2015

Effect of a Lifetime Health and Fitness Class on College Students

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This is to certify that the doctoral dissertation by

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Abstract

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Doctor of Philosophy

Public Health

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Abstract

Physical inactivity and obesity, both of which are modifiable cardiovascular disease (CVD) risk factors, increase substantially during the transition from adolescence to young adulthood. CVD is the 5th leading cause of death in people ages 18 to 29. This disease has enormous social and financial repercussions; however, many college age students do not see chronic disease as a personal threat. Few researchers have examined chronic disease risk in young adults or used a consistent, objective measurement of physical activity. A pre-post, quasi-experimental study was conducted to evaluate the association between a health and fitness class, physical education 215 (PHED 215) and chronic disease risk, cardiorespiratory fitness (CRF) level, body fat percentage, self-motivation, exercise self-efficacy, and transtheoretical model (TTM) physical activity stage of change progression among male and female college students (n = 64). The TTM was utilized as the theoretical framework for this study. Secondary data were analyzed via descriptive statistics, paired t test (or Wilcoxon signed-rank test if data were not normal), and Bowker's test of symmetry. Results showed a statistically significant association between PHED 215 and 2 dependent variables: cardiorespiratory fitness level (p = 0.0001) and progressive movement through the TTM stages of change (p = 0.0061). Because college age students are shaping their adult behaviors, positive health change adopted during this critical time could increase CRF, establish lifelong exercise habits, improve quality of life, and delay and decrease obesity risk and chronic disease and related costs. While further study in different settings is warranted, PHED 215 could be used as a blueprint for other interventions in the education, community, and healthcare settings.

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Dedication

To my parents…for always telling me that the sky is the limit, for challenging me to do something with the blessings God has given me, for always working so hard, dad for showing me what honor looks like, and mom for teaching me to "Run for the Roses."

To my grandparents…for their sterling example- Great Grandma Firle, the feisty one, Grandma Young, the spirited adventurer who faced adversity with courage, Grandma Kiecker, the lifelong learner and teacher who taught me to find silver linings, and Grandpa Kiecker, the kind man with quiet strength and wisdom.

To my siblings…you have been my supporters and friends my whole life- you've showed me how to be brave, and cheered for me in everything I've done. You've helped me believe in myself, made me laugh, and kept me from taking everything too seriously.

To my husband…thank you for believing in me, and going through this expedition with me every step of the way. You've had to sacrifice too, but your support and confidence in me never wavered. Because of you, I could go after my dream, and accomplish it, yet never had to sacrifice what is most important- God and family.

To my children…you came along on this journey, and loved me unconditionally. You made it a grand and worthwhile adventure, yet reminded me to take time to smell the lilacs. You are such a blessing. I hope I have and will continue to set a great example for you, like the one my parents and grandparents set for me: follow God's wisdom and guidance, work hard for your goals with humility, integrity and character, "let your light shine," "throw off the bowlines," "sail away from the safe harbor," "strive valiantly," "spend yourself in a worthy cause," "never, ever give up," and always, "dream big."

Acknowledgements

First of all, I would like to thank my Advisor, Dr. Chinaro Kennedy, for pushing me and supporting me throughout this entire dissertation process. You taught me so much due to your expertise and professionalism. I could never thank you enough, but I will still try- thank you for everything, Dr. K!

Also, I'd like to thank my committee member, Dr. Diane Cortner, for your valuable insights and kind and uplifting words. You helped inspire me and push myself to become a "Champion"- thanks for your encouragement Dr. Dee!

In addition, I'd like to thank my University Research Reviewer, Dr. Lawrence Fulton. I appreciate the time you took to examine my dissertation and the feedback you gave- thank you so much! All three of you helped me make my dissertation the best that it could be- you have my respect and my appreciation.

Thanks to my wonderful teachers along the way, from grade school through today. I admire you, emulate you, and learn from you still.

Also, I'd like to thank God for the countless blessings He has given me. You are my light, my rock, and my strength. I know you have more great plans for me.

And finally, I'd like to thank my family for their unconditional support.   You all believed in me and lifted me up, no matter what. You reminded me that things worth doing are seldom easy. You inspired me to push myself; I knew I would pass this way only once, so I should do it right. I could have never done it without you.

Table of Contents

List of Tables viii

List of Figures ix

Chapter 1: Introduction to the Study 1

Introduction 1

Background 3

Problem Statement 9

Purpose of the Study 9

Research Questions and Hypotheses 9

Theoretical Base 11

Nature of the Study 12

Definitions 13

Assumptions 16

Scope and Delimitations 16

Limitations 18

Significance of the Study 21

Social Change Applications 21

Summary 23

Chapter 2: Literature Review 25

Introduction 25

Literature Search Strategy 25

Theoretical Foundation 26

Literature Review Related to Key Variables and Concepts....................................33
Cardiovascular disease....................................33
Chronic Disease in College Age Students....................................34
Disease Risk Related to Weight and Waist Circumference....................................36
CVD Risk Management in the Young Adult....................................38
Physical Activity....................................38
Overweight and Obesity....................................41
The College Campus: A Promising Intervention Site....................................44
Health Promotion and Social Change in a Lifetime Fitness Class....................................46
Summary....................................48
Chapter 3: Research Method....................................50
Introduction....................................50
Research Design and Rationale....................................50
Study Variables and Measures....................................52
Research Design....................................52
Research Design Justification....................................53
Methodology....................................54
Population....................................54
Sampling and Sampling Procedures....................................54
Archival Data....................................56
Instrumentation and Materials....................................56
Data Analysis Plan....................................65

Threats to Validity 69
Ethical Procedures 71
Summary 73
Chapter 4: Results 74
Introduction 74
Purpose of the Study 74
Research Questions and Hypotheses 74
Data Collection 76
Time Frame 76
Descriptive and Demographic Characteristics of the Sample 76
Proportionality of Sample to Larger Population 78
Results 78
Introduction and Methods 78
Analysis Results and Interpretations 79
Health and Fitness Category Results 84
Analysis of Research Questions 101
Summary 107
Chapter 5: Discussions, Conclusions, and Recommendations 109
Introduction 109
Purpose and Nature of the Study 109
Summary of Key Findings 109
Interpretation of the Findings 110

Limitations of the Study......111

Generalizability......111

Possible Threats to Internal and External Validity......112

Response Bias in the Archival Data......113

Reliability......114

Recommendations......115

Implications......115

Positive Social Change......115

Theoretical Interpretations and Implications......116

Conclusion......117

References......119

Appendix A. Permission Letter to Use Archival Data......137

Appendix B. Informed Consent......138

List of Tables

Table 1: Classification of Chronic Disease Risk 37

Table 2: Obesity Classifications 43

Table 3: Study Variables and Measures...51

Table 4: Instrument Description 57

Table 5: Data Analysis Plan..69

Table 6: Age of the Study Subjects...77

Table 7: Pretest and Posttest Disease Risk 80

Table 8: Pretest and Posttest Disease Risk After Regrouping 81

Table 9: Descriptive Statistics 83

Table 10: Two-Way Table of Pretest and Postest Disease Risk (RQ1)...........................102

Table 11: Analysis Results (RQ2-RQ6) 106

List of Figures

Figure 1: Bar charts of pretest recovery index scores, by gender 85

Figure 2: Bar Charts of Posttest Recovery Index Scores, By Gender 86

Figure 3: Bar Charts of Pretest Height, By Gender 87

Figure 4: Bar Charts of Posttest Height, By Gender 87

Figure 5: Bar Charts of Pretest Weight (kg), By Gender 88

Figure 6: Bar Charts of Posttest Weight (kg), By Gender 89

Figure 7: Bar Charts of Pretest BMI, By Gender 89

Figure 8: Bar Charts of Posttest BMI, By Gender..90

Figure 9: Bar Charts of Pretest Waist Circumference (inches), By Gender 91

Figure 10: Bar Charts of Posttest Waist Circumference (inches), By Gender..................92

Figure 11: Bar Charts of Pretest Body Fat %, By Gender 93

Figure 12: Bar Charts of Posttest Body Fat %, By Gender 94

Figure 13: Bar Charts of Pretest Self-Motivation Score, By Gender 95

Figure 14: Bar Charts of Posttest Self-Motivation Score, By Gender..............................96

Figure 15: Bar Charts of Pretest Exercise Self-Efficacy Score, By Gender.....................97

Figure 16: Bar Charts of Posttest Exercise Self-Efficacy Score, By Gender 98

Figure 17: Bar Charts of Pretest PA Stage, By Gender 99

Figure 18: Bar Charts of Posttest PA Stage, By Gender 99

Chapter 1: Introduction to the Study

Introduction

Cardiovascular disease (CVD) caused 696,947 deaths in the United States in 2002 (National Center for Health Statistics [NCHS], 2004) and 661,828 in the United States in 2008 (NCHS, 2012). Heart disease was responsible for 217 deaths per 100,000 in 2004 (NCHS, 2007) and 186.5 per 100,000 in 2008 (NCHS, 2012). CVD is not only an American killer; approximately 29% or 16.7 million deaths worldwide have been linked to CVD (World Health Organization [WHO], 2005).

As these statistics show, cardiovascular disease has an overwhelming reach, and can start its progression in young adults in the form of CVD risk factors. For instance, physical inactivity is a major CVD risk factor, and reported rates of physical inactivity in college students vary from 26% to a staggering 60% (American College Health Association, ACHA, 2011; NCHA, 2002). Type II diabetes, another major CVD risk factor that has ties to obesity and physical inactivity, is now affecting an increasing number of adolescents (Halfon, Verhoef, & Kuo, 2012).

Researchers found that the proportion of youth aged 12 to 19 with prediabetes or diabetes increased between 1999 to 2008, from 9% to 23%, respectively (May, Kuklina, & Yoon, 2012). May et al. (2012) indicated that overweight or obese American adolescents face an increased CVD risk (May, et al., 2012). Obesity is another CVD risk factor, and over 30% of children and adolescents in the United States are obese (American College of Sports Medicine, ACSM, 2010b). According to the 2000 National College Health Risk Behavior Survey, 35% of college students were overweight or obese (Lowry et al., 2000). A recent ACHA (2012) assessment had similar results, with 34% of college students reporting they were overweight or obese.

Atherosclerosis, specifically, is a progressive type of CVD which results from arterial blockage due to plaque buildup, begins in childhood with varying degrees, and is the cause of most heart attacks (Powers & Dodd, 2009). Researchers have found that CVD risk factors present in adolescence are likely to track into adulthood, especially obesity and sedentary behavior (ACSM, 2010b). As a result, many experts urge adjusting CVD risk factors as a means to fighting this deadly disease (Smith, 2008). College age is an ideal time to combat CVD risk factors since young adults begin "making their own lifestyle choices that can impact future health" (Fernandes & Lofgren, 2011, p. 313). In addition, college can serve as an ideal setting and time for young adults to adopt positive lifestyle habits that could carry throughout adulthood (Fernandes & Lofgren, 2011).

An innovative approach to optimal health and exercise among college aged students will be examined in this inquiry. This advancement, in the form of a required physical education class entitled, Developing Life Skills, or PHED 215, had the potential to serve as a successful preventive measure in the fight against CVD. An innovation such as this was warranted since chronic diseases are leading causes of death in the United States, with heart disease decreasing in prevalence, but still reigning as the number one killer of Americans (NCHS, 2012). Major sections in this chapter are: (a) background, (b) problem statement, (c) purpose of the study, (d) research questions and hypotheses, (e) theoretical framework, (f) nature of the study, (g) definitions, (h) assumptions, (i) scope and delimitations, (j) limitations, (k) significance, and (l) summary.

Background

Physical Inactivity

Physical inactivity is one of over 100 risk factors for cardiovascular disease, which is associated with obesity and low levels of cardiorespiratory fitness (Howley & Franks, 2007; WHO, 2005). Aerobic exercise has shown great possibility to combat CVD by positively altering the blood lipid profile, decreasing blood pressure and heart rate to lessen the myocardium workload, bettering myocardium circulation, reducing hypoxic stress on the heart, and increasing both myocardial blood supply and glycolytic capacity (McArdle, Katch & Katch, 1996, p. 654). According to Healthy People 2010 (United States Department of Health and Human Services [HHS], 2000), physical activity and fitness are a priority for optimal health and wellness. However, approximately 50% of U.S. adults do not engage in the recommended amount of 30 minutes of moderate intensity physical activity per day (Centers for Disease Control and Prevention [CDC], 2003). In addition, of those who begin an exercise program, approximately half quit within 6 months (Dishman & Buckworth, 1997, as cited by Gieck & Olsen, 2007).

