

**STRESS REDUCTION AS A LINK BETWEEN AEROBIC ACTIVITY AND
ACADEMIC PERFORMANCE EXPERIENCED BY UNDERGRADUATE
WOMEN THROUGH THE USE OF THE STUDENT RECREATION CENTER
AT TEXAS A&M UNIVERSITY**

A Dissertation

by

MARTHA BRENNAN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2006

Major Subject: Educational Administration

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Approved by:

Chair of Committee,	John Hoyle
Committee Members,	Robert Hall
	Stephen Stark
	Christine Stanley

Head of Department,	Jim Scheurich
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ABSTRACT

Stress Reduction as a Link between Aerobic Activity and Academic Performance
Experienced by Undergraduate Women through the Use of the Student Recreation
Center at Texas A&M University. (May 2006)

Martha Brennan, B.S., Louisiana State University;

M.A., Louisiana State University

Chair of Advisory Committee: Dr. John Hoyle

The purpose of this study was to investigate the relationship between aerobic activity and academic performance through stress reduction using a student recreational facility. Research indicated that learning in college tends to focus on the academic aspects of the undergraduate experience - the classroom, laboratory, and the library - not other factors potentially affecting academic performance (Kuh et al., 1991).

Forty women were randomly selected from the undergraduate population at Texas A&M University in order to analyze the relationship between aerobic activity and academic performance by measuring perceived stress levels. All participants completed an on-line stress questionnaire, the Perceived Stress Scale (PSS), every three weeks. Exam scores from an introductory sociology course and an educational statistics course were used for data analysis also. The experimental group (exercise group) used twelve weeks of regular aerobic exercise, while the control group (non-exercise) remained sedentary. During the twelve-week period, all participants self-reported data for additional qualitative data.

Research findings of this study included:

1. The main benefit from aerobic activity was that women who exercised regularly felt more positive about academics and non-academic activities than women who did not exercise regularly.
2. There was no statistical significant difference between exam scores and academic performance of women who exercised regularly and those who did not exercise regularly.
3. There was no statistical significant difference between stress levels of women who exercised regularly and women who did not exercise regularly.

Based on the findings of the study, researcher recommendations include:

1. Continue to investigate the changing demographics of college students - namely, age, sex, and non-traditional students. This study was limited to full-time women between the ages of 18-24. Men and part-time students need to be included in a comparable study, providing campuses with more data that reflects the entire student population.
2. Explore additional areas in sociology and psychology that address exercise behavior trends in college students. Results from this study indicated that there are many variables, including stress, that affect college students in the behavioral sciences that can be attributed to differences in physical activity between sedentary and non-sedentary people.
3. Analyze health factors, which include amount of exercise, nutrition, and sleep patterns.

DEDICATION

This study and the hard work that went into it is dedicated to my mother, Jeanne Elizabeth Harris, who passed away January 1, 2001, and to my dad, Colin O. Harris. My mom did not complete a college degree in physical education, but spent her life being an educator as a coach. She understood the value of physical activity and its importance as a component in education. She motivated me and believed that continuing education in higher education was essential and worth the sacrifice through life changing events like children and changing jobs. She was truly an inspiration.

My dad, a career high school administrator, defined the leadership qualities needed to be an outstanding educator. He understood the value of completing a terminal degree and supported me during times of transition. His work ethic and perseverance taught me that I too can meet and achieve goals by being willing to work hard and stay optimistic.

ACKNOWLEDGMENTS

I would like to acknowledge several people that have been invaluable in my efforts to complete this document. My committee members, Dr. John Hoyle, Dr. Robert Hall, and Dr. Stephen Stark, all helped me through my academic journey. Dr. Laurence Sistrunk, a special person who volunteered his time and effort during the process of writing this dissertation, was also a great help. He truly inspired me to stay on task and provided me with guidance and in the final stages, editing. Dr. Dennis Corrigan provided me the funding to do this study and without him the study would not have been possible.

Additionally, a new job opportunity provided me with invaluable human resources during a time of transition. Dr. Sue Tarr, a professor in the Health & Human Performance Department at the University of Wisconsin-River Falls, needs to be thanked for her encouragement and help in the final stages of the dissertation. Another invaluable member of the campus community at River Falls is Dr. Brad Caskey, a member in the Psychology Department. He refreshed and helped me a great deal with the final chapters and daily questions. All of these people truly helped me complete this document over a lengthy period of time and through many changes.

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CHAPTER I

INTRODUCTION

Studies of learning in college tend to focus on academic aspects of the undergraduate experience—the classroom, laboratory, and the library (Kuh, Schuh, Whitt, & Associates, 1991). Academic rituals and routines, including the courses that students must take to earn a degree, are relatively simple to document. There is little controversy whether classroom learning activities are related to the institution’s educational goals, but there is less known about the contribution of the out-of-classroom learning. Bryant, Banta, & Bradley (1995) reported studies by Light (1990), Boyer (1997), and Pace (1990) dispelled the notion that all of the memorable and important learning in college goes on inside the classroom. It is necessary to study activities outside the classroom that result in positive academic performance. Several studies in the area of student development showed that involvement into recreational activities provide students with self-confidence, communication skills, and stress management skills, all necessary to excelling in the classroom (Bryant et al., 1995).

According to Bryant et al. (1995), recreation may constitute the single most common experience of college students. For years collegiate recreational sport administrators have maintained that student participation in recreational sports and fitness participation contributes to the learning, development, and persistence of college students (Belch, Gebel, & Maas, 2001).

The style and format for this dissertation followed that of the *Journal of Educational Research*.

In the same study, student persistence in participation at a student recreational center showed an increase in grade point record compared to those students who used the Student Recreation Center less frequently. Evidence exists that physical activity may be associated with increased academic performance (Allenworth, Lawson, Nicholson, & Wyche, 1997). Research by Summerfield also confirmed these findings (1998). Physical activity has been defined as “bodily movement produced by skeletal muscles that result in energy expenditure” (Pate et al., 1995). This relationship can be explained by looking at the body’s physiology.

By improving the physical state of the body, one may be able to improve the cognitive state of the mind, and potentially increase academic performance. In a study of adolescent students, frequent exercise resulted in higher grade-point averages compared to those who exercised less frequently (Field et al., 2001). Similar results appeared in a member profile at Texas A&M University. According to the data for Fall 2000, undergraduate students who most frequently entered the facility earned GPA’s higher than those entering the facility less frequently. Although other factors may have contributed to this outcome, physical activity was identified as a positive and influencing factor in students’ academic performance.

Therefore, aerobic activity may be a logical choice for achieving a higher level of cognitive performance, according to research in the field of physical activity. *Aerobic* means with air or oxygen and using the same large muscle groups, rhythmically for a period of 15-20 minutes or longer while maintaining 60-80% of your maximum heart rate (Balbach, 2002). Aerobic activity, not only increases blood flow to the brain, but

also speeds recall and reasoning skills (Etnier et al., 1997; Van Boxtel, et al., 1996).

There is also evidence to support these findings by looking at the biochemical make-up in the body and how aerobic activity affects it. Serotonin, a chief ingredient produced by the body and used in antidepressants, increased as a result of physical activity (Nash, 1996). Aerobic activity helps the body produce more of this chemical.

One of the many benefits from aerobic activity is a reduction in anxiety, or stress, and improvement in body image and mood (Manley, 1996). Stress in this case is *negative* stress causing distress in negative, often harmful ways (Stress Management, 2002). There is an accumulation of evidence showing that there are very real negative effects of stress on both the psychological and physical health of people (Howell, 2002). According to Dr. Kenneth Fox (1999), there are moderate effects for reduction in anxiety after exercise with most studies testing the effects of aerobic forms of exercise such as running. Therefore, this study will also investigate the affects of aerobic activity and stress-reduction of undergraduate women at Texas A&M University.

By studying the affects of aerobic activity on academic performance through stress reduction, recreational sports departments would be more able to justify their need and case for channeling increasingly scarce institutional funds into recreational programs (Bryant et al., 1995). Additional research in the department of recreation sports would only help validate its role in helping institutions meet their academic goals from outside the classroom.

Statement of the Problem

Historically, evidence to support a positive association between academic performance and participation in physical activity has been somewhat unclear (Daley & Ryan, 2000). Much of the uncertainty lies in the studies themselves. The current literature on academic performance and physical activity fails to identify certain factors, like stress-reduction, that may affect this relationship by the nature of their experimental designs.

Use of well-controlled, reliable research methods is largely lacking. The majority of studies have used cross-sectional or correlational techniques without random assignment to conditions (King et al., 1989). This is evident in the following studies that used questionnaire analysis. Several of the studies used questionnaires to collect data and not an experimental design in their research methods. Field, Diego, and Sanders (2001), administered a questionnaire to 89 high school seniors. The researchers used a 181-item Likert-type scale that produced data that was not valid. There were very few inferences that could be made from this study when only questionnaire data was used.

The same design problems existed in the study by Daley and Ryan (2000). Again, participants were asked to complete a questionnaire. In this study, there were several external factors that were not addressed. These missing factors included demographic variables that would play a significant role in the relationship between academic performance and physical activity.

Purpose of the Study

The purpose of this study was to investigate the relationship between aerobic activity and academic performance through stress reduction of undergraduate women at Texas A&M University who used the Student Recreation Center. Stress was measured in this relationship via the Perceived Stress Scale and also through self-report. This study prescribed aerobic activity and time spent engaged in aerobic activity while measuring current stress levels over a 12 week period. Additionally, the study assessed the impact of selected demographic variables such as study hours and work hours.

Research Questions

The aims of the study were to determine the following:

- 1.) Was there a significant difference between test scores as reported by undergraduate women who regularly exercised and those who do not regularly exercise through use of the Student Recreational Center at Texas A&M University?
- 2.) Was there a significant difference between stress levels as reported by undergraduate women who regularly exercised and those who do not regularly exercise through use of the Student Recreational Center at Texas A&M University?
- 3.) Was there a significant difference between stress levels and test scores as reported by undergraduate women who exercised regularly and those who do not exercise regularly through use of the Student Recreational Center at Texas A&M University?

Operational Definitions

The following operational definitions were used in this study:

Academic Performance

This was measured by student's exam scores. By comparing the relationship of each exam score to the events of activity, it is possible to assess the performance of the students over the timed study.

Aerobic Activity

Continuous movement for 15-20 minutes or longer while maintaining 60-80% of your maximum heart rate (Balbach, 2002). Activities include; walking, running, swimming, and cardio-machines.

Physical Activity

Pate et al. (1995) defined physical activity as the bodily movement produced by skeletal muscles that result in energy expenditure. Activities included aerobic activity like; running, cardio-equipment, swimming, walking, aerobic classes, rock climbing, and court activities like handball, basketball volleyball, racket-ball, and badminton.

PSS

The Perceived Stress Scale is an instrument that measures the degree to which situations in one's life are appraised as stressful.

Relationship

The independent variable has many quantitative levels and the experimenter is interested in showing that the dependent variable (academic performance) is some function of the independent variable (aerobic exercise).

SRC

The Student Recreation Center at Texas A&M University offers students a facility to engage in physical activity or recreational sport. It has a weight room, indoor/outdoor swimming pools, indoor track, numerous courts, and a rock-climbing wall.

Stress

Failure to adequately cope with stressors like deadlines, debts, fear, taking tests, failure, etc.

Stress Levels

High stress is represented by high symptom scores, and low stress levels are represented by low symptom scores determined from Perceived Stress Scale.

Texas A&M University

A land-grant, sea-grant, and space-grant institution located in College Station, Texas. It is centrally located between Houston, Dallas, and Austin. The enrollment includes approximately 44,000 students studying for degrees in 10 academic colleges.

Undergraduate Women

Females enrolled full-time at Texas A&M University between the ages of 18-22. They are not enrolled in graduate classes.

Assumptions

1. The methodology proposed and described here offered the most logical and appropriate design for this particular research project.
2. Respondents understood the instrument and responded objectively and honestly.
3. The researcher was impartial in collecting and analyzing the data.

Limitations

1. The study was limited to the information acquired from the literature review and questionnaire data.
2. The participants were gender specific and the data was self-report.

Methodology

Population

The population for this study was 40 randomly assigned, full-time undergraduate females at Texas A&M University enrolled as full-time students in Fall 2002. The population was females who were classified as sophomores, juniors, or seniors who did not exercise regularly (less than three times a week).

