to carry out responsibilities assigned to me | 1 | 2 | 3 | 4 | 5 |
| 19 | Feeling that I have too heavy a work load, one that I cannot possibly finish during the normal work day | 1 | 2 | 3 | 4 | 5 |
| 20 | Complying with state, federal, and organization rules and policies | 1 | 2 | 3 | 4 | 5 |
| 21 | Feeling that the progress on my job is not what it should or could be | 1 | 2 | 3 | 4 | 5 |
| 22 | Being unclear about the scope and responsibilities of my job | 1 | 2 | 3 | 4 | 5 |
| 23 | Feeling that meetings take up too much time | 1 | 2 | 3 | 4 | 5 |
| 24 | Trying to complete reports and other paperwork on time | 1 | 2 | 3 | 4 | 5 |
| 25 | Having to work with people who have more authority but are not as skillful or knowledgeable as I am | 1 | 2 | 3 | 4 | 5 |
| 26 | Trying to resolve differences between/among staff members and/or colleagues | 1 | 2 | 3 | 4 | 5 |
| 27 | Trying to influence my immediate supervisor's actions and decisions that affect me | 1 | 2 | 3 | 4 | 5 |
| 28 | Trying to gain public approval and/or financial support for university programs | 1 | 2 | 3 | 4 | 5 |
| 29 | Trying to satisfy concerns of constituent groups (alumni, the community, etc.) | 1 | 2 | 3 | 4 | 5 |

What is your current job title? ____________________________

How long have you been in this position? _____________________

How many people do you supervise? _________________________

Do you have budgetary responsibilities?  YES      NO

If so, what is the approximate dollar amount of the budget you manage? ___________________

Have you held any other administrator positions at this university or other universities?  YES   NO

If so, what position(s)? __________________________

How long were you in this/ these position(s)? ________________________

What is your marital status?

A. Single, Never Married
B. Married
C. Separated
D. Divorced
E. Widowed

Do you have children? YES NO

If “yes”, please select one or more of the following to describe their living situation. Indicate the number of children in each situation.

A. Children aged 0-21 living at home (full or part-time) ________
B. Children aged 0-21 living outside the home ________
C. Grown children (21+) living at home (full or part-time) ________
D. Grown children (21+) living outside the home ________

Major life events in the <u>past 12 months</u> (please select all that apply):

A. Personal illness
B. Illness of a family member or close friend
C. Drug/alcohol problem of family member or close friend
D. Change in living situation
E. Financial strain
F. Served as a primary caregiver
G. Significant relationship change
H. Other ___________________________________

**Appendix F:  Cortisol Collection Letter**

February 20, 2012

Dear _______________,

Thank you for participating in my dissertation research. Enclosed are the supplies and instructions needed to collect the saliva samples and the University Administrative Concerns Questionnaire. Please complete the questionnaire at your leisure during one of the days you are collecting the saliva samples.

I will pick up the complete saliva samples from your office on Wednesday ___________. Please let me know if it would be better to pick it up a different time or location and I will make other arrangements.

I look forward to seeing you at testing on _____________.

Please contact me by email or phone if you have any questions.

Sincerely,

Jaci

**Appendix G: Instructions for Saliva Collection**

## Instructions for Collection of Saliva Samples

**Collection Times:**

Please collect saliva samples at the following times on the **Monday _____________** and **Tuesday __________.** The saliva collection tubes (Salivettes) are labeled with the times and day they should be used.

1. Upon waking-preferably before you get out of bed
2. 20 minutes after waking
3. 12:00 pm
4. 4:00 pm
5. 6:00 pm
6. 9:00 pm
7. At bedtime

If it would help you to remember to collect samples, please feel free to use alarms on personal electronics (cell phones, etc.) to remind yourself.

The small alarm clock included in this packet is also set to vibrate at the 12 pm, 4 pm, 6 pm and 9 pm collection times. Since I didn't know what time you typically wake up or go to sleep, I didn't set alarms for those collections. You can wear this on your belt/waistband if you wish.

**Pre-collection Procedures:**

1. Rinse mouth thoroughly with water 10 minutes before sample is collected. This step is not necessary for the waking sample.

2. No food or fluids for 60 minutes prior to collection.

3. No caffeinated products before the first two samples. Please consume your "regular" amount of caffeine during the collection days.

4. No alcohol for 12 hours prior to collection.

5. Do not brush or floss teeth just prior to collection. This is especially important for the second measurement of the day. Do not collect a sample if the gums or mouth are bleeding, as it will invalidate the measurement.

6. Do not apply creams or lotions that contain steroids immediately prior to collection. This is to avoid contamination of the salivette swab.

**Collection Procedures:**

1. Locate the correct salivette tube for the time and date of collection.

2. Remove the cylindrical shaped swab from the tube and place in the mouth.

3. Chew on the swab for 1-2 minutes, or until you can no longer prevent swallowing excess saliva (swab is saturated).

4. If you cannot chew on the swab, it can be placed under the tongue for 1-2 minutes or until completely saturated.

5. After the swab is saturated, return the swab to the tube and place the cap tightly on the tube.

6. Place the tube into the baggie labeled "used" for that day. This will prevent contamination between the used and unused salivette.

7. Mark on the included log what time you took the sample. If you are concerned you may have not followed the pre-sample instructions, please note it in the provided section.

8. If you forget to take a sample, please take it as soon as your remember and mark the time you did take it on the log provided. If it nearly time for the next sample, skip the forgotten sample and take the next sample at the scheduled time.

9. The saliva samples should be stored at room temperature until they are picked up.

10. The saliva swabs will be collected from you on **Wednesday ________________.**

11. If you have any questions, please call.

## Appendix H: YMCA Cycle Ergometry Test Protocol

ID: ___________________________________

Height: ____________ Weight: _______________

Age: _______________ 85% of Age Predicted Max HR: _________________

YMCA Cycle Ergometry Test

| | | | | |
|---|---|---|---|---|
| | | 1st Stage | 150 kgm/min (0.5 kg) | |
| | HR<80 | HR: 80-90 | HR:90-100 | HR>100 |
| 2nd Stage | 750 kgm/min (2.5 kg) | 600 kgm/min (2.0 kg) | 450 kgm/min (1.5 kg) | 300 kgm/min (1.0 kg) |
| 3rd Stage | 900 kgm/min (3.0 kg) | 750 kgm/min (2.5 kg) | 600 kgm/min (2.0 kg) | 450 kgm/min (1.5 kg) |
| 4th Stage | 1050 kgm/min (3.5 kg) | 900 kgm/min (3.0 kg) | 750 kgm/min (2.5 kg) | 600 kgm/min (2.0 kg) |
| | *Source.* Thompson, W. R., Gordon, N. F., & Pescatello, L. S. (2010). *ACSM's Guidelines for Exercise Testing and Prescription* (8th ed.) Philadelphia: Lippincott Williams & Wilkins. | | | |

| | | Heart Rate | Blood Pressure |
|---|---|---|---|
| Rest | 0:00 | | |
| Stage 1 | 1:00 | | |
| | 2:00 | | |
| Stage 2 | 1:00 | | |
| | 2:00 | | |
| Stage 3 | 1:00 | | |
| | 2:00 | | |
| Stage 4 | 1:00 | | |
| | 2:00 | | |
| Recovery | 1:00 | | |
| | 2:00 | | |

Comments:___________________________________________________________________________

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