Obesity

Another CVD risk factor is overweight or obesity. Americans are reaching epidemic levels of overweight and obesity, increasing both mortality and morbidity risk (Huang et al., 2003, p. 83). Between 1976 and 1980, approximately 47.4% of

Americans were overweight; by 1999-2002, that percentage of overweight grew to 65.2% of the population (National Center for Health Statistics [NCHS], 2004). As a result of this increase, overweight is the most common nutritional disorder in the United States (Yanovski & Yanovski, 2002). Obesity was named as a leading health indicator in the Healthy People 2010 report (HHS 2000). According to this report, overweight and obesity are major contributors to many preventable causes of death and are associated with higher death rates (HHS, 2000). In addition to the obvious negative health consequences, obesity is also expensive, with total costs (medical cost and lost productivity) attributable to obesity alone amounted to an estimated $99 billion in 1995 (HHS, 2000). Obesity is one of many CVD risk factors, affecting many ethnic groups in both men and women; while it is more common in older people, CVD is also prevalent in the younger generations.

Measurement of Physical Activity and Obesity

In a meta-analysis of college students' physical activity behaviors, researchers reported that studies measuring physical activity have primarily relied on inconsistent, subjective measurement (Keating, Guan, Pinero, & Bridges, 2005). Such subjective physical activity (PA) measurement contributes to the challenges of effective PA promotion (Keating et al., 2005). In addition, Keating et al. (2005) reported a lack of attention and action by health professionals regarding college students' physical activity behaviors. Therefore, an objective physical activity and intensity measurement is warranted.

Measurement of body composition in large epidemiological studies often must rely on self-reported data. For example, the Health 2011 CDC report measured physical activity level and body composition based on self-reported data, not direct measurement (NCHS, 2011). In addition, overweight and obesity levels are estimated via body mass index (BMI). While BMI is a useful measure, especially with a large population, it is not the most accurate measure of body composition as it tends to overestimate overweight in fit populations (ACSM, 2010b). Experts urge more than one measurement of body composition in order to gain accurate results (ACSM, 2010b).

Cardiovascular Disease Risk Factors in College Students

College age students do not escape CVD risk. Investigators have found that although the disease usually does not become apparent until middle age, the warning signs of CVD begin early in life (Collins, Dantico, Shearer & Mossman, 2004, p. 407). Gorina, Hoyert, Lentzner, and Goulding (2006) predicted a revival of CVD in the future partly due to the increase of obesity and physical inactivity in younger age groups. Researchers stated that even though college students tend to report a high general knowledge base in regards to CVD risk factors, few personally apply that knowledge or take action to prevent CVD (Collins, et al., 2004). Therefore, according to Collins (2004), healthy lifestyle choices made at a younger age could decrease the chance of CVD later in life. Interventions focused on college students could decrease obesity and obesity-related complications (Desai, Miller, Staples, & Bravender, 2008) and increase physical activity (Keating, Guan, Pinero, & Bridges, 2005). Therefore, college is an ideal setting to educate young adults on healthy lifestyle choices that could eventually decrease the prevalence of CVD risk factors.

An Innovation in Physical Education Classes

PHED 215 was an innovative and unique approach in terms of a college-level physical education class. General class requirements were designed by the professors to be vigorous and focused on both knowledge and practice of health and physical fitness components. For example, first, students enrolled in PHED 215 were required to purchase their own heart rate watch and monitor for the class, much like other classes require a textbook. The Polar FT-60 watch and heart rate monitor ensured that students not only have the capability to objectively measure their weekly physical activity, but also enabled students to measure the intensity of their physical activity via reaching previously calculated target heart rate intensity zones. In addition, because students own their own watch, this hopefully facilitated continued physical activity after the semester long class has concluded.

Second, students were also required to upload their weekly workout information from their watch onto a Polar personal training website (www.polarpersonaltrainer.com); their Polar website activity was monitored by the instructor. This website allows the instructor and the student to easily keep track of minutes exercised and the corresponding intensity levels attained for each workout throughout the entire semester. Furthermore, the use of the Internet can be beneficial in regards to health promotion in the college student (LaChausse, 2012).

Third, PHED 215 had a physical activity requirement, composed of both a cardiorespiratory and resistance training portion, which counts for 70% of the students overall final grade. The cardiorespiratory portion of the physical activity requirement followed the CDC recommendation for maximum health benefits, which urges adults to attain 150 minutes per week of vigorous intensity aerobic activity (CDC, 2011). Therefore, PHED 215 aerobic exercise requirement was set at 150 minutes per week at an intensity of at least 70% of their heart rate maximum. The closer the student came to achieving the weekly goal, the higher the weekly grade.

Fourth, in the first week of class, students were given a fitness and weight room orientation, and were asked to fill out a Physical Activity Readiness Questionnaire and a Health Status Questionnaire to ensure safety for all students. Also, several other surveys were administered to ascertain their self-motivation, exercise self-efficacy, and current level of physical activity. These assessments are repeated at the end of the semester, in order to monitor change and development.

Fifth, students participated in a battery of fitness tests which evaluate each of the five fitness components; the tests at the beginning of the semester are utilized for goal setting and self discovery, while the fitness tests at the end of the semester are useful to monitor progress and continued goal setting. Sixth, because the maximum student capacity for each PHED 215 section was capped at 20 students, instructors were able to devote a generous amount of personal attention to each student. For instance, each student writes their own personal exercise prescription, and then the instructor reviews it with them individually to offer tips, modifications and suggestions. Also, instructors lead the students through all exercise testing, and supervise and assist the group during class time exercise sessions. Seventh, PHED 215 was the sole fulfillment of the college's physical education requirement, thus enabling the unique opportunity to positively influence every single student regarding health and fitness, at some point in their college career. Consequently, the possible short and long term impact of this individually tailored health and fitness class was extensive.

Effect of Health and Fitness Classes on College Students

While PHED 215 has many distinctive characteristics, as mentioned above, it also shares a foundation similar to many other successful interventions and classes. These courses and programs can play a major role in optimizing the weight, health and physical activity of college students. For instance, in a study designed to examine the impact of health, fitness, and physical activity courses on attitudes and behaviors, 286 students were surveyed at the beginning and end of the their health classes (DeVoe, Kennedy, Ransdell, Pirson, DeYoung, & Casey, 1998). Researchers found that 66% of all participants intended to make at least one positive health change, leading to the conclusion that such classes can significantly impact change in college students (DeVoe, et al., 1998). Project GRAD was a university course-based physical activity intervention which found a moderate physical activity increase in women (Boyle, Mattern, Lassiter, & Ritzler, 2011; Sallis et al., 1999). However, in a randomized, controlled physical activity intervention on Project GRAD, few long term physical activity effects were found, leading researchers to state the need for additional research regarding optimal physical activity interventions (Calfas et al., 2000).

Problem Statement

Chronic diseases such as cardiovascular disease, diabetes, and metabolic syndrome are on the rise in people ages 18-44, but few researchers have examined the relationship among various chronic disease risk factors in young adults (Morrell, Lofgren, Burke, & Reilly, 2012). While traditional, college-based interventions have attempted to decrease disease risk by modifying cardiovascular disease risk factors such as obesity or physical inactivity, few have used objective physical activity measures or made a lasting, positive impact (LaChausse, 2012). Therefore, an innovative, course-based approach that focuses on evaluation of cardiovascular disease, along with modification of cardiovascular disease risk factors reduction in college students, should be evaluated.

Purpose of the Study

In order to combat the rise of chronic disease and its risk factors in young adults, I evaluated a college-based course using currently existing 2012 data. Therefore, the purpose of this quantitative study is to explore the effect of a health and fitness class on college students. The effect of PHED 215, the independent variable, on the following six dependent variables were examined: (a) chronic disease risk, (b) cardiorespiratory fitness, (c) body fat percentage, (d) self-motivation, (e) exercise self-efficacy, and (f) physical activity stage of change.

Research Questions and Hypotheses

The research questions and the corresponding hypotheses of this study are listed below:

Research Question1: Is there an association between PHED 215 and chronic disease risk level?

H10: There is no association between PHED 215 and chronic disease risk level.

H1a: There is an association between PHED 215 and chronic disease risk level.

Research Question 2: Is there an association between PHED 215 and cardiorespiratory fitness level?

H20: There is no statistically significant difference between the means of cardiorespiratory fitness level before and after participation in PHED 215..

H2a: There is a statistically significant difference between the means of cardiorespiratory fitness level before and after participation in PHED 215.

Research Question 3: Is there an association between PHED 215 and body fat percentage?

H30: There is no statistically significant difference between the means of body fat percentage before and after participation in PHED 215.

H3a: There is a statistically significant difference between the means of body fat percentage before and after participation in PHED 215.

Research Question 4: Is there an association between PHED 215 and self-motivation level?

H40: There is no statistically significant difference between the means of self-motivation level before and after participation in PHED 215..

H4a: There is a statistically significant difference between the means of self-motivation level before and after participation in PHED 215.

Research Question 5: Is there an association between PHED 215 and exercise self-efficacy level?

H50: There is no statistically significant difference between the means of exercise self-efficacy level before and after participation in PHED 215.

H5a: There is a statistically significant difference between the means of exercise self-efficacy level before and after participation in PHED 215.

Research Question 6: Is there an association between PHED 215 and progressive movement through the TTM stages of change?

H60: There is no statistically significant difference between the means of stages of change before and after participation in PHED 215.

H6a: There is a statistically significant difference between the means of stages of change before and after participation in PHED 215.

Theoretical Base

The transtheoretical model (TTM) of behavioral change, also known as the stages of change model (SOC), has emerged as a valuable tool in the study of behavior change. Specifically, TTM has been applied to exercise behavior in terms of understanding how and why people adopt a positive change, or decide against it (Marcus & Simkin, 1994). The major components of the TTM include five stages of change and ten processes of change (ACSM, 2010b).

The five stages of readiness to change include *precontemplation* (I can't or won't participate in physical activity), *contemplation* (I might participate in physical activity), *preparation* (I will participate in physical activity, but not at the recommended level), *action* (I am participating in physical activity at the recommended level, but for less than 6 months), and *maintenance* (I have been participating in physical activity at the recommended level for more than 6 months; ACSM, 2010c).

Students in PHED 215 fit into many of the physical activity levels and corresponding stages of change at the beginning of the semester, from precontemplators to those in the maintenance stage. With a required aerobic physical activity and weight lifting portion, along with a health and fitness education component, students should progress in stage of change, and could benefit with enhanced body composition and cardiorespiratory fitness levels, along with a resultant decrease in chronic disease risk (Sailors et al., 2010). Participants were segmented into categories via the Stage of Physical Activity Questionnaire (ACSM, 2010b).

Supervised exercise has shown to have a positive effect on motivation (Courneya et al., 2012), so PHED 215 could also have an effect on self-motivation and exercise self-efficacy as well. Improved self-efficacy, as well as mastery experiences, have both shown to be factors in forward movement through the stages of change, along the path to positive behavior change (ACSM, 2010b). A more detailed discussion of the TTM occurs in Chapter 2.

Nature of the Study

I designed a pre-post, quasi-intervention study using an existing database to determine whether a collegiate health and fitness class, PHED 215, had an effect on the following dependent variables: (a) chronic disease risk, (b) cardiorespiratory fitness, (c) body fat percentage, (d) self-motivation, (e) exercise self-efficacy, and (f) physical activity stage of change. A descriptive and inferential analysis was performed on archival data previously generated as a byproduct of normal educational assessment practices.

Definitions

Body composition: A component of physical fitness; absolute and relative amounts of muscle, bone, and fat tissues composing body mass (ACSM, 2014).

Body fat percentage: Fat mass expressed as a percentage of total body mass. Percent body fat can only be estimated because no direct measurement methods are available for living organisms (ACSM, 2014).

Body mass index (BMI): A measurement of body overweight or obesity determined by dividing weight (in kilograms) by height (in meters) squared. BMI is highly correlated with body composition and is a crude index of obesity (ACSM, 2014).

Bioelectrical Impedance Analysis (BIA): A method of body composition; based on the principle that muscle contains more water than fat, so is a better conductor of electricity (ACSM, 2014).