Instrumentation

The researcher used questionnaire research methodology for collecting data and analyzing the data in this study. The instrument used for this study was the Perceived Stress Scale (PSS). The purpose of such research was to collect unobservable information regarding stress by asking the same questions of all individuals in the population (Gall, Borg, & Gall, 2002). The instrument was reliable and valid by

evidence presented in a paper by Cohen, Kamarck, and Mermelstein (1983). Additional information was obtained through self-report.

Procedures

Participants in the study were recruited from an introductory sociology class and an educational statistics course where they were asked to fill out an information sheet for participation. Subjects needed for the study were called by phone to participate and e-mailed. Through random assignment, subjects engaging in physical activity (20 of the 40 subjects) reported to the Student Recreation Center for 40 minutes of aerobic activity monitored by the researcher.

All participants completed a daily log of activity which includes; amount of exercise and number of study hours. Every three weeks, the subjects completed a questionnaire on-line through a website designed for this study. A cover letter assuring subject's confidentiality and explaining questionnaire instructions was completed and attached to the logbooks. After the sixth week of the study, subjects received \$100 and another \$100 at the end of the twelfth week (completion of the study). Compensation was picked up at the Student Recreation Center.

Data Analysis

The data gathered was examined by using quantitative and qualitative procedures. Analysis and interpretation of data followed the principles discussed in *Educational Research: An Introduction* by Gall, Borg, & Gall (2002). The data gathered was analyzed using a statistical program, *SPSS for Windows-Version 12.0* (2002).

Significance Statement

Although a variety of psychological benefits have been attributed to regular physical activity, few experimental controlled studies of healthy individuals currently exist (King, Taylor, Haskell, & DeBusk, 1989). In recent years, studies have provided evidence to substantiate earlier claims of the role of recreational sports and fitness participation on academic performance (Belch, Gebel, & Maas, 2000). Researchers suggested that participation in other college activities, like intramural sports, is connected to academic performance (Light, 1990). These studies have provided data based on academic measures like grade-point average and other nominal data, but lack a qualitative component to explain other factors associated with physical activity.

This study went beyond looking for a relationship between academic performance and physical activity through use of the Student Recreational Center. By doing an experimental design study, the researcher assessed stress levels and monitored regular physical activity over a prescribed time. Results from this study provide a more accurate analysis of physical activity and academic performance by using a stress measure, repeatedly.

Organization of the Dissertation

The dissertation is divided into five major units or chapters. Chapter I contains an introduction, a statement of the problem, a need for the study, specific objectives, limitations and assumptions, and a definition of terms. Chapter II contains a review of the literature. The methodology and procedures followed are found in Chapter III.

Chapter IV contains the analysis and comparison of the data collected in the study.

Chapter V contains the researcher's findings, conclusions, and recommendations.

CHAPTER II

REVIEW OF THE LITERATURE

Learning Inside the Classroom vs. Outside the Classroom

Learning in college tends to focus on the traditional academic aspects of the undergraduate experience: the classroom, laboratory, and the library (Kuh et al., 1991). Academic rituals and routines, including the courses that students must take to earn a degree, are relatively simple to document. There is little controversy whether classroom learning activities are related to the institutions educational goals, but there is less known about the contribution of the out-of-classroom learning. Bryant et al. (1995) acknowledges studies by Light (1990), Boyer (1997), and Pace (1990) dispelled the notion that all of the memorable and important learning in college goes on inside the classroom. Many faculty pay little attention or give minimal support to extracurricular activities (Boyer, 1997). According to Kuh et al. (1991), out-of-class experiences are rarely neutral with regard to student learning and if complimentary to the institution's educational purposes, significantly contribute to student learning and personal development.

Recreational Activities: Participation and Benefits

Recreation may constitute the single most common experience of college students (Bryant et al., 1995). The Quality and Importance of Recreation Services (QIRS) survey was used after an extensive review of literature on student development outcomes. The results from this survey provided descriptive and inferential statistical knowledge especially in its findings on recreational participation. Ninety-five percent of

the respondents said they engaged in some form of recreational activity several times per week and 20% were more likely to take part in recreational activity than any other campus activities, including cultural events, residence hall activities, and clubs in their majors (Bryant et al., 1995). This study confirms that health and wellness activities are increasingly popular. Participation and perceived benefits results from the survey emphasized the fitness and wellness interests of students on campus (Bryant et al., 1995).

For years, collegiate recreational sport administrators have maintained that student participation in recreational sports and fitness participation contributes to the learning, development, and persistence of college students (Belch, Gebel, & Maas, 2001). In the same study, student persistence in participation at a student recreational center showed an increase in grade point record compared to those students who used student recreation centers less frequently. Endo and Bittner (1985) reported that important variables distinguishing the University of Colorado resident persistence from resident voluntary dropouts was participation in intramural programs. Mallinckrodt and Sedlacek (1987), also reported that for African American students at the University of Maryland, participation in recreational trips and hours spent in the gymnasium were significant factors in predicting retention. Another study by Parsons (1989) found that 90.2% of the students employed in recreation at Bowling Green State University had earned at least a baccalaureate degree (Bryant et al., 1995).

Student development provides evidence to suggest that involvement in recreational activities provide students with perceived benefits like self-confidence and

stress management skills (Bryant et al., 1995). Many of these benefits are documented in research concerning the effects of exercise and mental health. In the past 20 years, there have been numerous studies concerning the effects of exercise and mental health (Rejeski, Gregg, Thompson, & Berry, 1991). In the mental health literature, there has been evidence that benefits from exercise include: decreased anxiety (Long & Van Stavel, 1995), increased cognitive functioning (Etnier et al., 1997) and self-esteem (McDonald & Hodgdon, 1991).

Physical Activity and Academic Performance

Physical activity has been defined as “bodily movement produced by skeletal muscles that result in energy expenditure” (Pate et al., 1995). It is closely related to, but distinct from exercise and physical fitness. Exercise is a subset of physical activity defined as “planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness (Pate et al., 1995).

Evidence exists that physical activity may be associated with increased academic performance (Allensworth et al., 1997). In a comprehensive review done by Shepard (1997), physical activity was related to academic performance. The findings from this study indicated the following: When a substantial proportion of curricular time is allocated to physical activity, learning seems to proceed more rapidly per unit of classroom time, so that academic performance matches and may even exceed that of students not involved in physical activity; individuals involved in additional physical activity show an acceleration of their psychomotor development, and this could provide a mechanism for accelerated learning of academic skills; other potential mechanisms by

which additional physical education could enhance academic skills include; increased cerebral blood flow, greater arousal, changes in hormone levels, enhanced nutrient intake, changes in body build and increased self esteem (Almond & McGeorge, 1998).

Further studies have also indicated that there is a modest relationship between motor performance and academic performance (Kirkendall, 1986). Results from a correlational study indicated a positive relationship between perceptual motor abilities, intellectual abilities, and academic performance (Almond & McGeorge, 1998). Biddle (1995) concluded that for some aspects of cognitive functioning exercise is associated with small to moderate beneficial effects. Tan (1997) concluded that there is support for the link between physical activity or motor/movement skill and its correlation with cognitive development. The relationship tends to be stronger in the early stages of development, but no direct causal link had been established (Almond & McGeorge, 1998).

In a study of adolescent students, frequent exercise resulted in higher grade point averages compared to those who exercised less frequently (Field et al., 2001). Eighty-nine high school seniors were administered a questionnaire that gathered information on their exercise habits, ranging from rarely to daily. Questions about academic performance were also included. There were other items included on the questionnaire also. Results indicated that students with high levels of exercise had higher grade point averages compared to those with low levels of exercise (Field et al., 2001).

Similar results appeared in a member profile at Texas A&M University.

According to the data for Fall 2000, undergraduate students who most frequently entered

the facility earned GPA's higher than those entering the facility less frequently.

Although other factors may have contributed to this outcome, physical activity was identified as a positive and influencing factor in students' academic performance.

Physical Activity (Aerobic) and its Benefits

There are two forms of physical activities under the umbrella of exercise, aerobic and anaerobic exercise. Anaerobic means without oxygen and includes activities like weight lifting. Aerobic means with air or oxygen and using the same large muscle groups, rhythmically for a period of 15-20 minutes or longer while maintaining 60-80% of your maximum heart rate (Balbach, 2002). Some examples of aerobic activities include:

- Brisk walking
- Jogging
- Bicycling
- Swimming
- Aerobic dancing
- Racket sports
- Rowing
- Ice or roller skating
- Cross-country or downhill skiing
- Using aerobic equipment (i.e. treadmill, stationary bike)
(www.personalhealthzone.com)

There is some debate concerning the quantity and intensity of aerobic activity as a form of exercise. Karvonen, Kentala, and Mustala (1957) suggested that one's heart rate is the key factor to determining training intensity and aerobic capacity. He concluded that to improve maximal oxygen uptake and the cardiovascular system the heart rate during exercise must be increased to at least 60% of maximum heart rate. For individuals with a low level of fitness, they will get a significant training effect with a

heart rate of 110 beats per minute or 120 beats per minute. Moreover, individuals with a higher level of fitness need a higher level of stimulation.

In the last couple of decades, aerobic activity has become popular among an increasingly health-conscious society, leading researchers to investigate aerobic activity and its possible links to improved physiological welfare according to the National Institute of Health Consensus Statement (Manley, 1996). It is evident through relevant research that aerobic activity can offer protection from coronary heart disease; improvements in circulation, respiration, fat metabolism, immune function; weight management and the reduction of body fat percentage; and a stronger, more resilient musculo-skeletal system (Sharkey, 1990).

Neurotransmitters in the Body

Additionally, exercise may alter the function of the immune system (Rabin, 1999). Exercise is capable of minimizing the effects of stress on altering the function of the immune system resulting in health benefits (Rabin, 1999). It produces alterations of the plasma concentration of glucocorticoids and namely catecholamines.

Catecholamines are any of several compounds occurring naturally in the body that serve as hormones (a secretory substance carried from one gland or organ of the body via the bloodstream to more or less specific tissues, where it exerts some influence upon the metabolism of the target tissue) or as neurotransmitters (chemicals that communicate information between neurons across small gaps) in the sympathetic nervous system (a branch of the autonomic nervous system). The catecholamines include such compounds as epinephrine, or adrenaline, norepinephrine, and dopamine.

They resemble one another chemically in having an aromatic portion (catechol) to which is attached an amine, or nitrogen-containing group. Norepinephrine is a neurotransmitter in the catecholamine family that mediates chemical communication in the sympathetic nervous system. Like other neurotransmitters, it is released at synaptic nerve endings to transmit the signal from a nerve cell to other cells. Norepinephrine is almost identical in structure to epinephrine, which is released into the bloodstream from the adrenal medulla under sympathetic activation. The sympathetic nervous system functions in response to short-term stress; hence, norepinephrine and epinephrine increase the heart rate as well as blood pressure. Other actions of norepinephrine include increased glycogenolysis (the conversion of glycogen to glucose) in the liver, increased lipolysis (the conversion of fats to fatty acids) in adipose (fat) tissue, and relaxation of bronchial smooth muscle to open up the air passages to the lungs. All of these actions represent a mobilization of the body's resources in order to meet a stressful challenge. Such a response is often termed the "flight or fight" response. These substances prepare the body to meet emergencies such as cold, fatigue, and shock, (Chudler, 2004). Catecholamines are very similar to those produced by psychological stressors (Sharkey, 1990). An alteration of the immune function could be expected by exercise. There may be other factors that influence the immune function that should be considered when considering exercise: intensity of exercise, duration of exercise, frequency of exercise, fitness of the subject, chronic stressors in the subject's life, acute stressors in the subject's life, developmental characteristics of the subject, and social support (Sharkey, 1990). These factors

potentially contribute to alterations of the function of the immune system and need to be considered when looking at the immune system and its functions.

Furthermore, studies done with rodents confirm that aerobic exercise is associated with improved neurotransmitter functioning (Dustman, Emmerson, & Shearer, 1994). Because of exercise, vascularization of activated brain areas increased (Isaacs, Anderson, Alcantara, Black, & Greenough, 1992) and there was an increase in cell hypertrophy and complexity (Gentile, Beheshti, & Held, 1987). Finally, aerobic training was associated with a reduction of CNS excitation such that inhibition played a stronger role in behavior (Nikiforova, Patchev, & Nikolov, 1989). These findings confirmed that aerobically trained animals generally had faster response times and better performance on passive avoidance (Spirduso & Clifford, 1978), spatial learning (Fordyce & Farrar, 1991), and memory tasks (Samorajski, Rolsten, Przykorska, & Davis, 1987) compared to the non-exercising animals. If the same conclusions can be made about humans, presumably humans that frequently engage in aerobic activity should outperform infrequent exercisers when compared on a variety of tasks that reflect CNS integrity (Dustman et al., 1994).