Cardiorespiratory Fitness: the ability to engage in physical activities that rely on oxygen consumption as the primary source of energy; best indicated by the body's ability to take in and utilize oxygen (VO2 maximum) (ACSM, 2014).

Chronic Disease Risk: The risk of developing a chronic disease, or disease of long duration. In this study, chronic disease risk describes the risk of developing Type 2 diabetes, hypertension, and cardiovascular disease (ACSM, 2014).

Exercise Self-Efficacy: self confidence in one's ability to maintain a healthy level of physical activity (ACSM, 2014).

FITT Principle: An integral basis of an exercise prescription which sets guidelines for an exercise program; the acronym FITT stands for frequency, intensity, time, and type of exercise (ACSM, 2014).

Frequency: Part of the FITT Principle; describes the number of days of physical activity participation per week (ACSM, 2014).

Intensity: Part of the FITT Principle; describes how hard a person exercises during physical activity. Heart rate is often used to gauge aerobic activity intensity (ACSM, 2014).

Heart Rate Maximum (HRM): The maximum number of times the heart beats per minute. Estimated by the following formula: HRM = 220-age. Intensity of aerobic activity can be based off of this formula, with a higher heart rate corresponding to a higher intensity of physical activity (ACSM, 2014).

Heart Rate Recovery (HRR): After exercise, the speed at which the heart rate returns to its normal, resting rate. Can be used alone as a predictor of cardiovascular disease and all-cause death; a decrease in <12 beats at 1 minute post exercise is considered abnormal (ACSM, 2014).

Intensity: Part of the FITT Principle. Describes Moderate Intensity Aerobic Activity: Working hard enough to raise your heart rate and break a sweat. (i.e. brisk walking, water aerobics, riding a bike on level ground). The CDC recommends 150 minutes of moderate intensity activity for important health benefits, or 300 minutes for even greater health benefits. According to the Polar Heart Rate Monitor, moderate intensity is achieved between 60 - 69% of heart rate max (i.e. Zone One) (ACSM, 2014).

Muscle Strengthening Activity: Exercise activity which works all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms); the CDC recommends this activity on two or more days per week (ACSM, 2014).

One Repetition Maximum: Maximal weight that can be lifted for one complete repetition of a movement; a measure of muscular strength (ACSM, 2014).

Obese: Adults with a BMI equal to or greater than 30 kg/m^2; excessive body fat.

Overweight: Adults with a BMI of 25 – 29.9 kg/m^2 (ACSM, 2014).

PHED 215 (Developing Life Skills): A required collegiate physical education course which focuses on health; the independent variable of this study (BLC, 2012).

Self-efficacy: An internal state in which the person feels competent to perform a specific task (ACSM, 2014).

Self-motivation: initiative to independently take on or continue a task; predicts adherence to regular exercise (ACSM, 2014).

Stage of Change Model: Includes five stages of change; utilized to understand and assist those attempting behavior change. Also known as the Transtheoretical Model (TTM) (ACSM, 2014).

Time: Part of the FITT Principle. Describes the length of time someone exercises during each physical activity session (ACSM, 2014).

Type: Part of the FITT Principle. Describes the mode of physical activity. Examples include running, jogging, biking, and swimming (ACSM, 2014).

Vigorous Intensity Aerobic Activity: Activity which causes your heart rate and breathing rate to go up considerably (i.e. jogging or running). The CDC recommends 75 minutes of vigorous intensity aerobic activity per week for important health benefits, and at least 150 minutes for even greater health benefits. According to the Polar Heart Rate Monitor, vigorous intensity is achieved at 70% heart rate max or above (i.e. Zone Two or Zone Three). (CDC, 2011).

Waist-to-hip ratio (WHR): Waist circumference divided by hip circumference; used as measure of upper-body or abdominal obesity (ACSM, 2014).

Assumptions

I assumed that the students were honest and accurate in their responses to the administered questionnaires, fitness testing results, and in their usage of their Polar Heart Rate Monitor to measure their weekly physical activity level. These assumptions were necessary due to the nature of self-reported questionnaires which were used by PHED 215.

Scope and Delimitations

The scope of this study was limited by several factors. First, I had the opportunity and permission to access this important archival data for filling a knowledge gap in current research literature. And second, the archival data itself limited the research questions and data analysis options available. The following delimitations were imposed with this study:

1. The subject sample was delimited to archival data describing students from a small Midwestern college, as opposed to another college.

2. The subject sample was delimited to archival data collected from students enrolled in PHED 215 during the 16-week fall semester of 2012. This time period was chosen since it had the most data to choose from in number and tools utilized, and thus could widen the scope of the study.
3. The measurement of chronic disease risk was delimited to the Classification of Disease Risk Based on Body Mass Index (BMI) and Waist Circumference (ACSM, 2014). This disease risk calculation was chosen as opposed to using BMI or waist circumference alone due to the recommendation of the Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults (Expert Panel, 1998).
4. The measurement of cardiorespiratory fitness was delimited to the use of the three minute step test, as opposed to the 1.5 mile run test. This tool was chosen due to several factors and included: (a) the archival database had more complete records of the step test in comparison to the 1.5 mile run test, (b) the step test is a reliable cardiorespiratory fitness assessment tool, and (c) the step test is beneficial when used to compare an individual's cardiorespiratory fitness progress (ACSM, 2014).
5. The measurement of body fat percentage was delimited to bioelectrical impedance analysis (BIA), as opposed to other methods of body composition analysis available within the archival data, due to the high correlations that have been established between BIA and other criterion methods. For instance, body fat percentage estimated by BMI values has a relatively large

standard of error and is not recommended to use as a lone percent body fat indicator (ACSM, 2014).

6. The measurement of self-motivation was delimited by the archival data tool utilized, the Self-Motivation Inventory (Dishman & Ickes, 1989).
7. The measurement of exercise self-efficacy was delimited by the archival data tool utilized, the "Exercise Self-Efficacy" questionnaire (Bandura, 1997).
8. The measurement of physical activity stage of change was delimited by the archival data tool utilized, the "Assessing Physical Activity Stages of Change" questionnaire (Marcus & Forsyth, 2003, adapted by ACSM, 2010b).

Generalizability

Because subjects are from a small college in the midwest, the data can only be generalized to a similar setting. In addition, results can only generalized within the defined parameters and delimitations associated with the population. For example, results could possibly be generalized to those of a similar age, who were tested in a similar way, graded against a similar rubric, had equivalent scored requirements, or taught with a comparable approach.

Limitations

This study had several limitations due to possible threats of internal validity, external validity, and response bias.

Possible Threats to Internal and External Validity

Internal validity refers to degree in which the independent variable is able to explain the outcome of the experiment; high internal validity shows elimination of rival explanations (Singleton & Straits, 2005). A few possible threats to internal validity include the subject's history, maturation, testing effects, instrumentation, statistical regression, selection, attrition, and an interaction among any of the aforementioned threats (Singleton & Straits, 2005). PHED 215 students may be affected by history—if they have taken a different health or physical education class in the past, their knowledge and fitness level may already be at a high level and so will not change a lot. PHED 215 was measured maturity in a way, as physical and mental progress will hopefully occur during the class. Another possible affect on maturity in regards to physical health and fitness would be if students were members of a fall sport, a winter sport, or a spring sport- their physical fitness level would increase and decrease according to their *in season* or *out of season* status. In addition, if students were taking classes that cover similar material simultaneously (Health or Exercise Science classes), that may influence results. Also, stress levels and extra time spent studying may have an effect on post-test levels since the post-testing was completed towards the end of semester (and close to/during finals week).

Instrumentation may result in a decrease in internal validity as well. Due to the nature of the course, students were required to test themselves for some of the fitness and health tests, so they become self-sufficient and confident in health and fitness testing. However, instructors, sometimes along with trained assistants, led, taught, and observed students during their self-testing, and these actions will help decrease confounding in these areas.

Because randomization was not possible because archival data were used, the preexisting data were analyzed via a preexperimental, one-group, pretest – posttest design. Due to the nature of a pretest – posttest design, testing effects may be another confounding factor against internal validity. Constancy of conditions across the group was stringent, and this will increase internal validity (Singleton & Straits, 2005, p. 159).

External validity "is basically a question of generalizability, or what the experimental results mean outside of the particular context of the experiment" (Singleton & Straits, 2005, p. 159). As far as external validity, results may only be applicable to similar settings (students from small, Midwestern college). This class may have more of an effect on those who are motivated to exercise and have prior knowledge—but tests on self-motivation, self-efficacy and their stage of change may shed some light in this regard. On the contrary, if someone already has a high level of self-motivation, self-efficacy, physical activity, and health and fitness levels, the class may not be able to show much effect. But because this was a lifetime fitness class, a healthy foundation may be laid, with lasting effects beyond the classroom.

Response Bias in the Archival Data

Students in PHED 215 may have attempted to shape their questionnaire responses in order to please their professor, or to obtain a higher score. However, response bias should not be an issue since students were not graded on bettering their pre and postscores or their proficiency of the health and fitness tests, but rather on their overall fitness knowledge and completion of the assigned tasks.

Significance of the Study

This study will help to better determine the effect of a lifetime health and fitness class on college students. The investigation can address research gaps regarding CVD prevention in college students (Huang et al., 2003), and also increase CVD risk factor knowledge within the population (Desai et al., 2008). In addition, previous research has indicated a need for educational interventions that target CVD knowledge in college students (Collins et al., 2004).

A need exists for evidence-based health and fitness interventions within the college setting (Gieck & Olsen (2007). According to Sailors et al. (2010, p. 13), "surprisingly few exercise intervention studies have targeted this age group and none have provided an exercise intervention in the form of a course for college credit." As a result of this investigation, college students could experience a lifestyle change resulting in both short- and long-term health benefits. Furthermore, this investigation will be able to explore positive health change in college students, as well as the possible effects of PHED 215 on students' levels of physical activity, self-motivation, self-efficacy, health, fitness, and intent to adopt a positive health change.

Social Change Applications

As a result of my research inquiry, college students could experience a lifestyle change resulting in both short- and long-term health benefits. In addition, if students are armed with knowledge of their individual health risk, they can make informed health decisions both now and in the future. These individual changes could transform into a societal change if the concept spreads; there is a chance that successful, evidence-based physical inactivity and obesity interventions at a variety of educational and community settings could be developed. For example, this course could be offered at other colleges, community centers, fitness and health clubs, or even online. Insurance companies, who have a vested interest in the health promotion and prevention of disease in their members, could offer this class as an incentive for lower health insurance premiums.

Another avenue of expansion that could provide a return on investment (ROI) is that of high schools or community colleges. Healthy People 2020 (HHS, 2010) listed an increase in daily physical activity as a major goal in both grade schools and high schools- instead of the expense of hiring or having a full-time teacher on staff, this class could be offered online to high school students by an area college for a more affordable fee. This would benefit the college as well by connecting with the larger community and by providing a small source of outside income for the college itself.

A community, senior citizen, education or health care entity might also complete a grant proposal to attempt to fund an educational endeavor such as this. The Affordable Care Act (ACA) law and policies, which place an emphasis on health education, could also prove to be a useful partner to this learning model (Society for Public Health Education, SOPHE, 2013). If effective interventions can be established, perhaps the dangerous trends of physical inactivity and obesity can be reversed. Therefore, the overarching aspiration of this investigation is to affect social change via the classroom- "analysis without the potential to enact social change is an empty project" (McDonald & Birrell, 1999, p. 295).

Summary

Cardiovascular disease is the long-reigning number one killer of Americans, and both physical inactivity and obesity are epidemic level CVD risk factors, so interventions in different settings could be extremely beneficial in turning back the tide. This study focused on the effect of a health and fitness course on the CVD risk factors of college students, in order to explore the possibility of utilizing the course as a successful intervention tool. A college campus, in particular, can provide a unique opportunity for health promotion, as students stand at the brink of adulthood, meanwhile coming to terms with full independence and freedom of choice that coincides with that jump.

In this chapter, I reviewed evidence regarding the need for an innovative approach to optimal health and exercise among college aged students. Six primary research questions were developed to address the significant problem of physical inactivity and obesity in young people today, which if left unchecked, will lead to climbing rates of chronic disease tomorrow. The remaining chapters will include a literature review (Chapter 2), which will cover topics previously introduced in greater detail, including an evaluation of literature on cardiovascular disease risk factors in the general population and in college students, the transtheoretical/stages of change model, and health and fitness measurements. Chapter 3 will include detail on the design and statistical analysis of the study, which features a matched pairs *t* test to analyze archival data collected by PHED 215 instructors, along with descriptive analysis of selected variables. Chapter 4 will present my research results and information on data collection and analysis of research questions. Chapter 5 will discuss key findings and include conclusions, and recommendations for further study.

Chapter 2: Literature Review

Introduction

Chronic diseases and chronic disease risk factors such as physical inactivity and obesity are at an alarming level in young people, but few successful interventions have been found. An innovative college course-based intervention could help decrease chronic disease risk and establish lifelong healthy habits, but more research is warranted. Therefore, in this study, I investigated the effect of a health and fitness class on college students' (a) chronic disease risk, (b) cardiorespiratory fitness, (c) body fat percentage, (d) self-motivation, (e) exercise self-efficacy, and (f) stage of change.

In the following chapter, major sections include the literature search strategy, the theoretical foundation, and a review of current literature regarding physical activity, overweight and obesity, the college campus as an intervention site, and health promotion and social change in a lifetime fitness class.

Literature Search Strategy

I conducted a literature review to review and summarize previous research, provide a theoretical framework for research. In this review, I also define key terms, search for gaps in the literature, investigate areas of further study, identify a research topic and recent work done on that topic, and identify productive methodology of similar studies. To investigate the effect of a health and fitness course on college students, I accessed a variety of databases including MEDLINE, PubMed, CINAHL, Academic Search Complete, ProQuest Central, ScienceDirect, and Nursing & Allied Health

Source. In addition, literature from the ACSM, AHA, CDC, HHS, NCHS, NHLBI, NIH, and WHO was utilized, as well as other reputable online journal and nonjournal websites and texts, primarily since 2005.

Key search terms that I used included the following: *body mass index, cardiovascular disease, cardiorespiratory fitness, chronic disease, college students, exercise, intervention, heart disease, physical activity, obesity, self-efficacy, self-motivation, stage of change theory (SOC), self-motivation inventory (SMI),* and *transtheoretical model (TTM)*. In addition, literature on archival data, physical activity interventions, obesity interventions, Healthy People, quasiexperimental research, National College Health Survey, and statistics from the National Center for Health Statistics, were all searched.

Theoretical Foundation

A college course-based intervention is warranted; however, success relies on the usage of common health behavior theories and models, as they can serve as a valuable guide in the evaluation of health promotion interventions (McKenzie & Smeltzer, 2001). One such model is the TTM, also known as the stages of motivational readiness for change model (SOC). Prochaska and DiClemente (1983) first developed the TTM as an integrative model of change while studying the stages and processes of self-change of smoking. The TTM has shown promise in understanding behavior change in many avenues, such as addictive behaviors, smoking cessation, alcohol abuse, weight control, and exercise (McKenzie & Smeltzer, 2001).

Transtheoretical Model/Stages of Motivational Readiness for Change Model

The TTM has the functional characteristic of bringing together several components of major theories (McKenzie & Smeltzer, 2001). Examples of this include utilizing a social change theory concept, self-efficacy (Bandura, 1997), along with the concept of decisional balance from the decision-making theory (Janz & Mann, 1977; Marcus & Simkin, 1994). As individuals attempt to make a change, the TTM focuses on similarities they face in terms of stages and barriers (ACSM, 2010b). The Stages of Change is the central organizing construct of the model (Velicer, Prochaska, Fava, Norman, & Redding, 1998). Movement through the stages is not always linear, but actually occurs in a more cyclical manner (Marcus & Simkin, 1994). The stages of change in regards to physical activity are as follows (ACSM, 2010b):

1. Precontemplation. The individual is not active or is not thinking about becoming active.
2. Contemplation. The individual is not active, but is considering becoming active.
3. Preparation. This stage includes those who are active, but not yet at the recommended amount.
4. Action. This stage includes those who have recently become active at the recommended amount, but for less than 6 months.
5. Maintenance. The individual has been able to sustain the recommended amount of activity for over 6 months.

In more detail, those in the precontemplation stage are generally not interested in changing and don't think they have a problem, or do not think they are able to change (ACSM, 2010c). To combat this, knowledge of the pros and cons of exercise can be very beneficial (ACSM, 2010c). Fitness testing can be one method to engage precontemplators to move toward the next stages (Howley & Franks, 2007).

The contemplation stage, as the name suggests, include those who are not physically active, but contemplating it (ACSM, 2010b). Getting individuals to take steps toward physical activity is a major goal of this stage; education should be provided regarding specific exercise guidelines, as well as identification of social support for their exercise endeavor (ACSM, 2010b; Howley & Franks, 2007).

The preparation stage means that individuals have adopted an exercise routine, but not yet at recommended amounts. According to the TTM model, physical activity reaches recommended levels once an individual exercises at a moderate intensity on most, if not all, days of the week (ACSM, 2010b). A recommended activity for those in the preparation stage is goal setting, which can help guide the person toward an increase in physical activity (ACSM, 2010b).

The fourth stage, action, is reached when an individual is now exercising at the recommended amount, but has been doing so for less than 6 months (ACSM, 2010b). Setting goals can also be helpful in this stage (Howley & Franks, 2007), as well as self-efficacy enhancement activities, such as performing mastery experiences which occur when an individual is successful at performing a physical activity (Bandura, 1986). In addition to mastery experiences, Bandura (1986) details three other activities that enhance self-efficacy, including vicarious experiences, verbal persuasion, modeling, and interpretation of physiological and emotional responses. The fifth stage, maintenance, is reached when an individual has been physically active at the recommended amount, for more than six months (Howley & Franks, 2007). Once at the maintenance stage, it is recommended to plan ahead for a possible relapse, along with periodic fitness testing and participating in new activities (ACSM, 2010b; Howley & Franks, 2007).

Success in the forward progression through the stages of change increases by matching the stage to the intervention strategy (ACSM Resource, 2014). As a person moves through the stages of change, processes of change can be used to help make a behavior change (ACSM, 2010b). Ten processes of change are further broken down into two categories: five behavioral processes and five cognitive processes, and a meta analysis concluded that all ten processes are used as a person makes a behavior change (Marshall & Biddle, 2001).

The five behavioral processes involve taking direct action, and include examples like rewarding oneself for participating in physical activity, finding alternatives to unhealthy behavior, committing oneself to exercise, reminding oneself to participate in the healthy behavior change, and surrounding oneself with supportive helpers (ACSM, 2010b; Howley & Franks, 2007). The five experiential or cognitive processes involve the mind, and include risk watchfulness, knowledge enhancement, benefit acknowledgement and understanding, health program utilization and awareness, and consideration about how ones behavior change, or lack thereof, affects others (ACSM, 2010b).

The TTM uses components found in other theories, such as self-efficacy, which is a key component of the social cognitive theory (ACSM, 2014). Exercise self-efficacy is self-confidence in ones ability to maintain a healthy level of physical activity (Bandura, 1997). Research indicates that high self-efficacy predicts exercise participation (McAuley, Morris, Motl, Hu, & Elavsky, 2007).

Self-Efficacy and Self-Motivation to Increase Physical Activity

Physical inactivity is one of over 100 risk factors for cardiovascular disease, which is associated with obesity and low levels of cardiorespiratory fitness (Howley & Franks, 2007; WHO, 2005). Physical activity and fitness are a priority for optimal health and wellness in America, as shown by their inclusion in both the Healthy People 2010 and 2020 reports (HHS, 2000; HHS 2010). However, according to the Healthy People 2020 report (HHS 2010), only 43.5% of adults participate in aerobic physical activity. Similarly, the Centers for Disease Control (CDC) approximated that 50% of U.S. adults do not engage in the recommended amount of 30 minutes of moderate intensity physical activity per day (Centers for Disease Control and Prevention, CDC, 2003). In addition, of those who begin an exercise program, approximately half quit within six months (Dishman & Buckworth, 1997, as cited by Gieck & Olsen, 2007). One way to combat the aforementioned alarming physical activity statistics is confidence in being able to perform a task, also known as self-efficacy (Teague, Mackenzie, & Rosenthal, 2007). “Exercise self-efficacy is associated with increased exercise participation” and exercise initiation (Howley & Franks, 2007, p. 333).

Self-efficacy is a concept developed by Albert Bandura (1997), and is defined as "an internal state in which the person feels competent to perform a specific task" (Teague, Machenzie, & Rosenthal, 2007, p. 9). Competency feelings towards exercise, for example, would indicate that the individual has confidence in their ability to maintain a healthy level of physical activity (Teague, et al., 2007). "Researchers have shown that knowledge and self-efficacy are important for not only the onset of exercise behavior but also adherence and maintenance of exercise behavior" (Gieck & Olsen, 2007, p. 33). In a controlled, six week, SOC-based intervention, subjects were shown to have an increase in self-efficacy, and had more confidence in their ability to perform physical activity (Goldstein, Pinto, & Marcus, et al., 1999).

A tactic previously mentioned, which is tailored to those in the action stage, is self-efficacy boosting (Bandura, 1986). Self-efficacy can be increased by mastery experiences, vicarious experiences, verbal persuasion and emotional state (Margolis & McCabe, 2006). The most robust source of self-efficacy are mastery or successful experiences, while vicarious experiences such as observing a peer achieve success can also improve self-efficacy (Margolis & McCabe, 2006). Positive feedback can be utilized to guide someone through a task thereby increasing self-efficacy, and the emotional state of a person determines self-efficacy depending on the frame of mind, with a positive mood increasing self-efficacy, while anxiety can undercut it (Margolis & McCabe, 2006).

Self-motivation is the initiative to undertake or continue a task or activity without another's prodding or supervision (Merkle, Jackson, Zhang, & Dishman, 2002).

Individuals who are deficient in self-motivation have trouble adhering to an exercise program (Merkle, et al., 2002). Some researchers report mixed results on self-motivation in regards to physical activity adherence (Garcia & King, 1991, Merkle, et al., 2002), but Merkle, et al., (2002) points to a possible physical activity measurement incongruity. Self-motivation is just one determinant of exercise adherence, but, as measured by the Self-Motivation Inventory, is a valid and reliable measure of the “tendency to persevere in absence of reinforcement” (Merkle, Jackson, Zhang, & Dishman, 2002, p. 57).

Self-efficacy beliefs produce effects through four mediating processes, including cognitive, motivational, affective, and selective processes (Bandura, 1997). Explicit and challenging goals enhance motivation (Bandura, 1997). Sustaining self-motivation is strongly tied to goal properties, including goal specificity, goal challenge, and goal proximity (Bandura, 1997). Self-motivation persists especially if the goals are set high, yet are attainable, proximal rather than distant, and organized in a hierarchal manner (Bandura, 1997). A high level of self-efficacy contributes to motivation in several ways, including influencing what challenges an individual pursues, how much effort they expend, and their perseverance (Bandura, 1997). "When faced with obstacles or failures, people who distrust their capabilities slacken their efforts or abort their attempts prematurely. Those who have strong belief in their capabilities intensify their efforts when they fail to achieve what they seek and persist until they succeed. Strong perseverance usually pays off in performance accomplishments" (Bandura, 1997, p. 129).

According to over 150 studies, TTM or SOC based interventions have shown to be an effective model for exercise promotion (Spencer, Adams, Malone, Roy, & Yost, 2006). Therefore, the TTM is an invaluable tool which can guide interventions and achieve social change.

Literature Review Related to Key Variables and Concepts

Cardiovascular Disease

In the United States, CVD is the number one killer and results in 616,067 deaths per year, or 204.3 deaths per 100,000 people (NCHS, 2010). CVD risk factors are traits associated with an increase in CVD occurrence (Alters & Schiff, 2003, p. 288). Major risk factors include the following: (a) age, (b) family history of CVD, (c) cigarette smoking, (d) high blood cholesterol levels, and (e) lack of physical activity (Alters & Schiff, 2003). Other factors that may increase the risk of CVD include obesity, diabetes, gender, anxiety disorders, high levels of low-density lipoprotein (LDL), and a high total cholesterol/high density lipoprotein (HLD) ratio (Alters & Schiff, 2003).

Cardiovascular Disease Risk Factors: Focus on Obesity and Physical Inactivity. Physical inactivity and obesity are CVD risk factors, or traits associated with an increase in CVD occurrence. They are both modifiable and of high importance in the fight against chronic disease (Alters & Schiff, 2003; Bushman, 2011). Both obesity and physical inactivity are related to six of the top 13 causes of death in the United States, including CVD (Bushman, 2011).