Neurotransmitters in the Brain

There is also evidence to support these findings by looking at the biochemical make-up in the body, especially the brain, and how aerobic activity affects it, namely serotonin. Serotonin, a chief ingredient produced by the body and used in antidepressants, increased as a result of physical activity (Nash, 1996). It is an organic compound that was first recognized as a powerful vasoconstrictor occurring in blood

serum. It was partially purified, crystallized, and named in 1948, and its structure was deduced a year later. Independent work indicated that serotonin was widely distributed in nature and occurred in tissues other than blood. It has been shown to be in many representatives of the animal kingdom, in wasp stings and scorpion venom, in various fruits, such as pineapples, bananas, and plums, and in various nuts. It has been estimated that an adult human contains about 5 to 10 mg of serotonin, 90% of which is in the intestine and the rest in blood platelets and the brain. One role of the compound is as a neurotransmitter whose participation is being sought in diverse functions including; learning, sleep, and control of mood (Chudler, 2004). Serotonin (5-hydroxytryptamine: [5-HT]) is produced by neurons located primarily in the pons and upper brain stem and also by platelets outside the central nervous system (CNS) (Rabin, 1999). It works in combination with the brain's transmission of electrochemical messages between and among neurons (cells specialized for conducting electrochemical impulses) (Gagne et al., 1993). An increase in serotonin may be one of the mechanisms that results from physical activity and potentially linked to improved academic performance.

Endorphins have commonly been implicated in the exercise-affect relationship. Endorphins are neurotransmitters found in the brain that have pain-relieving properties similar to morphine. There are three major types of endorphins: beta endorphins, found in the pituitary gland, enkephalins, and dynorphins (Columbia University, 2001). It is well documented that exercise results in increased endorphin-levels (Appenzeller, Standefer, Appenzeller, & Atkinson, 1980; Carr, Bullen, Skrinar, Arnold, Rosenblatt,

Beitins, Martin, & McArthur, 1981). These increased levels may also be what runners refer to as the “runners high” (Pargman & Baker, 1980).

Aerobic activity, not only increases blood flow to the brain, but also speeds recall and reasoning skills (Etnier et al., 1997). Participation in aerobic activity results in an increase in the oxygen-carrying capacity of the blood and improves the efficiency of oxygen delivery to working cells (Astrand, 1988 & DeVries, 1972). Because the brain tissue requires disproportionately more oxygen and glucose per gram weight than the rest of the body, and because adequate supplies of these nutrients are essential for neural metabolism, changes in cardiovascular efficiency directly affect the CNS (central nervous system) function (Dustman, Emmerson, & Shearer, 1994).

Further studies confirm the relationship between physical activity and neurocognitive functioning. Cross-sectional investigations of this relationship compare individuals who volunteered to participate in aerobic activities on a regular basis. Two investigations (Chodzko-Zajko, Schuler, Solomon, Heintz, & Ellis, 1992; Offenbach, Chodzko-Zajko, & Ringle, 1990) assessed fitness levels with several physiological measures that were shown to correlate well with VO_{2max} (VO_{2max} is the maximum amount of oxygen a person can consume when doing strenuous exercise) (Chodzko-Zajko & Ringle, 1987). There were two general findings from these studies; (a) for most cognitive/neuropsychological measures, individuals who maintained high levels of fitness performed better than people who exercised infrequently; (b) studies that also included comparisons of young with older adults demonstrated significant age effects on measures that were shown to differentiate high-fit from low-fit subjects (Dustman,

Emmerson, & Shearer, 1994). For the purpose of this discussion, (a) is of importance. A lifestyle of exercise was related to faster speed of responding during reaction time experiments (Baylor & Spirduso, 1988; Clarkson-Smith & Hartley, 1990; Dustman et al., 1994; Rikli & Busch, 1986; Spirduso, 1975; Spirduso & Clifford, 1978; Spirduso, MacRae, MacRae, Prewitt, & Osborne, 1988).

Additionally, fitness status was generally found to be related to performance on cognitive tests that measure “mental flexibility” and fluid intelligence (Dustman et al., 1994; Elsayed et al., 1980; Powell & Pohndorf, 1971), or “labor intensive” processing as opposed to automatic processing (Chodzko-Zajko et al., 1992). There was however an exception according to Spirduso et al. (1988), who found that physically active and inactive individuals performed comparably on symbol digit and trail-making tasks. Other variables and benefits of exercise that need to be considered are the psychological effects of exercise.

Exercise and Self-Esteem

Another potential benefit from physical activity is the relationship between physical activity and self-esteem. Self-esteem may be enhanced by physical activity as a result of favorable changes in the physical appearance of the body or due to the improved motor skills resulting from regular physical activity (Teasdale, 1993). Improvements in self-esteem may lead to better classroom behavior and a greater desire to learn (Bluehardt, Wiener, & Shepard, 1995; Cantell, Ahonen & Smyth, 1994).

Exercise and Self-Concept

Self-concept is another variable worth considering when assessing the psychological effects of exercise. This term is simply how one views them self. In studies on self-concept, researchers included self-esteem, self-image, self-awareness, and body-cathexis (satisfaction with physical attributes) as elements affected by regular exercise (McDonald & Hodgdon, 1991). Therefore, regular physical activity may contribute to improved self-concept confirmed by Hinkle (1992), whom also supported the notion that regular exercise may lead to enhanced self-concept.

In a study by Brown, Morrow, and Livingston (1982), fifty college-aged women participated in a fourteen-week exercise program (primarily jogging) that examined the effects of exercise and self-concept. The researchers focused on two subscales of the Tennessee Self Concept Scale (TSCS), physical self and total positive self. Findings from the study concluded that subjects in the experimental group emerged with a higher physical self-concept than those in the control group (Fitts, 1965).

Additional studies confirm the findings that regular exercise may contribute to improving self-concept. Wilfey and Kuncze (1986) examined the physical and psychological benefits of an eight-week walking/jogging/cycling program on physical self-concept. This study included eighty-three participants. At the end of the study, the experimental group (exercise group) scored higher on physical self-concept than the control group (non-exercise group). Similarly, Plummer and Koh (1997) studied the effects of aerobic dance on self-concept. One hundred sixteen undergraduate women in aerobic classes and the other one hundred seventy women in other nonphysical

education courses completed the TSCS in a pretest-posttest design. Significant differences were detected in self-concept between the two groups. The aerobics class scored more positively on seven of the nine subscales compared to the control group on the measure of self-concept. Again, the literature generally supports the notion that physical activity improves self-concept, which may include elements like self-esteem and body cathexis etc.

Exercise and Mood

Exercise can also affect mood. A large number of studies conducted in the exercise psychology field have examined the effects of regular exercise on general indices of mood (Hughes et al., 1986; Frazier and Nagy, 1989). Most researchers suggested that exercise improved global mood (Folkins & Sime, 1981; Gondola & Tuckman, 1982; McDonald & Hodgdon, 1991; Simons & Birkimer, 1988; Steptoe, Edwards, Moses, & Mathews, 1989). Mood is typically measured by POMS, a multi-dimensional instrument which describes mood states. It measures six mood factors including, tension, depression, anger, vigor, fatigue, and confusion (Rosenfeld, 1998). In a pre-experimental design, Gondola and Tuckman (1982) collected 348 non-elite marathoners who completed the POMS and described themselves as having less total mood disturbances (due to lower tension, depression, fatigue, and confusion scores, and higher vigor scores) than college-aged norms. This investigation is by no means conclusive but provides initial evidence for the affective outcomes of regular aerobic activity.

Simons and Birkimer (1988) studied the effects of an eight-week walking/jogging program on mood-states. Fifty-three subjects in an experimental group improved significantly in mood compared to the control group of seventy-five at the end of the study. In another study by Steptoe et al. (1989), twenty-four subjects participated in a ten-week study that involved exercise. There were twenty-three in the control group. All were considered sedentary. The experimental group exercised 3-4 times a week, while the control group did not. The exercise program resulted in significantly higher scores on the POMS-assessed mood for the experimental group compared to the control group, further evidence supporting the notion that regular exercise may improve mood states.

Aerobic Activity and Stress Reduction

One of the many benefits from aerobic activity is a reduction in stress (Manley, 1996). This is evident in research on the effects of aerobic exercise on psychological states. Initial interest in the topic arose from avid exercisers, especially runners who focused on the emotional and psychological benefits induced from their participation (Greist, Klein, Eischens, & Faris, 1978; Sacks & Sachs, 1981). Runners initially started running to improve their physical health but then noticed the activities effects on their mood and well-being, and it was this “runners high” that kept them hooked (Rosenfeld, 1998). From here, the field of sport psychology generated convincing evidence from elite athletes, whose involvement regular aerobic activity scored more positively on psychological measures than their non-athletic counterparts (Browne & Mahoney, 1984; Morgan, 1980). Research in the combined areas of mental health professionals and

sports scientists began to investigate the relationship between aerobic activity and its potential effects on mental health, mainly stress and anxiety/tension.

Perceived Stress

The confusion over the term “stress” has existed for many centuries according to Rutter (1983). He states that the term “stress” dates back to at least the fourteenth century, at which time it already had several different definitions. The term “stress” had four definitions: (1) a form of stimulus (or stressor), (2) a force requiring change or adaptation (strain), (3) a mental state (distress), and (4) a form of bodily reaction or response (Rutter, 1983).

Considerable research has made it apparent that an individual’s perception of an event—that is, a potential stressor—is more important than the objective event itself (Spacapan & Oskamp, 1987). Perceived levels of stress are influenced by daily hassles, major events, and changes in the availability of coping resources (Cohen et al., 1983). For the purpose of this study, both measures will be incorporated through the use of the Perceived Stress Scale (PSS) (Cohen et al., 1983). This scale measures the degree to which situations in one’s life are appraised as stressful (Cohen et al., 1983). The instrument is a global one (i.e. not tied to specific events) and measures on-going stress, anticipation of future stressors, and stress that one may be experiencing vicariously through a friend’s or family member’s life (Spacapan & Oskamp, 1987).

McGrath (1976) defines stress to be an environmental situation where one’s perception of a demand threatens to exceed the person’s capabilities and resources for meeting it, under conditions where (the person) expects a substantial differential in the

rewards and costs from meeting the demand versus not meeting it. From this definition, propositions about stress are summarized in six themes paraphrased by McGrath (1976):

Theme 1: *Cognitive Appraisal*

Subjectively experienced stress depends on the person's perception and interpretation of the "objective" or external stress situation.

Theme 2: *Experience*

An individual's familiarity with the situation, past exposure to the stressor conditions, and/or prior practice or training in response to deal with the situation can influence his or her level of subjectivity experienced stress.

Theme 3: *Reinforcement*

An individual's past successes and failures in a given type of situation can operate to reduce or enhance, respectively, the level of subjectively experienced stress for that individual in that type of situation.

Theme 4: *The Inverted U*

At low levels of subjectively experienced stress (arousal), task performance is poor; increases in stress up to some level (a level that is optimal for a particular individual regarding performance of a particular task) enhance task performance; further increases in stress beyond that optimal level lead to performance decrements.

Theme 5: Task Differences

The relationship among subjectively experienced stress, task performance, and ensuing consequences depends on type of task and how that task relates to the stressor conditions being investigated.

Theme 6: Interpersonal Effects

Presence and activities of other persons in the situation may influence the subjective experience of stress and may also influence responses to stress and the consequences of these responses. These influences may operate in several partially conflicting ways. Presence of other people may increase arousal level. Other people may also be sources of potential irritations and antagonism, especially when exposure is for long periods of time and/or under conditions in which the focal person does not fully control performance may be directly and/or indirectly helped or hindered by other people who are interdependent with focal person with respect to task performance. Some of these effects may operate to increase arousal, some to reduce it. Some may modify task performance and its consequences independent or arousal levels. How strongly each of these functions operates in a given situation depends on the task structure and interpersonal composition of that situation (Krohne & Laux, 1982).

Stress can also be identified with terms like anxiety or tension. Anxiety can be irrational fear that may result in the cognitive-behavioral complaints of tension, worry, feelings of inadequacy, over-sensitivity, difficulty concentrating, insomnia; and the somatic complaints of rapid heart rate, shortness of breath, irregular breathing, excessive sweating, and diarrhea (Gleitman, 1992). In this study, stress that causes strain and

distress in potentially harmful ways will be analyzed and considered negative stress (Stress Management, 2000). There is an accumulation of evidence showing that there are very real negative effects of stress on both the psychological and physical health of people (Howell, 2002). Therefore, reducing stress may be an option for improved health and well-being.