Generally, obese individuals are at a higher risk for cardiovascular disease partly due to coinciding unhealthy blood lipid profile, insulin resistance, and metabolic syndrome (Kosola et al., 2012). Worldwide, more than 1.6 billion and 400 million people are currently overweight or obese, respectively, and those numbers are expected to increase (WHO, 2006). According to the Physical Activity Guidelines Advisory Committee, physical inactivity is the fourth leading cause of death in the United States (HHS, 2008) and is beneficial to both lean and overweight/obese individuals (Herman, Hopman, Vandenkerkhof, & Rosenberg, 2012).

Some researchers have even shown that mortality and cardiovascular disease risk for overweight/obese can equalize or even be less than that of the lean, yet physically inactive (Herman et al., 2012; Li et al., 2008). Moreso, Herman (2012) stated that when analyzing physical activity and BMI together, physical activity has shown to be a more important factor in health-related quality of life (Herman, 2012). Physical inactivity and obesity contribute to "poor health, independently and synergistically with each other" (Janz & Kwan, 2011, para. 1). Kosola et al (2012, p. 563) found that cardiorespiratory fitness seems to "protect overweight subjects from the atherogenic lipid profile." Therefore, recent research further confirms the established concept that physical activity can help decrease obesity and, in general, the risk of premature mortality, while helping to improve health and quality of life (HHS, 1996).

Chronic Disease Risk in College Age Students

Chronic disease and chronic disease risk factors occur in young adults. In the last few decades, , a significant increase in obesity and obesity-related disorders has occurred in children and adolescents (Halfon, Verhoef, & Kuo, 2012). Chronic diseases previously thought of as adult onset, such as cardiovascular disease, Type II diabetes, hypertension and metabolic syndrome, are now being seen in children and youth (Halfon et al., 2012). Metabolic syndrome, a cluster of metabolic abnormalities related to central obesity, dislipidemia, hypertension, and hyperglycemia, is seen as a predecessor to CVD and has been documented in young adults (Fernandes & Lofgren, 2011).

In addition, data from a 15 year, population based longitudinal study on young adults aged 18 to 30 years indicated that poor cardiorespiratory fitness levels during young adulthood was associated with development of cardiovascular disease risk factors (Carnethon et al., 2003). Specifically, Carnethon et al. (2003) discovered that the risk of developing hypertension, diabetes, metabolic syndrome, and hypercholestemia was inversely associated with cardiorespiratory fitness level in young men and women. Despite the findings of chronic disease and its risk factors in young people, this age group has been largely ignored in research studies (Fernandes & Lofgren, 2011).

However, *Health, United States 2008*, a health status report of America, included a special section dedicated to young adults ages 18-29 years of age (NCHS, 2008). A warning of decreasing physical activity and increasing obesity prevalence, "from 8% in 1971-1974 to 24% in 2003-2004" accompanied a chronic disease warning (NCHS, 2008, p. 109). In addition, death rates for diseases and leading causes of death are included for all ages (NCHS, 2008). Death rate for heart disease has decreased overall in young people between 1950-2005 (NCHS, 2008). For instance, in people ages 15-24, deaths per 100,000 decreased from 6.8 to 2.7 between 1950 to 2005 (NCHS, 2008). However, heart disease still ranks in the top 10 causes of death for young people. Between the years 1950 to 2005, in people ages 15-24, heart disease remained the 5th leading cause of death, with 1,223 and 1,119 deaths, respectively; for people ages 25-44, heart disease remained the 3rd leading cause of death, with 14,513 and 15,937 deaths, respectively (NCHS, 2008).

The National College Health Assessment, compiled by assessing over 80,000 US college students, reported overweight and obesity rates above 30% in college students (American College Health Association, ACHA, 2007). Also, the National Heart Lung and Blood Institute report indicates that the span from adolescence and young adulthood experiences the biggest decrease in physical activity; ages 15 to 18 experience the primary physical activity drop, with the decline continuing up to 29 years of age (Casperson, Pereira, & Curran, 2000). But, according to Morrell, Lofgren, Burke and Reilly (2012, p. 82), “few groups have examined the relationship between weight status, dietary choices, physical activity, and biomarkers of chronic disease risk among young adults.”

Disease Risk Related to Weight and Waist Circumference

Obesity increases the risk of various diseases; “an increased risk of hypertension, sleep apnea, Type 2 diabetes mellitus, certain cancers, CVD, and mortality are associated with a BMI ≥30.0 kg.m” (ACSM, 2014, p. 63). Health risk can also be gauged by waist circumference due to abdominal obesity (ACSM, 2014). The Expert Panel on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults (Expert Panel, 1998), provided a disease classification based on both BMI and waist circumference. As the BMI and/or waist circumference increases, so does the risk for the following diseases: Type 2 diabetes, hypertension, and cardiovascular disease (Expert Panel, 1998).

Interestingly, the link to BMI in the overweight range and higher mortality remains less clear than the link between the obesity BMI range and a higher mortality rate (ACSM, 2014). Therefore, the Expert Panel (1998) developed a table that evaluated both BMI and waist circumference. For instance, an overweight (BMI of 25.0 – 29.9 kg.m) male with a waist circumference ≤ 102 cm would have an increased disease risk, but an overweight male with a waist circumference greater than 102 cm has a high risk of disease (Expert Panel, 1998). Table 1 represents the findings of disease risk based on BMI and waist circumference (Expert Panel, 1998).

Table 1

Classification of Chronic Disease Risk

Weight class	BMI	Waist Circumference	Disease Risk
Underweight	<18.5	≤102cm(men);≤88cm(women)	No additional risk
Underweight	≤18.5	>102cm(men);>88cm(women)	No additional risk
Normal	18.5-24.9	≤102cm(men);≤88cm(women)	No additional risk
Normal	18.5-24.9	>102cm(men);>88cm(women)	No additional risk
Overweight	25.0-29.9	≤102cm(men);≤88cm(women)	Increased risk
Overweight	25.0-29.9	>102cm(men);>88cm(women)	High risk
Obese class I	30.0-34.9	≤102cm(men);≤88cm(women)	High risk
Obese class I	30.0-34.9	>102cm(men);>88cm(women)	Very high risk
Obese class II	35.0-39.9	≤102cm(men);≤88cm(women)	Very high risk
Obese class II	35.0-39.9	>102cm(men);>88cm(women)	Very high risk
Obese class III	≥40.0	≤102cm(men);≤88cm(women)	Extremely high risk
Obese class III	≥40.0	>102cm(men);>88cm(women)	Extremely high risk

CVD Risk Management in the Young Adult

Cardiovascular disease, and the dangerous risk factors that go along with it, span across many ethnic and socioeconomic groups and touches many lives- whether young or old, male or female. While age-adjusted death rates from CVD have declined 28% from 1999-2007, much still can be done in regards to prevention (NCHS, 2010). The current majority of CVD deaths (81%) are among people 65 years of age or older (NCHS, 2010). However, the young adults "are now developing CVD much earlier in their lives and carry a greater risk factor burden than past generations" (Page, Ghushchyan, & Niar, 2011, p.284). The lifestyle that can lead to this far-reaching disease starts many years before (NCHS, 2010), and modification of CVD risk factors will have a greater impact if implemented younger in life (Lloyd-Jones, Leip, Larson, D'Agostino, Beiser, et al., 2006). Therefore, Lloyd-Jones et al. (2006) recommended a focused effort on CVD risk factor prevention in young individuals. Faced with the recent alarming data trends and the "enormous public health burden imposed by CVD, renewed efforts are needed to promote prevention" (Lloyd-Jones et al., 2006, p. 791). One place that is ideal for change, prevention and health promotion is a college campus, in that young adults are generally increasing their awareness of health consequences and are beginning to make their own health decisions- choices that can last a lifetime.

Physical Activity

Physical activity recommendations. Adults between the ages of 18 and 64 years of age are recommended to engage in aerobic physical activity and muscle strengthening activity (CDC, 2011). Muscular strengthening activities are recommended at least two days per week, and should focus on all the major muscle groups, such as legs, hips, back, abdomen, chest, shoulders, and arms (CDC, 2011). The CDC (2011) aerobic activity category recommendations, depending on the corresponding level of health benefits; more time equals more health benefits. For "important health benefits," which is the minimal benefit level, 150 minutes of moderate level aerobic activity or 75 minutes of vigorous aerobic activity is recommended (CDC 2011). Moderate level aerobic activity would include brisk walking while still being able to talk, for example, while examples of vigorous aerobic activity would include modes such as running, jogging, swimming, and biking, which would increase one's heart rate and breathing to the point that a person wouldn't be able to say more than a few words while exercising (CDC, 2011). The second category, "greater health benefits," recommends at least 300 minutes of moderate aerobic activity or 150 minutes per week of vigorous aerobic physical activity in order to obtain major health benefits (CDC, 2011).

Intensity of aerobic activity is often measured via various expressions, which are based off a maximal physiological response, such as heart rate (Howley & Thompson, 2012). Maximal heart rate (MHR) is the maximal number of times a person's heart beats per minute, and can be estimated via the heart rate max formula (MHR = 220 – age) (Howley & Thompson, 2012). Intensity of aerobic activity can thus be determined by percentage of maximal heart rate (%HRmax) (Howley & Thompson, 2012). Maximal heart rate percentage has been utilized for many years, as researchers and clinicians have found it is simple and easy to teach (Howley & Thompson, 2012).

Physical activity trends. Physical activity level recommendations are useful tools to facilitate meeting health benefits; however, less than half (48%) of adults meet the 2008 guidelines (CDC, 2012b). College students show similar trends to the general population in regards to physical inactivity (Keating, Guan, Pinero, & Bridges, 2005). While inactivity rates within the general population were approximately 40% (HHS, 2000), according to the 1995 National College Health Risk Behavior Survey, approximately 36% of college students reported no physical activity during leisure time (Douglas, Collins, & Warren, et al., as cited by Keating, et al., 2005). In the 2005 National College Health Assessment (NCHA, 2002), 57% and 61% of men and women, respectively, indicated no vigorous or moderate exercise in at least 3 of the previous 7 days. However, the 2010 ACHA National College Health Survey reported somewhat lower rates of physical inactivity; 23 and 25 percent of male and female college students reported no moderate cardiovascular or aerobic exercise in the past seven days, respectively (ACHA, 2011). On the other hand, Keating, et al. (2005) reported higher levels of inactivity among college students with rates between 40-50 percent.

While reported physical activity statistics may vary, one clear theme has emerged: Physical activity tends to decrease considerably as students move from high school to early adulthood (HHS, 2000). The 1996 Surgeon General's Report on Physical Activity and Health (HHS, 1996) noted a similar trend, with nearly half of American youths aged 12 to 21 not engaging in physical activity on a regular basis, showing a dramatic physical activity decline during adolescence. This physical inactivity trend has serious health consequences. For instance, in a study of over 4,000 college students, investigators found that inactive college students were more likely to be overweight or obese (Desai, Miller, Staples & Bravender, 2008).

Measurement of physical activity. Polar heart rate monitor system (PHRMS). Researchers studying the effect of a "Lifetime Fitness For Health" class on student's exercise behavior utilized self-reported data to determine physical activity level (Cardinal & Spaziani, 2007). However, for future studies, Cardinal & Spaziani recommended utilizing an objective measurement in order to decrease self-report bias; the Polar Heart Rate Monitor (PHRMS) system is such a measurement.

The PHRMS is utilized by PHED 215, and is an ambulatory, inexpensive method to directly and continuously monitor the heart rate by utilizing a heart rate strap, which is a transmitter worn around the chest (Goodie, Larkin, & Schauss, 2000). A Polar watch is worn around the wrist, and serves as a receiver for the HR data (Goodie, et al., 2000). Researchers reported that the PHRMS is valid measure of heart rate, and corresponded well with an electrocardiograph (ECG) measurement (Goodie, et al., 2000).

Overweight and Obesity

Overweight and obesity are reaching alarming levels in America, showing a dramatic increase in obesity during the last twenty years from 1990 through 2010 (CDC, 2012a). In 2011, more than one-third of U.S. adults (35.7%) were obese, with varying rates across the states from a low of 20.7% in Colorado to the high of 34.9% in Mississippi (CDC, 2012a). Many of the leading causes of preventable death are obesity-related conditions, such as CVD and Type II diabetes (CDC, 2012a).