Assessing Stress

Stress can be assessed in two general models; major life events and daily hassles (Wagner et al., 1988). Major life events include events like a death of a relative, divorce, and family relocation. Daily hassles, on the other hand, focus on smaller more chronic stressors. These ongoing stresses of daily living refer to stress in the immediate context of thought, feeling, and action (Wagner et al., 1988). In previous studies, daily stressors have been shown to be a better predictor of symptoms related to stress among young adults compared to major events (DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1982; Holahan, Holahan, & Belk, 1984; Kanner, Coyne, Schaefer, & Lazarus, 1981; Monroe, 1983; Oppenheimer & Prinz, 1985).

Issues in the Measurement of Stressors

There are two dominant types of scales used to measure stressors, life events measures and hassle measures. Life events are considered major stressors, such as a death in the family, and may be positive or negative. Hassles are relatively minor, daily stressors, such as traffic jams or taking an exam (Mendoza, 1990). There is continual debate over which measure more accurately measures stressors. In an article by Cohen et al. (1983), he states that subjective and objective measures of stress used in the global

and event-specific stress levels is limiting. The more accurate instrument for measuring stress levels is through an instrument that measures perceptions. Measuring perceived stress provides valuable information about the relationship between stress and pathology (Cohen et al., 1983).

Stress and Indicators

The most important indicator of stress is the adrenal medullary and adrenal cortical activation, although there are several variables have been used as indicators of stress such as heart rate, blood pressure, and muscular tension (Krohne & Laux, 1982). In studies done by Frankenhaeuser, Nordheden, Myrsten, and Post (1971), it has been demonstrated that the activity of the adrenaline medulla, as reflected in the urinary excretion of adrenaline is of importance for successful adaptation to various psychosocial stress situations and for maintaining a high level of performance on tasks. Catecholamine (mentioned earlier in the discussion) excretions are also an indicator of stress and affected by performance, especially physical work and also mental tasks (Krohne & Laux, 1982). It has been shown that both monotonous tasks and complex tasks induce an increase of adrenaline excretions also (Frankenhaeuser et al., 1971). Increased output of adrenaline has also been reported during the defense of a doctoral dissertation (Johansson, 1977). It is concluded that mental effort stimulates large amounts of adrenaline (Krohne & Laux, 1982).

Cortisol levels are also indicators of stress. Cortisol levels measure the amount of cortisol, a steroid hormone produced by the adrenal cortex (Jain, 2004). Cortisol levels are often measured to evaluate the pituitary and adrenal function. Normal values

are usually in the morning at 8:00 AM at 23 mcg/dl (micrograms per deciliter). Physical and emotional stress can increase serum cortisol because a normal response to stress involves increased secretion of ACTH by the pituitary gland (Jain, 2004). In a study done by Lovallo (1997), high cortisol levels during arousing events such as exercise resulted in enhanced memory. Evidence from animal studies indicates that corticosteroids may be necessary for memory enhancement to occur also.

Stress Reduction

There are two ways of reducing the uncertainty or proceeding or stress: by (1) removing the preponderance of demands over capacities by raising capacity (this can be done by practicing) and by (2) removing the preponderance of demands over capacities by reducing task demands (Krohne & Laux, 1982). The more the uncertainty of proceeding increases, more information becomes available to the person involved so that he or she decides to discontinue the ongoing activity and thereby terminate or avoid a period of stress (Krohne & Laux, 1982). It is the inadequate coping behavior that is the main condition for the occurrence of stress (Krohne & Laux, 1982). Therefore, identifying an appropriate coping behavior may reduce stress.

Researchers have investigated the effects of aerobic exercise and anxiety in both clinical and sub-clinical populations and confirm that regular aerobic activity does lower anxiety in various populations (Jambor, Rudisill, Weekes, & Michaud, 1994; Labbe et al., 1988, Leste & Rust, 1984; Long & Haney, 1988; Long & Van Stavel, 1995; McDonald & Hodgdon, 1991; Petruzello et al., 1991; Wykoff, 1993). This is evident in studies done with rats exercising in a running wheel. Rats that were exercising on a

running wheel and then experienced stress (a foot shock) had an increase in concentrations of norepinephrine in the locus coeruleus (a small nucleus found on both sides of the upper pons containing norepinephrine neurons that are considered to be a key brain center for anxiety and fear) and dorsal raphe (cell bodies in the middle region of the brain stem) in comparison with the sedentary controls that received the stress (Dishman et al., 1994). These trials demonstrated that aerobic activity caused changes in neuropeptides and responses to stress (Rabin, 1999). Therefore, exercise probably modifies catabolism and synthesis of neuropeptides in various parts of the brain, possibly contributing to sensitization (Rabin, 1999).

In 1994, Jambor et al. examined the effects of an eight-week aerobic aqua running program on various psychological outcomes in healthy adults. Thirty subjects were assigned to treatment and control conditions based on their individual preferences. After eight weeks, their cognitive and somatic anxiety scores, as assessed by the Competitive Sport Anxiety Inventory (Martens, Burton, Vealey, Bump, & Smith, 1982), decreased in both conditions. Conclusions from the study indicated that the aqua running exercise sessions showed a reduction in anxiety.

In a meta-analytic review, Petruzello et al. (1991) examined anxiety-reducing effects of regular exercise. The results from the study suggested that regular aerobic activity is associated with reduction in stress, with an effect size of 0.36. The study was conducted over ten weeks, with each session lasting twenty minutes. Long and Van Stavel (1995) conducted a similar study examining the effects of exercise training and stress management for adults. Results suggested a low-to-moderate positive effect, with

regular exercise improving anxiety levels 0.36 standard deviations over alternative conditions. The regular aerobic effect size (the magnitude of an experimental result) was 0.46. The results implied that individuals with stressful lifestyles showed a greater reduction in stress after regular aerobic activity than those who did not regularly exercise.

Therefore, the literature suggests that regular aerobic activity may be a means for reducing anxiety. Regular aerobic exercises can expect to experience less stress after engaging in a regular aerobic activity. This is consistent for high- and low- stress and normal populations (Rosenfeld, 1998).

Bodies Responses to Stress through Exercise

Regular exercise is useful in removing the by-products of the stress response by providing the opportunity to simulate the fighting or running dictated by the fight or flight phenomenon (Stress Management, 2002). Aerobic activity may be a coping behavior for reducing stress by looking at the body's response to aerobic activity. According to Fox (1999), there are moderate effects for reduction in anxiety after exercise with most studies testing the effects of aerobic forms of exercise such as running. Further investigations by Michael (1957) reported that repeated exercise "conditions" the stress adaptation mechanism of the body affecting the adrenal glands and the autonomic nervous system. Regular exercise may increase the adrenal sensitivity and the reserve steroids available to counter stress. Therefore, regular exercise may enable the body to have an improved response to stress by returning the body to homeostasis faster and reduce the physical impact of psycho-social stress.

Another exercise-induced alteration of the stress response can be seen in the brain. If areas of the brain affected by exercise overlap with areas of the brain that are activated by a psychological stressor, habituation may occur (Krohne & Laux, 1982). When an individual experiences a psychological stressor, habituation may lead to the reduction in the magnitude of activation of the brain areas repeatedly activated by exercise. Of course the opposite reaction could occur also. Some areas of the brain may produce an inhibitory signal to the SNS (sympathetic nervous system) and HPA axis (hypothalamic-pituitary-adrenal axis), which regulates cortisol production, resulting in attenuation of stressor-induced immune alteration (Cushing, 2004).

The effect of stress on the production of hormones in the brain is also affected by exercise. It is not known if the induced hormonal alterations are minimal or extensive in the brain, but there is a hormonal change (Krohne & Laux, 1982). Some of these hormonal responses can be a result of stress-buffering behaviors that are not physical like perception of social support, a belief system, and a sense of humor, but exercise is a physical activity. In order to produce alteration in the function of the immune system, areas of the brain need to be activated in order to activate the SNS and the HPA axis. By finding less alteration of the immune system in subjects who are physically fit suggests that regular exercise may activate areas of the brain that modify immune function, resulting in the response of the brain to psychological stress (Krohne & Laux, 1982).

It would be important to know if exercise has a beneficial effect on the health of every individual who participates in exercise programs. It is possible that individuals

that exercise may be very different than individuals that do not exercise. For example, individuals that regularly exercise may:

- Be more comfortable in social interactions and have more social support.
- Eat a better diet.
- Seek out medical care more readily when appropriate.
- Have less activation of the SNS and HPA axis when experiencing a psychological stressor because of different properties of the CNS (Krohne & Laux, 1982).

An aspect of stress reactivity may be evident in the hormonal changes induced by exercise. In a study of elite athletes (Perna & McDowell, 1995), plasma cortisol (level of cortisol in the blood) concentrations were measured after exercise. One cortisol response pattern consisted of rapid recover to baseline. Another cortisol response pattern displayed persistence of cortisol elevation for approximately 20 hours.

Individuals with consistently high cortisol levels reported more stressors in their lives. If persistent cortisol levels are associated with deleterious effects on the brain, then individuals who exercise and sustain cortisol levels may have a better response to stress (Perna & McDowell, 1995).

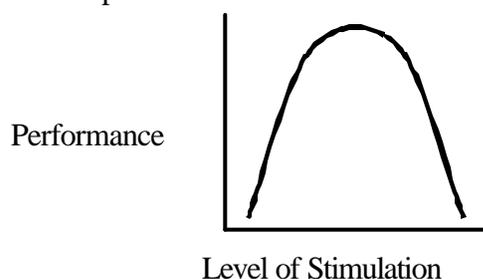
In attempts to link the two, exercise and stress reduction, Van Liere et al. (1954) explored the relationship by looking at the autonomic nervous system. His studied showed the dominance of the parasympathetic system to react and demonstrate a lower pulse rate in trained individuals (Palmer et al., 1995). According to Selye's theory, the initial reaction to "non-specific" stress allows for either a general adaptation (GAS) to stress or a breakdown. The general adaptation syndrome includes the function of the adrenal cortex and a learning process of defense against future exposures to stress (Palmer et al., 1995). Increased sensitivity of the adrenal glands through exercise may

allow individuals to adapt to stress more easily than those that do not exercise. It may be the case that exercise increases coping abilities for stress as individuals who engage in regular exercise have less depression and more feelings of well being than individuals who do not exercise regularly (Stephens, 1988).

Stress and Performance

Stress and performance can be studied by looking at the relationship between stress and arousal (activation). Different types of stressful situations, physical and psychological stimulation, as well as demanding tasks are all assumed to contribute to an increase in arousal levels (Krohne & Laux, 1982). The inverted U curve is the best, known model relating stress-induced arousal to performance (Hebb, 1955). In this model, performance tends to be poor if arousal and activation levels are too low. As arousal levels increase, performance increases to an optimal level. Once an individual is past an optimal point, too much arousal results in deteriorated performance (Hebb, 1955). Figure 1. illustrates the relationship:

Figure 1. Relationship between stress-induced stimulation and performance.



The optimal level of stimulation depends on the difficulty of task, being lower for difficult than for easy tasks. The later relationship is consistent with the Yerkes-Dodson

Law (YDL) (Yerkes & Dodson, 1908). This is one of the oldest psychological laws to date. It has generated many decades of research, and in a sense, its current status reflects broader divisions within psychology itself. The YDL is generally interpreted as predicting a negative quadratic relationship between arousal and performance, and that the optimal level of arousal for a more difficult task will be lower than for an easier task (Watters, Martin, & Schreter 1997).

This model is very flexible and has been supported by many experiments (Atkinson, 1974). Hockey & Hamilton (1970) point out that the advantage to a flexible model is almost any result can be explained, but on the other hand, any result may not be easily disproved. Therefore, it is important that a critical test of this model involve a systematic variation along the assumed arousal continuum, keeping other factors constant (Krohne & Laux, 1982).

The inverted U curve describes the relationship between intensity of arousal (stress) and performance, but it does not account for possible temporal effects of stress on performance (Krohne & Laux, 1982). By looking at models suggested by Broverman, Klaiber, Vogel, and Kobayashi (1974), short-term and long term memory stress were affected by adrenal and cholinergic functions and to performance on different types of tasks. The theory states that short-term stress aids performance on routine and repetitive tasks, but does not aid in tasks that involve perceptual restructuring or tasks that are being learned (Krohne & Laux, 1982). According to the inverted U model, short-term stress and performance can be described, but the same is not true for the long-term stress and performance when looking at perceptual

restructuring tasks. Therefore, it is necessary to look at long-term stress, as it is associated with a decrease in arousal levels. Performance on complex tasks may improve and performance on simple tasks may decrease (Krohne & Laux, 1982). Again, this is evident in the YDL.

Information Processing-Learning

Information processing is the process of analyzing the cognitive elements underlying intellectual performance (Gagne et al., 1993). It consists of several components that work together to generate cognitive performance. These components are as follows: initial reception to information, selective perception, working memory, storage and long-term memory, retrieval, response generation/effects, and control processes (Gagne et al., 1993). By defining the components in the brain responsible for information processing, it may be feasible to link the affects of exercise and cognitive processing.

Initial reception to information is the process of external stimuli (touch, or in the case, exercise) being received by receptors that send impulses to the brain (Gagne et al., 1993). This reception can happen in many forms then transferred to one common form. From here the message is sent to immediate memory where the brain decides where the information should go (selective perception) (Gagne et al., 1993). Immediate memory stores memory for a very brief period of time. From here, information is sent to working memory, is lost, or is sent to long-term memory.

Memory is critical in information processing. In the process of information processing, working memory is what you are aware of at any given moment and lasts

about 10 seconds (Gagne et al., 1993). It has limited capacity. For academic purposes, it is important to get information to long-term memory. Long-term memory is a storage area for information to be used at a later time (Gagne et al., 1993). The process of doing this may be enhanced by repetition.

Stress and Learning

Many stress models emphasize the “mismatch” between the individual and his or her environment (Whitman et al., 1986). Learning can be inhibited with too much or too little stress. Because individuals perceive stress differently, it is difficult to define the levels of stress experienced by students. Some college students, when stressed by academic demands, use ineffective mechanisms for coping, like, putting-off writing assignments or avoiding studying (Whitman, Spindlove, & Clark, 1986).

Therefore, this study will also investigate the affects of aerobic activity and stress-reduction of undergraduate women at Texas A&M University. By studying the affects of aerobic activity on academic performance through stress reduction, recreational sports departments will be more able to justify their need and case for channeling increasingly scarce institutional funds into recreational programs (Bryant, Banta, & Bradley, 1995). Additional research in the department of recreation sports will only help validate its role in helping institutions meet their academic goals from outside the classroom.

Statement of the Problem

Historically, evidence to support a positive association between academic performance and participation in physical activity has been somewhat unclear (Daley &

Ryan, 2000). Much of the uncertainty lies in the studies themselves. The current literature on academic performance and physical activity fails to identify certain factors, like stress-reduction, that may affect this relationship by the nature of their experimental designs.

Use of well-controlled, reliable research methods is largely lacking. The majority of studies have used cross-sectional or correlational techniques without random assignment to conditions (King, Taylor, Haskell, & DeBusk, 1989). This is evident in the following studies that used questionnaire analysis. Several of the studies use questionnaires to collect data and not an experimental design in their research methods. In the article by Field, Diego, and Sanders (2001), a questionnaire was administered to eighty-nine high school seniors. The researchers used a 181-item Likert-type scale that produced data that was not valid (Field et al., 2001). There were very few inferences that could be made from this study when only questionnaire data was used.

The same design problems existed in the study by Daley and Ryan (2000). Again, participants were asked to complete a questionnaire. In this study, there are several external factors that were not addressed. Missing factors included demographic variables that could play a significant role in the relationship between academic performance and physical activity.

Additionally, several studies focus on the intervention of acute exercise compared to chronic exercise in predicting the benefits of physical activity. Acute exercise was researched by studying a single session of exercise and chronic exercise over time (10 weeks or longer) (Morgan, 1980). When measuring the affects of physical

activity on academic performance, one must consider a timeline comparable to an academic setting like a collegiate semester. Therefore more research needs to be done that measures chronic exercise instead of acute exercise.

Purpose of the Study

The purpose of this study was to investigate the relationship between aerobic activity and academic performance through stress reduction of undergraduate women at Texas A&M University who used the Student Recreation Center. Stress was measured in this relationship over time. This study prescribed aerobic activity and time spent engaged in aerobic activity while measuring current stress levels over a twelve-week period. Additionally, the study assessed the impact of selected variables like time spent studying and time spent working.

CHAPTER III

METHODOLOGY

Population

The population for this study included 40 full-time undergraduate women at Texas A&M University enrolled in liberal arts classes in Fall 2002. The women were classified as non-freshman who did not exercise regularly (less than three times a week). All students were between the ages of 19 and 22-years of age. Participants who completed required tasks were retained for this analysis.

Instrumentation

The Perceived Stress Questionnaire was used as an instrument for collecting data in this study (Cohen et al., 1983). The researcher altered the Perceived Stress Scale (PSS) in order to collect a more accurate response of perceived stress. The questionnaire used by Cohen et al. (1983) is presented in Appendix A. and the version of the PSS altered by the researcher is presented in Appendix B. The researcher altered the 5 point scale used by Cohen et al. (1983) ranging from 0 to 4 to a 100 point scale, ranging from 0 to 100. The larger scale also provided respondents greater latitude by using an on-line sliding scale compared to the original scale used by Cohen et al. (1983).

The PSS is a 14-item measure of the degree which measures the degree to which situations in one's life are appraised as stressful, assuming centrality of the cognitive appraisal process opposed to or in addition to objective stress (Cohen et al., 1983). Items on the instrument were designed to detect the degree to which respondents found their lives unpredictable, uncontrollable, and overloaded (Cohen et al., 1983). Questions

in the PSS, answered by participants, asked about feelings and thoughts during the last month. The respondents were asked how often they felt a certain way.

The scale includes a number of questions about current levels of stress. This made it an appropriate choice for appraising stress from daily conflicts, major events, and changes in coping resources through a time period of four to eight weeks (Cohen et al., 1983). Since the scale measures responses that are perceived, it provides a more accurate measure of the level of stress experienced by the respondents. It is the level of appraised stress, not the objective occurrence of events that determines one's response to stress (Lazarus, 1977).

PSS scores are obtained by reversing the scores on the seven positive items, e.g. 0 = 4, 1 = 3, 2 = 2, etc. and then summing across all 14 items. Items 4, 5, 6, 7, 9, 10 and 13 are positively stated items in the questionnaire (Cohen et al., 1983). The altered scale would include responses on a larger interval where 0 = 100, 25 = 75, 50 = 50, 75 = 25, and 100 = 0. The final scores were obtained by reversing the scores on the seven positive items and then summing all fourteen responses.

In a study by Cohen et al. (1983), the overall mean score for the scale was 13.02 and standard deviation 6.35. This was obtained from a national Harris Poll telephone interview of 2,387 people where their perceived stress scores were obtained. For the purpose of this study, the mean score for women between the ages of 18-29 was 14.2 and standard deviation 6.2. Scores higher than the mean were considered to be scores of people who need more self-assessment or were considered "stressed." The sample mean

for the sliding scale was 609.1. This was the average level of perceived stress self-reported by the participants.

Reliability and Evidence for Concurrent and Predictive Validity

Three samples were used establishing the reliability and validity of the PSS. Two of the groups consisted of college students and the other a more heterogeneous group enrolled in a smoking-cessation program (Cohen et al., 1983). Validation data was collected from the three samples. Researchers indicated that the PSS had adequate internal and test-retest reliability and correlated in the expected manner with a range of self-report and behavioral criteria (Cohen et al., 1983).

The 14-item Perceived Stress Scale was factor analyzed, using the principal components method with varimax rotation (See Table 1).

Table 1. Perceived Stress Scale Principal Component Analysis.

Items of PSS	Eigenvalues
1	3.60
2	2.20
4	0.17
5	0.03
12	0.11
13	0.39

The principal components analysis revealed that 10 items loaded positively on the first factor at 0.48 or above. Items 4, 5, 12, and 13 had relatively low loadings of 0.17, 0.33, 0.11, and 0.39 respectively. The analyses further revealed that there were

two factors with eigenvalues over 1.0. Factor 1 = 3.60 and factor 2 = 2.20 which together accounted for 41.6% of the total variance (Spacapan & Oskamp, 1987). Looking at the loading factors for each item indicated that 25.9% of the variance weighted most heavily on those items that were negatively worded and 15.7% of the variance reflected positively phrased statements (Spacapan & Oskamp, 1987). The distinction between the two factors was considered irrelevant. Scores across all 14 items were summed and Cronbach's alpha coefficient for the internal reliability with a = 0.75 (Spacapan & Oskamp, 1987).

Validity and reliability issues concerning the Perceived Stress Scale were also addressed. Validity of the PSS depends on whether the predictor of a non-confounded outcome (utilization of health services, physical health, or smoking cessation), is related to perceived stress or to psychological distress (Spacapan & Oskamp, 1987). There was no definite answer, but at the very least, it was reasonable to argue that the PSS measured what it was designed to assess, the perceived degree to which environmental demands exceed the abilities to cope. Additionally, the PSS is used in studies to measure stress over shorter lengths of time, 4-12 weeks. It is more predictive compared to other scales. The data from the study by Cohen et al. (1983) concluded that predictive validity of the PSS was best between one and two months. In order to determine the instrument's reliability, unobservable information regarding stress was collected by asking the same questions of all individuals in the population (Gall, Borg, & Gall, 1996). The instrument was reliable and valid by evidence presented in a paper by Cohen, et al. (1983). Additional information was obtained through self-report.

Procedures

Participants in the study were recruited from an introductory sociology class and an educational statistics course where they were asked to fill out an information sheet (see Appendix C) for their interest in participating in a study involving aerobic activity and academic performance. Only women who exercised less than three times a week were asked to complete the information sheet. The original number of participants was 44. There were 22 in both groups to account for attrition. Forty women were chosen for the study by the original requirements and then by major and class load. Participants needed for the study were then e-mailed confirming their willingness to participate. The participants were then randomly assigned to the control group (non-exercise) or the experimental group (exercise group) by the investigator.

Subjects engaging in aerobic activity reported to a recreation center on campus for 30 minutes of aerobic activity twice a week for twelve weeks. The researcher monitored the activity and provided instruction on the physical activity. Aerobic activity was chosen not only because of its health benefits, but also because participants would have access to this kind of activity, namely running or walking. Participants walked or jogged a quarter mile for warm-up on the indoor track at the recreational center. The subjects completed a series of stretches and active movements (see Appendix D) before they engaged in 30 minutes of aerobic activity. Every week the aerobic activity consisted of a combination of walking, running, and general strength for 30 minutes. The combination of aerobic activity during the 12 weeks is described in Table 2.

Table 2. Twelve Week Aerobic Activity Schedule of Selected Undergraduate Women at Texas A&M University.

Week	Aerobic Activity
1	Walk/jog every 350 meters. 10 sit-ups, 10 squats, and 10 push-ups
2	Walk/jog 350 meters (walk 350m, jog 350m) with 5 squats before active lap
3	Walk/jog 350 meters with 3 lunges each leg before active lap 20 sit-ups and 20 push-ups.
4	Walk/jog every 175 meters.
5	Time trial for distance
6	Fartlick (alternating speeds) run for 30 minutes
7	Walk/jog every 175 meters.
8	Walk/jog every 350 meters with 5 squats before active lap
9	Walk/jog 350 meters.
10	Subjects choice of activity
11	Walk/jog every 175 meters.
12	Walk/jog time trial for distance.

The protocol was defined as follows: week one, subjects walked or jogged every other lap (350m), depending on their physical ability; week two, the participants added five standing squats to the alternate pattern of adjusted speed immediately before increasing intensity on next lap; week three, participants did standing lunges instead of squats; in week four, participants actively walked or jogged the straights and went slower on the curves (straights and curves refer to the shape of the indoor track at the recreational

facility where approximately 145 meters were more intense and 30 meters were less intense); week five, subjects completed as many laps as possible in 30 minutes; week six, the subjects exercised for five minutes intensely and five minutes less intensely; week seven consisted of alternating straights and turns, similar to week four; week eight was the same routine as week three; week nine consisted of alternating laps with adjusting speeds and week 10 was the participants choice; week 11 the subjects alternated laps with adjusted speed and the study concluded with a time trial in week 12.