Obesity goals and health guidelines. State and national obesity levels are based on self-reported body mass index (BMI), which is a ratio of weight to height (CDC, 2012b). BMI has become a preferred method of determining obesity with clinicians because BMI is closely connected to body fatness in adults, and a high BMI has a clear correlation to negative health issues (Howley & Thompson, 2012). In addition, BMI is a quick and convenient method to determine obesity (Howley & Thompson, 2012).

On the other hand, BMI tends to overestimate obesity in athletic, muscular individuals and does not differentiate between fat and muscle (Howley & Thompson, 2012). An alternative method to estimate obesity is the skinfold measurement, which is frequently utilized as a fairly accurate tool if the person has been properly trained to use the skin caliper (Howley & Thompson, 2012). Skinfold measurement estimates body fat percentage by measuring skinfold thickness; an increase in skinfold thickness coincides with an increase in body fat (Howley & Thompson, 2012). Both BMI and skinfold measurements have positive and negative attributes when it comes to estimating obesity, and both have been utilized in a variety of fitness and research settings (Howley & Thompson, 2012).

Table 2 shows BMI and general body fat percentage levels with corresponding labels of underweight, normal weight, overweight, and obesity. While a general consensus exists on BMI recommendations, note that there is not a universally recommended body fat percentage, and ranges differ dramatically based on age and gender (Howley & Thompson, 2012). Many experts agree that over 38% for women and over 25% for men is considered obese (Howley & Thompson, 2012), while others recommend other standards (ACSM 2010c; Powers & Dodd, 2003). Therefore, the body fat percentage recommendations below reflect a consensus among experts, which is also easy to apply and remember (Powers & Dodd, 2003).

Table 2

Obesity Classifications

Fat	*Underweight*	*Normal*	*Overweight*	*Obese I*	*Obese II*	Obese III
BMI ($kg.m^2$)	< 18.5	18.5 – 24.9	25.0-29.9	30.0 – 34.9	35.0 – 39.9	≥ 40.0
Body Fat %						
men	< 10%	10-20%	21-25%	> 25%		
women	< 15%	15-25%	26-30%	>30%		

Healthy People 2010 set a national goal to lower obesity prevalence to 15% by 2010; no state met that goal (CDC, 2012a). In 2010, Minnesota had a 24.8% obesity rate (CDC, 2012a). This disturbing trend is present in adults of all ages, including college age students.

Overweight and obesity in college students. College age students face a health risk from obesity and obesity-related disorders such as type 2 diabetes, hypertension, and dyslipidemia (CDC, 2006; Mestek, Plaisance, & Grandjean, 2008; Sparling, 2007; HHS, 2001). The Behavioral Risk Factor Surveillance Survey showed an increase in obesity rates among young adults ages 18 to 29 years during the last two decades

(Mokdad, et al., 2003). According to the National College Health Risk Behavior Survey, 35% of college students were reported to be overweight or obese (Lowry, et al., 2000). This data are similar to self-reported data from the National College Health Survey (NCHS) conducted through the American College Health Association (ACHA, 2011). According to the NCHS, out of approximately 30,000 students surveyed, 54% of men and 56% of women reported they were "about the right weight." Conversely, 31% of men and 36% of women stated they were "slightly" or "very overweight" (ACHA, 2011). However, it is interesting to note that when asked within the last 30 days if they had exercised to lose weight, 43% t and 57% of men and women said they did, respectively (ACHA, 2011). If 31% of men and 36% of women think they are "about the right weight," why then were 43% of male students and 57% of female students still exercising to lose weight? This means that 12% of men and 21% of women are exercising to lose weight, even though they consider themselves to be "about the right weight." This apparent disconnect could join in with the staggering physical inactivity and obesity statistics to show that college students would benefit from a health intervention targeting an increase in knowledge and practice regarding both physical activity and the fight against obesity.

The College Campus: A Promising Intervention Site

The United States government has focused attention toward utilizing college campuses as health promotion and intervention sites as stated in Healthy People 2010 and more recently, Healthy People 2020, the latest edition of the nationwide health promotion plan (HHS, 2000; HHS 2010). According to the ACHA (2009), the Healthy

People agendas can assist college and university administrators, faculty, staff and students in the development of healthier campuses via support and guidance "toward health enhancing behaviors." Healthy People 2010 states that educational settings can play a key role in preventing disease, improving health, and enhancing the quality of life (HHS, 2000). Colleges have been specifically included in the Healthy People 2010 and 2020 report as a site for educational and community-based programs (HHS 2000, HHS 2010). Distinctively, objective 7-3 states the need to "increase the proportion of college university students who receive information from their institution on each of the six priority health-risk behavior areas" including injuries (intentional and unintentional), tobacco use, alcohol and illicit drug use, dangerous sexual behaviors, dietary patterns that cause disease, and inadequate physical activity (HHS, 2000; HHS 2010). In 1995, only six percent of college students reported receiving information on all six areas; the goal for Healthy People 2010 was to increase this amount to 25 percent (HHS, 2000). Specifically, in regards to physical inactivity, "56.0 percent of college and university students received health-risk behavior information on inadequate physical activity from their institution in 2009;" the 2020 goal is to increase that level to 61 percent (HHS, 2010). Concerning unhealthy dietary patterns, "52.0 percent of college and university students received health-risk behavior information on unhealthy dietary patterns from their institution in 2009;" the 2020 goal is to increase that target to 57.2 percent (HHS, 2010).

In the 2010 National College Health Survey (ACHA, 2011), students were asked if they would like to receive information from their college or university regarding 19 various topics, ranging from alcohol to depression to violence. According to the survey, 57.8 percent of college students surveyed (49 and 63 percent of men and women, respectively) indicated they would like more information regarding nutrition, earning a ranking of the second most popular subject matter (ACHA, 2011). Coming in third, 54.6 percent of college students (48 and 59 percent of men and women respectively) indicated they would like to receive information about physical activity (ACHA, 2011). Of the 19 topics students, only one area outranked physical activity and nutrition, with 60.7 percent of college students reporting a desire for more information regarding stress reduction (50 and 67 percent of men and women, respectively) (ACHA, 2011). Therefore, as a means to "establish national college health objectives and serve as a basis for developing plans to improve student health," the American College Health Association (ACHA, 2009) designed Healthy Campus 2010. Designed to coincide with Healthy People 2010, the ACHA manual, *Healthy Campus: Making It Happen*, outlines ten leading health indicators, two of which include physical activity and overweight and obesity (ACHA, 2009). According to these aforementioned statistics, college students both need and desire more information from their colleges and universities regarding physical activity, obesity and nutrition. Therefore, a health promotion based on a college campus is warranted.

Health Promotion and Social Change in a Lifetime College Fitness Class

At its core, health promotion is based on the foundation of social change to promote health, because, by joining people with their environment, health promotion blends "personal choice and social responsibility" (WHO, 2009, p. 29). According to the World Health Organization (WHO, 2009), health promotion enables people to improve and be in charge of their health. In 1984, WHO (2009) developed five principles of health promotion in order to clarify concepts and issues. First, instead of focusing just on individual disease prevention, health promotion should center on “the population as a whole in the context of their every day life” (p. 29). Second, health promotion requires taking action on the building blocks of health (p. 29). Third, in order to combat health dangers, health promotion should consolidate many approaches; education and communication are two of many possibilities (p. 30). The fourth principle, effective public participation, requires “decision-making life skills both individually and collectively” (p. 30). The final principle states that health professionals can uniquely aid health promotion via “education and health advocacy” (p. 30).

The alarming physical inactivity and obesity statistics paint a stark picture without a medical breakthrough in site. College students are at significant chronic health risk as a result of current levels of physical inactivity and overweight/obesity (Mestek, Plaisance, & Grandjean, 2008), and according to recent studies, young people fail to recognize their risk of developing cardiovascular disease (Collins, Dantico, Shearer, & Mossman, 2004; Smith, Dickerson, Sosa, McKyer & Ory, 2012; Wendt, 2005). According to Morrell et al., (2012), few studies thus far have investigated cardiovascular disease risk factors in young adults. However, a college campus as an intervention site shows much promise in helping young adults make positive, lifelong, and impactful health choices (HHS, 2000). Colleges can serve as a powerful setting where students have the potential to not only increase short-term physical activity, but also lifetime fitness (HHS, 2000). In addition, college campuses can provide a key in breaking the obesity trend (Sparling, 2007). Gieck & Olsen (2007) reported a significant decrease in body fat and body mass in female college students after participating in a holistic wellness program. Researchers have pointed to a possible need for future physical activity and obesity interventions for college students to offer gender-specific opportunities to satisfy diverse preferences (Mestek, et al, 2008). According to Buckworth and Nigg (2004), physical inactivity interventions within the college population should focus on making physical activity seem more accessible and rewarding than sedentary behaviors, such as computer use and television viewing for men and women, respectively. These adjustments could have both short and long term positive health benefits for college students (Buckworth and Nigg, 2004).

Summary

A lifetime health and fitness college course holds great potential as far as the wellbeing of those involved, but the level and reach of impact both on the students and on society is not fully understood (Cardinal & Spaziani, 2007; Sparling, 2003). In addition, more research is needed in regards to optimal class format (Cardinal & Spaziani, 2007). To my knowledge, no study has been done on a lifetime health and fitness college course which measured weekly physical activity via the Polar Heart Rate Monitor system. This objective evaluation method not only measures physical activity and intensity levels in a more accurate way, but could also increase physical activity due to the increased level of monitoring.

In this chapter, my literature search strategy was described and I presented a literature review in conjunction with my research topic. The following chapter will present my research design and rationale, methodology, including archival data procedures, research questions and hypotheses, instrumentation, threats to validity, and ethical procedures.

Chapter 3: Research Method

Introduction

From the staggering physical inactivity and high obesity rates in America, it is evident that a solution must be found and implemented. The National Physical Activity Plan (NPAP, n.d.) has pointed to colleges as an optimal site for health intervention, but more research is warranted regarding successful approaches. Therefore, in this quantitative study, I explored the effect of a lifetime fitness and physical education class on college students. In the following chapter, I describe the (a) research design and rationale, (b) methodology, including archival data procedures, (c) instrumentation, (d) threats to validity, and (e) ethical procedures.

Research Design and Rationale

In the research design and rationale, I will describe the study variables, including the independent variable and the dependent variables, the research design, and design justification. Table 3 shows the study variables and measurements, including variable names, variable type, and measurement of the variable.

Table 3

Study Variables and Measures

Variable name	Variable type	Measurement of variable
PHED 215 class	Nominal	Archived data list of class registration (before participation in PHED 215, after participation in PHED 215)
Disease risk	Nominal	Archived data; disease risk calculated by BMI and waist circumference; weight taken by scale, height measured by stadiometer, waist circumference measured by measuring tape. A subject could be classified into a category of no additional risk, increased, high, very high, or extremely high disease risk.
Body fat percentage	Interval	Archived data; body fat percentile calculated by bioelectrical impedance (BIA)
Cardiorespiratory fitness recovery index score	Interval	Archived data; cardiorespiratory fitness level determined by 3-minute step test heart rate recovery sum, or recovery index
Exercise self-fficacy score	Interval	Archived data; exercise self-efficacy level measured by Exercise Self- Efficacy Level Questionnaire
Self-motivation score	Interval	Archived data; self-motivation level measured by Self-Motivation Inventory
Stage of change score	Interval	Archived data; calculated by Stages of Change Questionnaire

Study Variables and Measures

Developing Life Skills (PHED 215) is a 16-week health lifetime fitness class designed to encourage and activate self-responsibility through knowledge of physical fitness, wellness and lifestyle management. The following is a description of the variables of interest collected from physical activity data and health and fitness tests taken during PHED 215 throughout the semester. The six variables are (a) chronic disease risk, (b) cardiorespiratory fitness level, (c) body fat percentage, (d) exercise self-efficacy, (e) self-motivation, and (f) progress from initial physical activity stage of change.

Research Design

A quasi-experimental comparative study design, which examined the relationship between an explanatory variable and a response variable" was utilized (Gerstman 2008, p. 21). In this study, I utilized archival data to determine if PHED 215 has an effect on any of the following dependent variables: (a) disease risk, (b) cardiorespiratory fitness, (c) body fat percentage, (d) self-motivation, (e) exercise self-efficacy, and (f) physical activity stage of change.