Activity Logs

All participants completed a weekly log of activity, which included: amount of exercise, type of exercise, study hours, total work hours, and a statement of well-being and stressful events (Appendix E). The logbook was collected after the fourth, eighth, and twelfth weeks. A majority of the logs were collected in the investigator's class. The remaining logs were delivered to the investigator's office on campus. A cover letter assuring subjects confidentiality and explaining questionnaire instructions was completed and attached to the logbooks.

Compensation

After the sixth week of the study, subjects received \$100 and another \$100 at the end of the twelfth week (completion of the study). Compensation was available for the participants after the researcher received their daily logs and confirmed their participation on the on-line questionnaire. Compensation was picked up on campus.

Perceived Stress Test

Both groups of subjects completed an on-line stress questionnaire, the Perceived Stress Scale (PSS). This questionnaire was available to the participants by logging on to a website. They gained access to the questionnaire after entering their name and a password, consisting of numbers in their social security number. They completed the on-line questionnaire the first week of the study and repeated the same procedure in the fourth, eighth, and twelfth weeks of the study. Subjects included in the analysis on the variable “stress tests” were included only if they completed at least two on-line stress tests. This included 33 subjects of the total 34 participants. One subject did not submit the score properly for analysis.

Exams

Five exams were recorded from the investigator’s class and from other classes, namely sociology. Those subjects not in the investigators class (educational statistics) self reported five exam scores from a sociology class whose instructor had scheduled exams comparable to the investigator’s exam schedule. Thirty subjects participated in the analysis of exam scores. Twenty-seven of the 30 subjects were in the investigator’s class. The remaining three subjects were from another subject area mentioned earlier. Four subjects did not submit exam scores from the sociology class but remained in the study because they completed the on-line stress questionnaire and provided data on the self-report weekly logs.

Quantitative Data Analysis

Data used for the study was largely quantitative and explored the relationship between aerobic activity, academic performance, and perceived stress. The statistical analysis software used was SPSS 12.0 for Windows (Norusis, 2000).

In addition, inferential statistics included both t-test and analysis of variance for computation. Experimental design with several variables and a repeated measure like stress made this the most appropriate option for analysis. Repeated-measures design reduces the overall variability by using a common pool of subjects for all treatments and allowed for removal of subject differences from the error term, leaving the error component independent from treatment to treatment.

The F statistic was also used in the data analysis. It tests the null hypothesis. F was obtained by dividing $MS_{\text{treatment}}$ by MS_{error} . $MS_{\text{treatment}}$ is an estimate of the population variance (s^2) if H_0 is true, but not if it is false. MS_{error} is an estimate of the population variance (s^2). When the ratio is determined, a number close to one indicates whether or not there is support for the null hypothesis (Howell, 2002).

Independent sample t-tests and correlations were also used in the data analysis. The t-test measures the difference between the means of two independent groups, in this case, the mean sums of subject in the control group and the subjects in the experimental group (Howell, 2002). After t-test calculations were identified in research question one and two, correlational analysis was used to determine the relationship between the variables “stress test” and “exam scores” for the final research question.

The statistical test Chi-Square (χ^2) was used in the data analysis to describe the qualitative data collected through self-report. The *goodness-of-fit test* answered the statistical question whether there was a “good fit” between the data (observed frequencies) and the theory (expected frequencies). The chi-square distribution table was used with $df = 1$ (degrees of freedom). The distribution in this table is limited to the upper 5% for each degree of freedom (Howell, 2002).

CHAPTER IV

RESULTS

The primary purpose of this study was to investigate the relation between aerobic activity and academic performance through stress reduction of undergraduate women at a public institution of higher education. In order to study this relation, perceived stress was analyzed with the variable aerobic activity and with the variable academic performance (exam scores). Additional factors that were considered in the study were variables that impact college students like, *hours spent working* and *hours spent studying*. Further qualitative information was gathered from the participants in the study which provided more insight into the relationship between perceived stress and aerobic activity.

The information gained from this study will be available to professionals in the field of educational administration and student development who are interested in finding ways to educate students beyond the standard methods of teaching in a classroom setting. This information can also be used by professionals in the area of recreational sports in promoting the need for recreational facilities and programs on college and university campuses. Finally, the results from this study should be useful for anyone associated with education and believes in the positive effects of physical activity as a component of a healthy lifestyle.

This chapter provides the results of the data collected from the selected population through the on-line perceived stress questionnaire, exam scores, and self-reported data from both the experimental (exercise group) and control groups (non-

exercise group) in the study. There is also additional data like *time spent studying* and *time spent working* that was included as elements useful in determining behavioral issues of the participants. The analysis of the data that follows was organized by looking at the groups together on selected variables and then separately to answer the purposed research questions.

The first section of the results defines the variables used to investigate the research questions: the exams used in the study, the perceived stress scores, and hours spent either working or studying used in the study. The next section of the data analysis is organized by the research questions where the groups are examined against each other verses separately as in the beginning section of the data analysis. In the first section of the data analysis, participants in the exercise group self-reported additional forms of activity in addition to what was prescribed by the researcher. Exam scores from all participants were submitted from an educational statistics course and an introductory sociology course over the course of the semester.

All participants completed an on-line perceived stress test that included 14 questions. These questions measured perceived stress by asking the participants how often they felt or thought a certain way ranging from “Never” to “Almost Never,” “Sometimes,” “Fairly Often,” and “Very Often.” By putting the questionnaire on-line, the researcher was able to obtain more accurate responses from the participants by adjusting the 5 point scale to a sliding scale already mentioned. The sliding scale ranged from

0 to 100 instead of 0 to 4. The same procedure was used for analyzing the scores as recommended by the PSS. By having a sliding scale, respondents were able to answer the questions fairly quickly so not to over analyze their feelings.

Additional elements which described behavior are also analyzed in the first section. Time *spent working* and time *spent studying*, by participants was self-reported on their weekly log sheets. Hours recorded were averaged for every week in the study.

The final sections of the data analysis not only provide results answering the proposed research questions, but also valuable self-report data which provided insight on respondent's behavior. Respondents were offered the opportunity to self-report how they were feeling on their weekly log sheets and also any additional comments they wanted to add to the on-line perceived stress questionnaire. They were asked to comment on any specific things that had happened to them over the course of the past few weeks that had an impact, positively or negatively, on their thoughts or feelings. Other self-report data from the participants included other forms of physical activity beyond the prescribed activity by the researcher. The researcher prescribed aerobic activity that was monitored two days a week. The other days the exercise group participated and self-reported the following activities: brisk walking, jogging, bicycling, swimming, aerobic dancing, and aerobic activity using cardio-equipment (i.e. treadmill and pre-core). The following section defines the participants in the study followed by the sections just discussed.

The study was composed of 19 participants in the control group (non-exercise) and 15 participants in the experimental group (exercise) described by classification in

Table 3. Of the 15 women in the experimental group, five were added at week seven of the study to account for attrition in the first part of the study. Women dropped out of the study in the exercise group due to injury and a change in schedule, resulting in non-participation at the weekly exercise sessions.

Therefore, participants were added to keep numbers in both groups as equal as possible for the duration of the study. The additional participants were enrolled in the introductory sociology class and were non-freshman. They also did not exercise regularly. The participants in the study were composed of 4 sophomores, 18 juniors and 12 seniors. The additional participants at week seven replaced the same classifications of participants that were lost in attrition.

Table 3. Classifications of Undergraduate Women Participating in a Stress Reduction Study as a Link Between Aerobic Activity and Academic Performance at Texas A&M University.

Groups	Sophomore	Junior	Senior	Total
Non-Exercise	1	12	6	19
Exercise	3	6	6	15
Total	4	18	12	34

Exams

Over the course of the semester participants in educational statistics and sociology classes completed five exams. These exams were given within a week of each other over the course of the semester. Exams are presented in Table 4. *N* varied across exams

due to the discussion in the methods section concerning exam participants. Mean exams scores varied from 68.42 to 80.79 during the semester. The researcher was interested in knowing whether the mean scores depended on the time during the semester in which the exams were taken. Since mid-term exams were approximately at the time as exam three and finals were taken around the time as exam five, it was necessary to examine these scores independent of time; the mean exam scores were lower during these times.

Table 4. Descriptive Data for Exam Scores of Undergraduate Women Participating in a Study of Stress Reduction Between Aerobic Activity and Academic Performance at Texas A&M University.

Exams	N	Min.	Max.	Mean	SD
1	30	35.71	92.85	75.17	15.62
2	30	44.57	95.08	80.79	11.40
3	30	41.14	92.28	68.42	14.41
4	29	52.50	95.55	76.93	10.48
5	27	31.63	89.45	60.37	16.83

A 1-way ANOVA was calculated to determine if there was a difference between groups on the variable of exam scores over the course of the semester. $F(1, 24) = 1.83$, $p > .05$, indicating that there was no difference in exam scores over time. The timing of exams during mid-terms or finals did not have a significant effect on exam scores.

Therefore, mean exam scores were not dependent on certain times of the semester. The consistency of the exam scores allowed for the generation of a mean exam score for each participant. This score was used in subsequent analysis.

Stress Tests

Table 5 describes the statistics concerning the stress tests taken by all participants. Participants completed four stress tests taken over a 12 week period during the semester. Total number of subjects varied on the stress tests because not all subjects completed the same stress test over time at the indicated time. The stress tests were taken the first, fourth, eighth, and twelfth week of the study. The mean stress scores ranged from 503.7 to 572.4. These numbers are different than what would be expected by Cohen et al.'s (1983) work on the PSS because the researcher used a sliding scale ranging from 0-100 compared to the 0-4 scale on the original PSS. A 0-100 index scale allowed for greater latitude and more accurate responses of perceived stress. The mean score on the original PSS was 14.2 for women ages 18-29 using the scale 0-4 (Cohen et al., 1983). The sample mean using the on-line sliding scale was 609.2. The mean scores for the respondents would be considered "average stress" according to Cohen et al. (1983). However, the scores did lower from test one ($M = 641.93$) to test four ($M = 602.03$) during the semester. Again, the researcher wanted to make sure that time did not have an effect on perceived stress.

Table 5. Descriptive Data for Perceived Stress of Undergraduate Women Participating in a Study Linking Stress Reduction with Aerobic Activity and Academic Performance at Texas A&M University.

Tests	N	Min.	Max.	Mean	SD
1	30	257.0	876.0	641.93	140.72
2	32	274.0	925.0	608.16	183.56
3	29	245.0	850.0	590.59	156.39
4	29	216.0	980.0	602.03	153.45

The perceived stress test scores were analyzed using ANOVA to see if there was a difference over time during the semester. Analysis indicated that $F(1, 32) = .029, p > .05$. Therefore, there was no significant difference in stress test scores over the course of the semester. It did not matter when the subjects completed the stress tests. The consistency of the stress test scores allowed for the valid generation of a mean stress score for each participant that would be used in further calculations.

Work and Study Hours

Table 6 presents the self-reported data from the subjects regarding time spent working and studying per week. “Working” referred to time spent getting paid for a job like painting, baby-sitting etc. “Studying” referred to time spent reading, writing, doing research, and completing group projects outside of the classroom. The maximum number of work hours reported were 26.42 hours and the average number of hours worked by all subjects was 7.54 hours. The maximum number of hours reported by all subjects was 30.20 hours with the average number of study hours totaling 9.98 hours.

Table 6. Descriptive Data for Time Spent “Working” and “Studying” of Undergraduate Women Participating in a Study Linking Stress with Aerobic Activity and Academic Performance at Texas A&M University.

Hours	N	Min.	Max.	Mean	SD
Work	34	.00	26.42	7.54	7.87
Study	34	.00	30.20	9.98	5.80

Analysis was done using an independent sample t-test to determine whether one group worked more than the other group, and whether or not, one group studied more than the other. Descriptive data in Table 7 displays the variable “work hours” where $M = 6.67$ hours for the non-exercise group and $M = 8.66$ hours for the exercise group. Results indicated that the exercise group did not significantly work more than the non-exercise group, $t(33) = .73, p > .05$. Subjects that exercised regularly did not work significantly more than those subjects that did not exercise regularly and worked less.

Table 7. Descriptive Data for Time Spent “Working” Between Groups of Undergraduate Women Participating in a Study Linking Stress with Aerobic Activity and Academic Performance at Texas A&M University.

Group	N	Mean	SD
Non-Exercise	19	6.67	7.12
Exercise	15	8.66	8.86

Additional analysis was done on the variable “study hours.” In Table 8, the non-exercise group studied 8.88 per week and the exercise group spent time 11.39 hours per week studying. The same analysis was done on the variable “study hours” to see if there

was a difference. Results indicated $t(33) = 1.26, p > .05$. Although the participants in the exercise group studied slightly more hours, the difference was not statistically significant. Therefore, there was not a difference between groups on the variable “study hours.”