While the gold standard of intervention research design is the randomized clinical trial (Murray, 1998), since archival data were employed, a longitudinal or case-control experimental study is not possible. This approach was appropriate for this study due to its feasibility when a control group is not possible (Batterham & Hopkins, 2005). Even though quasi-experimental designs lack randomization, they have been successfully used for many years, and while they are not as strong on internal validity as true experiments, they are often stronger on external validity since they take place outside a clinical setting (Murray, 1998).

Research Design Justification

My goal in this study was to determine the effect of a health and fitness class on college students. Several methodological designs were considered, including quantitative, qualitative, mixed method, and quasi experimental. When choosing a design method, the strengths and weaknesses of each method should be evaluated according to the issue being investigated, (Patterson & Morin, 2012).

Qualitative research enables researchers to build knowledge by nonstatistical methods of inquiry and social phenomenon analysis (Marlow, 1993). One strength of qualitative research is that an issue can be investigated in depth, but the method tends to be time consuming and some within the scientific community still have reservations regarding qualitative research (Anderson, 2010). Both qualitative and a mixed methods design were considered, but neither design fit with the archival data being used.

Researchers have previously used similar designs when comparing pre- and post-tests. For example, a Wilcoxon signed-rank test, a nonparametric alternative of a paired t test, was utilized to compare college students' perception of healthful foods after a point of selection intervention at a dining hall (Peterson, Duncan, Null, Roth, & Gill, 2010). In addition, investigators used a matched pairs *t* test to evaluate the effectiveness of Australia's Get Healthy Information and Coaching Service, a lifestyle improvement intervention focused on changes in behavior and anthropometric measures (O'Hara et al., 2013).

Methodology

Population

The target population was male and female college students who were enrolled in a health and physical education class (Developing Life Skills/PHED 215) at a small, Midwestern college in Minnesota. Archival data collected includes the sampling frame of approximately 70 college students who were enrolled in a health and physical education class (PHED 215) during the fall semester of 2012. PHED 215 was a required class for all students, and is the sole fulfillment of the physical education requirement.

Sampling and Sampling Procedures

Procedures and sampling frame. In this study, I used archival data, which included information from all students taking PHED 215 in the fall semester of 2012. Students were tested within the first 2 weeks of the 16-week semester (Week 1- Week 2), and retested the last two 2 of the 16-week semester (Week 15- Week 16). The first testing took place in early September 2012, while the posttest occurred in December 2012.

Steps to data abstraction. Using archival data presents a unique set of constraints in regards to statistical analysis. First, determination was made about what information I was looking for and why. I work in the college setting as an Assistant Professor in the Exercise Science department, and am also involved in assessment, both for the Exercise Science major and the general education requirements. One of the classes being used for the general education assessment is PHED 215. Thus an abundance of useful and relevant data were available to answer the question: does

PHED 215 truly accomplish its objective of demonstrating "proficiency and knowledge of healthy lifestyle choices" (BLC, 2012).

The secondary data that I used for this study provided a plethora of opportunity in regards to other effects and benefits the class may have on its students. PHED 215 was incorporating innovative ideas, and by using this archival data, this investigation could possibly show a useful and needed tool to combat the downward spiral of obesity and physical inactivity. Chronic disease is gaining a larger foothold in young adults today, and maybe that trend can be reversed by targeting young adults in the college setting as they begin to shape their health habits, exert their independence and take ownership of their personal health choices.

Sample size. I conducted a power analysis in order to determine the minimum sample size required for this study. The power analysis was based on paired *t* test for investigating if there is a statistically significant difference between the means of cardiorespiratory fitness, body fat percentage, self motivation level, exercise self-efficacy level, and progressive movement through the TTM stages of change before and after participation in PHED 215 (O'Brien & Muller, 1993). Assuming a medium effect size of 0.5, in order to achieve a power of 80% at the 0.05 level of significance, a minimum of 29 pairs (i.e., 29 subjects) were needed for this study (Cohen, 1992). The archival data that I used provided information on all PHED 215 students from the fall of 2012. There were five sections of approximately 12-15 students each, resulting in a sample size of approximately 70 students maximum. The actual sample size (64 students) was greater than the minimum sample size required for this study (29 students).

Archival Data

I used archival data, collected by instructors of PHED 215 during the fall semester of 2012. These data were collected with the original purpose of class evaluation, in conjunction with possible future collegiate assessment requirements. Data available to examine included: a preclass health history questionnaire, pre- and post-class health and fitness test results, pre- and post-class self-reported physical activity levels, pre- and post-class self-motivation levels, pre- and post-class physical activity self-efficacy levels, weekly physical activity logs, and a postclass questionnaire inquiring the student's intent and rationale regarding the adoption of a positive health change. The data sets from all PHED 215 sections were collected by the each instructor, and then stored in a locked file cabinet. I was given access to these records by the college IRB (Appendix A).

Instrumentation and Materials

Variables were measured via health and fitness tests that adhered to American College of Sports Medicine (ACSM) guidelines, found in the ACSM Guidelines for Exercise Testing and Prescription (ACSM, 2010a) or procedures described in Total Health & Fitness (Powers & Dodd, 2003; Powers & Dodd, 2009). See Table 4 for a brief overview of instrumentation and materials.

Table 4

Instrument Description

Variable	Measurement tool
Disease risk	ACSM Table (2010a) utilizing a combination of BMI and waist circumference to obtain disease risk
Cardiorespiratory fitness	Three Minute Step Test (Powers & Dodd, 2009)
Body fat percentage	Bioelectrical Impedance (BIA) via the Tanita 350 Body Composition Analyzer
Self-motivation	Self-Motivation Inventory (Dishman & Ickes 1981; Merkle, 1997)
Exercise self-efficacy	Exercise Self-Efficacy Scale (Bandura, 1997)
Stage of change	Assessing Physical Activity Stages of Change (Marcus & Forsythe, 2003; ACSM Resource Manual, ACSM, 2010b)

Disease risk. The first variable of interest is disease risk. Disease risk will be treated as a nominal, categorical variable, and the following disease risk classifications will be utilized: (a) no additional risk, (b) increased risk, (c) high risk, (d) very high risk, and (e) extremely high risk. Disease risk was assessed via a combination of body mass index (BMI) and waist circumference levels (ACSM, 2010a). According to Table 1, as BMI and waist circumference levels increase, so does the risk of specific diseases, including type II diabetes, hypertension, and cardiovascular disease (ACSM, 2010a).

Body mass index. Body mass index (BMI), also known as the Quetelet index, is used to examine weight relative to height (ACSM, 2010). BMI is calculated by dividing weight in kilograms by height in meters squared ($kg \cdot m^2$), with levels of 25-29.9 $kg \cdot m^2$ and $\geq$30 $kg \cdot m^2$ indicating overweight and obesity, respectively (ACSM, 2010a). BMI does not take into account fat, muscle or bone mass, and while it can be used to estimate body fat percentage, it is not a recommended method due to a rather large standard error of estimate (ACSM 2010a; Howley et al., 2006; Lohman, Houtkooper, & Going, 1997). However, BMI is useful in calculating possible health danger, and research shows that a BMI >30 kg·m² is associated with a higher risk of mortality, coronary disease, and hypertension (Alters & Schiff, 2003; Rimm, et al., 1995). Conversely, Brooks., et al (2007) reported that BMI is a poor health status indicator in young adults, so BMI was not used alone to indicate the chronic disease risk of college students in this study.

Waist circumference. Body fat distribution is an important predictor of obesity-related health risks (Howley, et al., 2006). Girth measurements can be useful in determining the existence of central or android obesity, which increases risk of CVD, hypertension, type 2 diabetes, dyslipidemia, coronary artery disease, and premature death (Whaley, Brubaker & Otto, 2006; Alters & Schiff, 2003). Waist circumference is calculated by horizontally measuring a subject at the narrowest part of the torso, above the umbilicus and below the xiphoid process (ACSM, 2010a). Waist circumference alone can be a useful health indicator, as it examines central obesity as a disease predictor (Whaley, Brubaker & Otto, 2006).

Waist circumference and BMI combination to calculate disease risk. Waist circumference combined with body mass index (BMI) can provide an expansive disease risk estimate (e.g., CVD, type 2 diabetes and hypertension) via a classification system created by the Expert Panel on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults (ACSM 2010a; Expert Panel, 1998). See Table 1 for the guidelines used to establish disease risk based on the combination of body mass index and waist circumference. In summary, a subject could be classified into five possible categories: (a) no additional disease risk, (b) increased disease risk, (c) high disease risk, (d) very high disease risk, and (e) extremely high disease risk.

Step test. The second variable of interest is cardiorespiratory fitness. I treated the cardiorespiratory fitness indicator, a heart rate recovery index in numerical form, as a continuous, intervalvariable. The heart rate recovery index was compared, not the more general cardiorespiratory fitness category, to ensure that even a small change was detected during the relatively short time the class was offered (i.e., 16 weeks). Commonly used to estimate cardiorespiratory fitness, the step test required subjects to step up and down on a bench for a specified time (usually three minutes) at a precise rate (Howley & Franks, 2007). Heart rate response was measured via post-exercise heart rate recovery heart rates (ACSM, 2010a).

A high postexercise heart rate indicates a low cardiorespiratory fitness level, while a low post-exercise heart rate indicates a high fitness level (ACSM, 2010a). In addition, researchers show that heart rate recovery improves with cardiorespiratory fitness (ACSM, 2010a). In addition, in a 20-year longitudinal study, Carnethon et al. (2012) reported that a slow heart rate recovery in middle age is “significantly associated with traditional contrary heart disease risk factors” (p. 273).

In PHED 215, cardiorespiratory fitness and heart rate recovery, or how fast the heart rate slows back down postexercise, and has been found to be especially useful in tracking an individuals’ progress of cardiorespiratory fitness (Kenney, Wilmore, & Costill, 2012).

The step test procedure, from Powers and Dodd (2009), consisted of subjects stepping up and down on an 18-inch bench to a set cadence of one complete step (up-up, down-down) every 2 seconds, for 3 minutes. After step test completion, students immediately sat down and shortly after, began the heart rate recovery measurement procedure. Heart rate recovery was measured via counting the student's heart rate during three, thirty-second time frames, from 1 to 1:30, 2 to 2:30, and 3 to 3:30 minutes post- exercise, while all subjects remained seated. Heart rate from each time frame was totaled, and that total was then compared to age- and gender-specific fitness norms. A faster heart rate recovery resulted in a higher level fitness score. Results were compared to fitness categories based on men and women, aged 18-25 years (Powers & Dodd, 2009). In this study, the mean step test index before and after participation of PHED 215 was compared. The norms for cardiorespiratory fitness were calculated from the sum of three recovery heart rates obtained following the step test. The women's cardiorespiratory fitness categories were:

- superior, with a heart rate recovery between 95-120 beats;
- excellent, with a heart rate recovery between 121-135 beats;
- good, with a heart rate recovery between 136-153 beats;
- average, with a heart rate recovery between 154-174;
- poor, with a heart rate recovery between 175-204; and
- very poor, with a heart rate recovery between 205-233 (Powers & Dodd, 2009).

The men's cardiorespiratory fitness categories were:

- superior, with a heart rate recovery between 95-117;

- excellent, with a heart rate recovery between 118-132 beats;
- good, with a heart rate recovery between 133-147;
- average, with a heart rate recovery between 148-165;
- poor, with a heart rate recovery between 166-192; and
- very poor, with a heart rate recovery between 193-217 (Powers & Dodd, 2009).

Body fat percentage. The third variable of interest is body fat percentage. For data analysis, body fat percentage will be analyzed, not the more general body fat percentage category, to ensure that even a small change may be detected during the relatively short time the class was offered (i.e., 16 weeks). Body fat percentage was treated as a continuous interval, variable. Body composition was assessed via bioelectrical impedance analysis (BIA) to estimate body fat percentage. The Tanita BF-350 Body Composition Analyzer, as part of the Polar TriFit system, was used to measure BIA. Bioelectrical impedance analysis has an accuracy that is generally equivalent to skinfold testing, as long as protocols are strictly followed (ACSM, 2010a). Such precautions include making sure the subject is adequately hydrated, has not exercised within 12 hours before the test, has urinated completely within 30 minutes of the test, and has not consumed alcohol within 48 hours of the test (ACSM, 2010c).