Table 8. Descriptive Data for Time Spent “Studying” Between Groups of Undergraduate Women Participating in a Study Linking Stress with Aerobic Activity and Academic Performance at Texas A&M University.

Group	N	Mean
Non-Exercise	19	8.88
Exercise	15	11.39

Results thus far indicated additional information for the main research questions of this study discussed in the following section.

Research Question # 1

Was there a significant difference between exam scores as reported by undergraduate women who regularly exercise and those that did not regularly exercise through use of the Student Recreational Center at an institution of higher education?

An independent sample t-test was run and determined to be $t(29) = 1.18, p > .05$, indicating that there was not a significant difference on mean exam scores between groups. Participants in the exercise group had a lower exam mean ($M = 70.02$) compared to the participants in the non-exercise group ($M = 75.08$), but it was not a statistically significant difference. Again, 30 subjects participated in this analysis from

discussion in the methods section accounting for the total number of subjects being different from the total number of participants (34).

An additional analysis was done to determine if there was a difference between the individual exam scores between the non-exercise group and the exercise group. Earlier analysis indicated no difference on the mean exam scores, but the actual scores of each participant needed to be analyzed also. A MANOVA was calculated looking at exam scores as the dependent variable and exercise as the independent variable. Wilks' Lambda was 0.64, $p > .05$. Hence, no statistically significant difference in exam scores between women who exercise and women who did not exercise.

Research Question # 2

Was there a significant difference between perceived stress tests reported by undergraduate women who regularly exercise and those who did not regularly exercise through use of the Student Recreational Center at an institution of higher education?

Again, an independent sample t-test was calculated to be $t(32) = .17, p > .05$. The total number of participants was 33. One participant did not complete the questionnaire correctly and was not included in the analyses of perceived stress scores. Participants in the exercise group had a lower stress mean ($M = 603.9$) compared to the participants in the non-exercise group ($M = 611.4$), but it was not a statistically significant difference. Therefore, it did not matter if the women exercised or not, their perceived stress levels were not different.

An additional analysis was done to determine if there was a difference between the individual perceived stress scores between the non-exercise group and the exercise

group. Earlier analysis indicated no difference on the mean stress scores, but the actual scores of each participant needed to be analyzed also. A MANOVA was calculated looking at the perceived stress scores as the dependent variable and exercise as the independent variable. Wilks' Lambda was determined to be 0.76, $p > .05$. Hence, no statistically significant difference in perceived stress scores between women who exercised and women who did not exercise.

Research Question # 3

Was there a relationship between stress levels and exam scores as reported by undergraduate women who exercised regularly and those who did not exercise regularly through use of the Student Recreational Center at an institution of higher education?

Additional correlations were calculated by separating the groups on each variable for further information on the relationship between mean stress test and mean exam scores. The correlation for the non-exercise group was $r = -.40$, $p < .05$. This analysis indicated a significant inverse relationship between mean exam score and mean stress scores. Women who did not exercise had higher stress and lower exam scores. The correlation analysis for the exercise group indicated $r = -.22$, $p > .05$. Unlike the non-exercise group, this correlation did not reach a level of statistical significance.

Self-Report Analysis

Comments classified into two categories, *stressful events* and *physical well-being* were recorded by subjects on their weekly log sheets. The comments on both variables were classified as either academic or non-academic. The *stressful events* comments included academic related comments like; exams, homework, and school work. Non-

academic comments included; friends, family, and social events. Comments in the *physical well-being* category were also classified by either being positive or negative in nature. Positive comments were defined as “fine,” “okay,” “good,” and “great.” Negative comments were defined as “sick,” “tired,” “stressed,” and “nervous.” Positive and negative comments on the *physical well-being* variable were totaled between the experimental and the control group from their daily recorded logs. The same procedure was used on the *stressful events* data where the comments were either classified as academic or non-academic.

The positive responses were counted between the two groups and shown in Table 9. In the experimental group there were 41 academic comments and 26 non-academic comments. In the non-experimental group there were 28 academic responses and 15 non-academic responses.

Table 9. Positive Academic and Non-Academic Comments Reported by Undergraduate Women Participating in a Study Linking Stress with Aerobic Activity and Academic Performance at Texas A&M University.

Group	Academic	Non-Academic	Total
Non-Exercise	28	15	43
Exercise	41	26	67*
Total	69	41	110

* $p < 0.05$

From the χ^2 distribution, $\chi^2_{0.05}(1) = 3.84$. Hence, since $\chi^2 = 5.23$, we reject the null hypothesis and conclude that the obtained frequencies differed from those expected under the null hypothesis by more than could be attributed to chance. This result was significant at the .05 level indicating subjects who exercised regularly reported more positive comments than subjects who did not exercise regularly.

Negative responses were counted between the two groups and shown in Table 10. The experimental group reported 39 negative academic responses and 22 non-academic negative responses. In the non-experimental group, subjects reported 31 negative academic responses and 16 non-academic negative responses. Between the two groups, there were 70 negative comments regarding academics and 38 negative comments regarding non-academic responses.

Table 10. Negative Academic and Non-Academic Comments Reported by Undergraduate Women Participating in a Study Linking Stress with Aerobic Activity and Academic Performance at Texas A&M University.

Group	Academic	Non-Academic	Total
Non-Exercise	31	16	47
Exercise	39	22	61
Total	70	38	108

$p > .05$

Results in Table 1.6 were calculated from the χ^2 distribution table with $\chi^2_{0.05}(1) = 3.84$.

χ^2 was determined to be 1.82, $p > .05$. Here, we failed to reject the null hypothesis

because $1.82 < 3.84$, meaning no significant difference in responses.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

There are a number of factors that can contribute to a student's academic performance in college. The initial assumption for this study was that college-aged women who regularly exercised (aerobically) would have lower perceived stress levels in their lives compared to other college-aged women who did not exercise regularly. This assumption was then potentially linked to increased academic performance for women who exercised regularly than those that did not exercise regularly. Through reviewing the literature, in combination with the results from the study, conclusions help provide information for improved methodology and research on this topic.

It is well documented that academic performance can be achieved through many forms of learning. Bryant et al.(1995) acknowledged studies by Light (1990), Boyer (1997), and Pace (1990) dispelled the notion that all of the memorable and important learning in college goes on inside the classroom. Boyer (1997) agreed that learning outside the classroom in the form of extracurricular activities was beneficial to learning. Therefore, the researcher chose aerobic activity as a variable to analyze the relationship between perceived stress and academic performance of college-age women at an institution of higher education.

Summary

After prescribing a twelve week plan to the experimental group, conclusions and concerns were addressed in the following discussion. Initially, both groups were analyzed separately, so the researcher could make initial conclusions about participants

in the study. To account for attrition concerns, participants were added at week six (the half-way point of the study). These participants therefore only completed perceived stress tests three and four and recorded three exams towards the end of the semester. By doing an analysis of mean scores on both the perceived stress test and existing exam scores, the researcher was able to determine if it mattered when stress tests and exams were taken for each individual in the study. Since participants were added to the study, this was a concern. By doing a 1-way ANOVA, results indicated that it did not matter when stress tests and exams scores were completed, although there were mean differences at “high stress” periods like mid-terms and final exam dates. There was no difference in exam scores $\{F(1, 24) = 1.83, p > .05\}$ or on stress tests $\{F(1, 31) = .81, p > .05\}$. This analysis was also done so the researcher could collapse across variables into a simple t-test analysis in future calculations, reflecting individual participants and scores during the semester.

Additional data in the study that needed to be considered was the amount of time participants spent working and studying. Results indicated that on the variable, “work hours,” the exercise group’s mean hours was higher than the non-exercise group, but the difference was not statistically significant difference $\{t(33) = 1.26, p > .05\}$. The same results were evident on the variable, “study hours.” The exercise group’s study hours mean was higher than the non-exercise study hours mean, but not a statistically significant difference $t(29) = 1.18, p > .05$. Analysis of “work hours” and “study hours” did not provide statistically significant data, however, both variables account for

activities that required time commitments that may or may not have an impacted academic performance.

Conclusions

Question # 1

Research question number one explored the relationship between both groups and mean exam scores. Shepard (1997) suggested that when a substantial amount of school time is dedicated to physical activity, academic performance meets and even exceeds that of students not receiving additional physical activity. Scheuer & Mitchell (2004) indicated that there existed a positive relationship between physical activity and academic performance. A t-test indicated that there was not a statistical significant difference between groups on the variable “exam scores” $\{t(29) = 1.18, p > .05\}$. The non-exercise group had a higher exam mean scores ($M = 75.08$) but not a significantly higher mean scores compared to the exercise group ($M = 70.02$). Results contradicted previous findings in the literature and the researcher’s hypotheses that regular aerobic activity improved academic performance. Since there was no difference between groups, the researcher revisited the “work” and “study” hours of each group to see if that previous data may have contributed to there being no difference. Again, mean differences on the variable “work” and “study” did not indicated a significant difference or explanation for there being no difference on mean exam scores. There was not a difference on exam scores between participants that exercised and participants that did not exercise.

Question # 2

Research question number two investigated mean perceived stress scores between groups. Earlier discussions mentioned that there were neurological benefits of aerobic activity that helped reduce stress levels (Sallis and Owen, 1999). The original hypotheses stated that regular aerobic activity reduced perceived stress levels. By reducing perceived stress levels between the groups, the researcher hypothesized that this relationship could be linked to improved academic performance. Results indicated that the exercise group had a lower mean stress score ($M = 502.0$) than the non-exercise group ($M = 568.2$), but it was not statistically different, $p > 0.05$. Individual participant scores were examined to see if there were any outliers that may have affected the mean scores, but this was not the case. Both groups reported comparable levels of perceived stress whether aerobic activity was a part of their daily routine or not.

Question # 3

Question three focused on the combination of questions one and two by correlating exam score means and perceived stress test's means. Research indicated evidence of a positive relationship between physical activity and academic performance so a correlation was done to investigate mean perceived stress scores and mean exam scores (Scheuer & Mitchell, 2004). In order to analyze the relationship between academic performance and perceived stress the researcher analyzed each group, exercise and non-exercise separately on the variable of mean exam scores and mean stress scores.

Results indicated that there was a statistical significance ($r = -.54, p < .05$) correlation between the exam score mean and the perceived stress score mean. Since r

was negative the relationship between perceived stress levels and exam scores for the non-exercise group was inversely related. Therefore, perceived stress levels increased as exam scores decreased for participants that did not engage in regular aerobic exercise. The results of this correlation confirmed findings by Whitman et al. (1986) that exam stress typically impacts exam scores, negatively. The researcher found this to be one of the most significant findings of the study.

The same analysis was done for the exercise group. Analysis indicated a correlation value that did not reach a level of statistical significance ($r = -.45, p > .05$). There was not a significant inverse relationship between perceived stress scores and exam scores. Therefore, stress levels negatively affected exam scores for the non-exercise group, but not for the exercise group; clearly, a significant finding in this study. This data provides evidence that stress reduction should be a variable that can potentially improve academic performance.

Self-Report Discussion

Qualitative data provided additional information from the participants, taking into account the psychological effects of aerobic activity. Qualitative data was used to compute a quantitative value because the researcher was looking to find a *goodness-of-fit test* that would answer the statistical question whether there was a “good fit” between the data (observed frequencies) and the theory (expected frequencies) (Howell, 2002). Both groups were asked to provide brief statements of “well-being” on their log sheets. These statements ranged from feeling “great” to feeling “stressed and tired.” Participants in the exercise group reported more positive comments than participants in

the non-exercise group. Results were consistent with literature in the area of exercise psychology and topics which include affect, mood, and emotion. Steinhardt and Dishman (1989) concluded that feeling better and reducing tension are among the most common perceived benefits of exercise endorsed by young people and adults.

Additionally, self-esteem may be enhanced by physical activity as a result of favorable changes in the physical appearance of the body or due to the improved motor skills resulting from regular physical activity (Teasdale, 1993). Improvements in self-esteem may lead to better classroom behavior and a greater desire to learn (Bluehardt, Wiener & Shepard, 1995; Cantell, Ahonen, & Smyth, 1994). Physical activity may contribute to improved self-concept confirmed by Hinkle (1992), whom also supported the notion that regular exercise may lead to enhanced self-esteem.

Mood states were also discussed earlier and provided additional insight on the benefits of aerobic activity. In a pre-experimental design, Gondola and Tuckman (1982) collected 348 non-elite marathoners who completed the POMS and described themselves as having less total mood disturbances (due to lower tension, depression, fatigue, and confusion scores, and higher vigor scores) than college-aged norms. When positive thoughts are present, moods might alter the way information is processed, which biases cognitions (Smith & Crabbe, 2000). It is suggested that positive thoughts allow a biological link for neural pathways to be more accessible than negative thoughts and feelings (Buckworth & Dishman, 2002).

Therefore, the self-reported data from the participants reinforced the literature review concluding that aerobic activity produces more positive feelings than negative

feelings. Negative academic and non-academic comments reported by participants did not indicate a statistically significant difference in responses but provided insight on possible variables that affect academic performance. One of the most frequent negative responses of “well-being” was “being tired.” The effect of sleep or lack of sleep on academic performance can be a substantial factor in college student’s academic progress. One study done in the area of sleep by Kelly, Kelly, and Clanton (2001), classified sleepers into three categories; (1) short sleepers, individuals who, when left to set their own schedule, slept six or fewer hours. (2) Average sleepers, individuals who slept even or eight hours, and (3) long sleepers, individuals who slept nine or more hours out of twenty-four. The study found that people who were considered long sleepers reported increased academic performance compared to the short and average sleepers. Therefore, a lack of sleep increased stress which can affect academic performance (Kelly et. al., 2001).

In summary, aerobic physical activity makes people feel better, but it did not significantly affect student’s academic performance in this study. It is difficult to accurately measure or identify the variables that affect student’s perceived stress and ultimately academic performance. This study analyzed perceived stress as a variable that would allow researchers to understand the relationship of one out-of-class room activity and academic performance.

Recommendations

Based on Study

The researcher was unable to monitor the prescribed aerobic activity at every session. Many of the participants in the experimental group walked and jogged for their aerobic activity at the recreation center. Only two of the three required activity sessions were monitored because of scheduling difficulties. The third session of aerobic activity was self-reported by the participants. Not every session of activity was monitored.

The aerobic activity could have been monitored more closely if the study would have included participants enrolled in an activity course like “running” or “walking” in order to make the self-report of activity more accurate. The researcher would have contact with the students on a weekly basis if grades depended on attendance.

Academically, this study could have been improved by measuring academic progress through an extended period of time. The study was 12 weeks long and needs to span at least an entire semester if not a four year period. Participant’s academic progress over a longer period of time would provide the researcher with a more accurate measure of academic progress.

Additionally, even though there was compensation available for participation there needs to be weekly incentives to improve adherence to exercise throughout the study. Possible incentives could be grade-based or perhaps fitness and health-related measure like body-fat testing or heart-rate monitors.

Future Studies

Future research should address some of the following issues not addressed in this study. Research should continue to better understand the relationship between physical activity and the stress response in individuals of different ages and sex with different amounts of stress in their lives (Rabin, 1999). This study consisted of female college students between the ages of 18-22. These students were all traditional students. Today, there are many non-traditional students on campus having very different stressors in their lives compared to the traditional college-age student. One factor for a growing number of students is the responsibility of caring for a family. There are an increasing number of non-traditional students coming back to school (Womble, 2003). Many of the non-traditional students are part-time students and not full-time. Therefore, it would be beneficial to study this group of students since they are a larger portion of the student body than in years past. Men in the same age range would provide for more valuable information also.

Additional research including the topic of achievement motivation would be useful in assessing the relationship between academic performance and aerobic activity. The theory of achievement motivation focuses on two motives: the motive to achieve success and the motive to avoid failure. These motives are generally considered as relatively stable individual differences. In combination with the subjective probability of success, and the incentive value of the task, the strength of these motives determines the achievement tasks that are selected and the level of effort that will be shown on such tasks. For example, high need for achievement has usually been found to predict greater

persistence and higher performance on tasks and examinations (Krohne & Laux, 1982). Future research in this area would help to strengthen the initial findings from this study.

Sociological approaches need to be considered when assessing the affects of physical activity on academic performance. Social approaches are typically measured with indicators of social support (Buckworth & Dishman, 2002). Some studies have shown that the amount of social support from the university and outside contributors like family, friends, and mentors can impact a student's academic progress tremendously. Years at college can be stressful and life-changing, therefore the social aspect of academic performance and stress need to be investigated also (Womble, 2003).

There are also a number of health related factors that can be attributed to a student's academic performance which need to be investigated in future research. The amount of exercise, nutritional routines, and also the amount of social support the student perceives all can contribute to how a student academically performs (Hammer et al., 1998). Exercising too much or too little can be a factor contributing to academic performance. In a study conducted by Trockel, Barnes, and Eggett (2000), "students who exercised seven or more hours a week obtained significantly lower grades than students who exercised six or fewer hours weekly or not at all." Closely monitored physical activity by researchers could allow for more consistency in exercise routines in future studies.

Nutrition is also a problem with college students and should be documented in further research. Students have difficulty finding time to cook adequate meals. Most students are learning to live on their own, and learning to cook can prove to be

challenging. Since many dorm rooms are limited on storage, food storage may not be possible at all (Troekel et. al., 2000).

Prior grade-point-average and SAT scores need to be considered for future studies. Grades and prior grade point average can be factors that affect academic performance (Devadoss & Foltz, 1996). Having a base-line starting point would allow the researcher to follow the progress of students relative to their ability. A SAT score would provide a better base-line point also. As mentioned earlier, academic performance could be more accurately measured if a relative starting point for all participants was established.

Additionally, future research could provide educators and administrators at all levels with more practical information on the importance of outside-the-class room activities like physical activity. Educators and administrators at the K-12 level need more information on the value of physical activity. The nation's obesity rate continues to climb in adolescence (Sallis & Owen, 1999). In a study by Simon-Morton, Taylor, Snider, Huang, and Fulton, (1994), physical activity in a physical education accounted for only three minutes in the average 30 minute class. Researchers in higher education have a responsibility to continue to do research that identifies determinates that can be correlated with behaviors that may have a causal effect on student's behaviors towards physical activity in order to promote healthy, active, lifestyles. Research shows that the environment in which students exercise and the social component (group exercise) of exercise is important in student's motivation to participation in physical activity (Sallis & Owen, 1999). Again, the need for campus' to value facilities and programs that

promote physical activity as a part of the educational mission are critically important to students and to educators at the K-12 level. This would imply that funding for student recreational centers on campus, which promote physical activity, need to be adequately funded and supported comparable to academic needs.

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APPENDIX A

Items and Instructions for Perceived Stress Scale

The question in this scale asks you about your feelings and thoughts during the last month. In each case, you will be asked to indicate *how often* you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

For each question choose from the following alternatives:

- 0. never
- 1. almost never
- 2. sometimes
- 3. fairly often
- 4. very often

- 1. In the last month, how often have you been upset because of something that happened unexpectedly?
 - 2. In the last month, how often have you felt that you were unable to control the important things in your life?
 - 3. In the last month, how often have you felt nervous and "stressed"?
 - 4. In the last month, how often have you dealt successfully with irritating life hassles?
 - 5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?
 - 6. In the last month, how often have you felt confident about your ability to handle your personal problems?
 - 7. In the last month, how often have you felt that things were going your way?
 - 8. In the last month, how often have you found that you could not cope with all the things that you had to do?
 - 9. In the last month, how often have you been able to control irritations in your life?
 - 10. In the last month, how often have you felt that you were on top of things?
 - 11. In the last month, how often have you been angered because of things that happened that were outside of your control?
 - 12. In the last month, how often have you found yourself thinking about things that you have to accomplish?
 - 13. In the last month, how often have you been able to control the way you spend your time?
 - 14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
-

APPENDIX B

Online questionnaire for altered Perceived Stress Scale

Perceived Stress Scale

The questions in this scale ask you about your feelings and thought during the last month. In each case, you will be asked to indicate **how often** you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

To ensure that your data is submitted properly, please use Internet Explorer as your browser.

Make sure you include your username and password.

Submit	Reset
--------	-------

User ID	<input type="text"/>	Your user id is your first initial and last name - all lowercase, no spaces. For example, Joan Smith (jsmith)
Student #	<input type="text"/>	Your student number is the last 5 digits of your social security number

For each question, move the slider to the spot that best reflects your feelings or thought. The slider scale moves from 1 to 100 and covers the general categories:

Never -- Almost Never -- Sometimes -- Fairly Often -- Very Often

- In the last month, how often have you been upset because of something that happened unexpectedly?**

Never	Almost Never	Sometimes	Fairly Often	Very Often
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APPENDIX B (continued)

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



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



4. **In the last month, how often have you dealt successfully with irritating life hassles?**



5. **In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?**



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



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



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



APPENDIX B (continued)

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



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



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



12. In the last month, how often have you found yourself thinking about things that you have to accomplish?



13. In the last month, how often have you been able to control the way you spend your time?



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



APPENDIX B (continued)

15. **Comments:** Please comment on any specific things that have happened to you over the past few weeks that you feel have had an impact, positively or negatively, on your thoughts and feelings.



[Thank you for your participation.](#)

Cohen, Sheldon, Kamarck, Tom, and Mermelstein, Robin. "A Global Measure of Perceived Stress" (1983). *Journal of Health and Social Behavior*. 24 (December): 385-396.

<http://bobhall.tamu.edu/Brennan/PerceivedStressScale>

APPENDIX C

Information Sheet from All Participants

Name: _____

Age: _____ Ethnic/Racial Classification: _____ Classification (Year):

Phone Number: _____ Major: _____

Do you regularly participate in physical activity (3 times a week or more)?

{Circle no or yes, then define}

No.

Yes. If yes, what types of activity and how long?

What times are most convenient for you to participate? Please fill in when you would be available.

Mornings

Afternoons

Evenings

Monday _____

Tuesday _____

Wednesday _____

Thursday _____

Friday _____

Saturday _____

Sunday _____

APPENDIX DDaily Warm-up Protocol for Exercise Group

5 minute jog

5 minutes of stretching to include the following exercises:

Exercises

Arm Circles for 30 seconds

Hip Circles for 30 seconds.

Calf Stretch for 30 seconds.

Single Leg Stretch (Right and Left) for 30 seconds =1 minute.

Straddle Stretch for 30 seconds.

Thigh Stretch (both legs) for 1 minute total, 30 seconds each.

Pretzel Stretch for 30 seconds.

Standing Squats for 15 seconds

Sit-ups for 15 seconds.

APPENDIX E

Weekly Student Log of Undergraduate Women at Texas A & M University.

September-02							
Week 1	Distance	Time	HeartRate	Aerobic Activity	Study Time/Work Hours	Stressful Events	Physical Well-being
	Record	30 min.	<160	Walking	Document	Document	Document
Monday	23						
Tuesday	24						
Wednesday	25						
Thursday	26						
Friday	27						
Saturday	28						
Sunday	29						

Notes:

Heart Rate: Get pulse at neck, Count Beats for 6 seconds, then x 10. Do this during and at end of workout. Record Ending HR.
 Other Aerobic Activity: Please record.

VITA

Martha Brennan

410 South 3rd St.
River Falls. WI 54022

martha.brennan@uwrf.edu
Office (715) 425-0714

Objective: Coach and teach at the collegiate level.

Education:

August 1995	Bachelor of Science in Mathematics <i>Louisiana State University</i>
December 1996	Master's of Arts in Educational Administration Concentration: Higher Education/Sports Administration <i>Louisiana State University</i>
May 2006	PhD in Educational Administration Concentration: Higher Education/Student Development <i>Texas A&M University</i>

USA Track and Field Level I Certification
USA Track and Field Level II Certification
(Jumps)

Experience:

September 2004- Present	<u>Head Track and Field Coach/Lecturer</u> <i>University of Wisconsin-River Falls</i> Lecturer: Physical Activity Behavior, Individual Sports, and Coaching: Track and Field
September 1997- August 2004	<u>Assistant Track Coach</u> <i>Texas A&M University</i> Coach: Heptathlon, decathlon, men's and women's pole vault. NCAA/Big XII rules and regulations.
January 1997- July 1997	<u>Assistant Track Coach</u> <i>University of Iowa</i> Coach: Jumps, throws, and multi-events. NCAA/Big 10 rules and regulations. Strength and Conditioning Coordinator: Women's track team. Recruiter: Recruited nationally and internationally. Equipment Manager: Monitored track budget.
August 1995-	<u>Graduate Assistant</u> <i>Louisiana State University</i>