There are no universally accepted body fat percentage norms (ACSM, 2010b). However, general recommendations for health indicate that 10% to 22% and 20% to 32% for men and women, respectively, are acceptable ranges (ACSM, 2010a). The ACSM (2010a) used a more stringent table of age- and gender-matched norms. For purposes of this study, body fat percentages were compared to a moderate level of norms used by students in PHED 215 (Powers & Dodd, 2003; 2010); these norms are represented in Table 2. Because the study period was only 3 months, in this study, the mean body fat percentage before and after participation of PHED 215, rather than the percentile rank or body fat percentage category, was compared.

Self-motivation. The fourth variable of interest was self-motivation. The measure that I used to analyze self-motivation was the self-motivation score which can range from 35 to 175; the self-motivation score was treated as a continuous interval variable. Instructors utilized a preexisting instrument, the 35-item Self-Motivation Inventory (SMI) to ascertain self-motivation level

The Self-Motivation Inventory (SMI), a 40-item, 10-subscale questionnaire, was originally developed by Dishman and Ickes (1981) to evaluate self-motivation as a predictor of exercise program adherence. In 1997, a researcher further examined the construct validity of the SMI, finding that six of the original ten factors were highly correlated to self-motivation (Merkle, 1997). This finding enabled the practice of using a single SMI score, which is the sum of the associated six factors (Merkle, 1997). Consequently, Merkle (1997) reduced the SMI to a 35 item, 6-factor scale, including the following subscales: commitment, lethargy, drive, persistence, reliability, and discipline.

This self-report instrument has a possible score between 35 and 175; the higher the score, the higher the level of self-motivation. The five-point Likert scale is used for scoring the positively or negatively keyed items, ranging from very uncharacteristic of me (+3) to very characteristic of me (-3; Merkle, 1997). The SMI includes statements such as, “I’m not very good at committing myself to do things,” “I’m good at keeping promises, especially ones I make myself,” “I’m basically lazy,” and “I like to take on jobs that challenge me” (Merkle, 1997). Stability reliability was found to be high (over .86) and internal consistency reliability was estimated at .91 and .88 for the original and revised forms, respectively (Dishman & Ickes, 1981; Baumgartner, Jackson, Mahar & Rowe, 2007).

Regarding validity, researchers found that the SMI accurately predicted exercise adherence in a medically supervised cardiovascular and muscular endurance program (Dishman & Ickes, 1980). In addition, Merkle (1997) developed an exercise drop out profile within a college student population, which included high body fat percentage, high body weight, and a low SMI. Merkle (1997) reported a significant correlation between SMI and self reported exercise habits in college students. Jackson and Ross (1997) developed percentile-rank norms for the SMI by testing over 1600 college students who completed a required personal fitness class. Self-motivation norms are separated into quartiles: *low* (35-70), *moderate* (71-105), *high* (106-139), and *very high* (140-175).

Exercise self-efficacy. The fifth variable of interest is exercise self-efficacy. The exercise self-efficacy scale ranges from 0 to 100, and this measure will be treated as an interval, continuous variable. Self-efficacy is a concept developed by Albert Bandura (1997), and is defined as “an internal state in which the person feels competent to perform a specific task” (Teague, Machenzie, & Rosenthal, 2007, p. 9). Competency feelings towards exercise, for example, would indicate that the individual has confidence in their ability to maintain a healthy level of physical activity (Teague, et al., 2007). "Researchers have shown that knowledge and self- efficacy are important for not only the onset of exercise behavior but also adherence and maintenance of exercise behavior" (Gieck & Olsen, 2007, p. 33).

The Exercise Self-Efficacy Scale (Bandura, 1997)includes 18 statements, describing situations that can make it hard to stick to regular exercise (3 or more times a week). Students were to rate their confidence that they can perform the task described in each question on a scale from 0 to 100, with 0 depicting "cannot do at all" to 50, "moderately certain can do" to 100, "certain can do." In this study, the mean self-efficacy level before and after participation of PHED 215 was compared.

Current stage of change. The sixth variable of interest is the stage of change. Five stages of change are possible, and each stage has been assigned a number between 0 and 4: (a) precontemplation (score of 0), (b) contemplation (score of 1), (c) preparation (score of 2), (d) action (score of 3), and (e) maintenance (score of 4). This scoring system will enable the measure to be treated as a categorical, interval variable. The stages of change are utilized within the transtheoretical model, and is a useful tool to assess readiness to change (ACSM, 2010b). In order to measure the current stage of change for each student, the students were given the "Assessing Physical Activity Stages of Change" analysis, developed by Marcus & Forsythe (2003), and recommended by the ACSM Resource Manual (ACSM, 2010b, p. 728). After reading the directions and definition of regular physical activity ("it must add up to a total of 30 or more minutes per day and be done at least 5 days per week"), the students were directed to answer yes or no to the following four statements: 1) I am currently physically active; 2) I intend to become more physically active in the next 6 months; 3) I currently engage in regular physical activity; and 4) I have been regularly physically active for the past 6 months (Marcus & Forsyth, 2003, as cited by ACSM, 2010b, p. 728). Table 5 describes the stage of change scoring system (ACSM, 2010b). The stage of change scoring system is based on how the subject answers the aforementioned 4 questions as follows:

- The precontemplation stage (score 0), answered “no” to statement 1 and statement 2;
- the contemplation stage (score of 1), answered “no” to statement 1 and “yes” to statement 2;
- the preparation stage (score of 2), answered “yes” to statement 1 and “no” to statement 3;
- the action stage (score of 3), answered “yes” to statement 1 and statement 3, “no” to statement 4; and
- the maintenance stage (score of 4), answered “yes” to statement 1, statement 3, and statement 4 (ACSM, 2010b).

In summary, a score could be assigned for each stage: 0 = *precontemplation*, 1 = contemplation, 2 = *preparation*, 3 = *action*, and 4 = *maintenance*. The mean score of stage of change before and after participation of PHED 215 was compared.

Data Analysis Plan

The archival data from PHED 215 provided data from two sets of observations- at the beginning of the semester and at the end. Missing data excluded a participant. All data analyses were conducted using Statistical Analysis Software (SAS) (Statistical Analysis Software Institute Inc., 2012). Archival data retrieved from instructors of Developing Life Skills (PHED 215) during the fall of 2012 was examined.

Research questions and hypotheses. The research questions and the corresponding hypotheses of this study are listed below.

Research Question 1: Is there an association between PHED 215 and chronic disease risk level?

H10: There is no association between PHED 215 and chronic disease risk level.

H1a: There is an association between PHED 215 and chronic disease risk level.

Research Question 2: Is there an association between PHED 215 and cardiorespiratory fitness level?

H20: There is no statistically significant difference between the means of cardiorespiratory fitness level before and after participation in PHED 215.

H2a: There is a statistically significant difference between the means of cardiorespiratory fitness level before and after participation in PHED 215.

Research Question 3: Is there an association between PHED 215 and body fat percentage?

H30: There is no statistically significant difference between the means of body fat percentage before and after participation in PHED 215.

H3a: There is a statistically significant difference between the means of body fat percentage before and after participation in PHED 215.

Research Question 4: Is there an association between PHED 215 and self-motivation level?

H40: There is no statistically significant difference between the means of self-motivation level before and after participation in PHED 215.

H4a: There is a statistically significant difference between the means of self-motivation level before and after participation in PHED 215.

Research Question 5: Is there an association between PHED 215 and exercise self-efficacy level?

H50: There is no statistically significant difference between the means of exercise self-efficacy level before and after participation in PHED 215.

H5a: There is a statistically significant difference between the means of exercise self-efficacy level before and after participation in PHED 215.

Research Question 6: Is there an association between PHED 215 and progressive movement through the TTM stages of change?

H60: There is no statistically significant difference between the means of stages of change before and after participation in PHED 215.

H6a: There is a statistically significant difference between the means of stages of change before and after participation in PHED 215.

I used descriptive statistics to summarize the data. A paired *t* test compares two means, and is useful in making before-and-after comparisons (Koosis, 1997). Therefore, for research questions 2 to 6, a paired *t* test was used to compare pre- and post- PHED 215 means of body composition level, cardiorespiratory fitness level, self-motivation level, physical activity self-efficacy level, and stage of change. For p-value < 0.05, the test rejected the null hypothesis in favor of the alternative hypothesis. The normality assumption of the paired t-test was examined. If the normality assumption was violated, the Wilcoxon signed rank test was performed.

For research question 1, the purpose was to investigate if there was an association between participation in PHED 215 and disease risk. Recall that disease risk is a variable with five categories: no increased risk, increased risk, high risk, very high risk, and extremely high risk. Therefore, the generalized McNemar test, Bowker's test of symmetry was proposed to investigate if the 2 X 2 table ("disease risk before participation in PHED 215" X "disease risk after participation in PHED 215") is symmetric (Bowker, 1948). The null hypothesis was that the table is symmetric and the alternative was the table is not symmetric. For p-value < 0.05, the test rejected the null hypothesis in favor of the alternative hypothesis. This is, if we do not reject the null hypothesis, we conclude that the participants' disease risk is the same before and after participation in PHED 215. Table 5 below summarizes the data analysis plan.

Table 5

Data Analysis Plan

Research Questions	**Variable Description**	**Statistical Test**
RQ 1: Disease Risk	Categorical; Five Possible Risk Categories Including: No Increase, Increased, High, Very High, Extremely High	McNemar Test, Bowkers Test of Symmetry
RQ 2: Cardiorespiratory Fitness	Continuous; Recovery Index Score	Paired t-test (Wilcoxan Signed Rank Test If Data Were Not Normal)
RQ 3: Body Fat Percentage	Continuous; Body Fat Percentile	Paired t-test (Wilcoxan Signed Rank Test If Data Were Not Normal)
RQ 4: Self-Motivation	Continuous; Possible Score Between 35 and 175	Paired t-test (Wilcoxan Signed Rank Test If Data Were Not Normal)
RQ 5: Exercise Self-Efficacy	Continuous; A Scale From 0 To 100	Paired t-test (Wilcoxan Signed Rank Test If Data Were Not Normal)
RQ 6: Stage of Change	Continuous; Score Ranging From 0 To 4	Paired t-test (Wilcoxan Signed Rank Test If Data Were Not Normal)

Threats to Validity

Internal validity refers to degree in which the independent variable is able to explain the outcome of the experiment; high internal validity shows elimination of rival explanations (Singleton & Straits, 2005). As previously mentioned, randomization is impossible and thus decreases internal validity. A few additional possible threats to internal validity include the subject's history, maturation, testing effects, instrumentation, statistical regression, selection, attrition, and an interaction among any of the aforementioned threats (Singleton & Straits, 2005).

Due to the nature of a pretest – posttest design of PHED 215, testing effects may be another confounding factor against internal validity. Several methods exist to increase internal validity, such as random assignment, use of a control group, and constancy of conditions across the group (Singleton & Straits, 2005, p. 159). While use of archival data limits the possibility of random assignment or use of a control group, the constancy of conditions across PHED 215 students was high, and so will increase internal validity.

Instrumentation may result in a decrease in internal validity as well. Due to the nature of the course, students are required to test themselves (fitness and health tests) so they become self-sufficient and confident in health and fitness testing. However, the professors or trained exercise science lab supervisor led, taught, and observed them during their self-testing.

External validity "is basically a question of generalizability, or what the experimental results mean outside of the particular context of the experiment" (Singleton & Straits, 2005, p. 159). As far as external validity, results may only be applicable to similar settings (students from small, Midwestern college). This class may have more of an effect on those who are motivated to exercise and have prior knowledge- but tests on self-motivation, self-efficacy and their stage of change may shed some light in this regard. On the contrary, if someone already has a high level of self-motivation, self-efficacy, physical activity, and health and fitness levels, the class may not be able to show much effect. Again, archival data limited how external validity threats could be addressed.

The archival data that will be used for this study originated via a lifetime health and fitness class (PHED 215) at a small, Midwestern college. This class requires students to participate in a battery of health and fitness tests, both at the beginning and end of the semester. The secondary data were previously collected during the fall semester of 2012 from all students in all five sections of PHED 215 for the primary purpose of general education assessment for the college. For this study, this secondary data will now be utilized to assess the effectiveness of PHED 215. In conclusion, a quasiexperimental, comparative design will be used to analyze archival data, and thus allow a descriptive study which can explain the effect of PHED 215 on college students, and also yield a foundation for further research.

Ethical Procedures

Permission to gain access to archival data was granted by the Bethany Lutheran College Institutional Review Board on June 5, 2013. (Appendix A). IRB approval for conducting this study was granted by Walden University on October 3, 2014 (approval #10-03-14-0096073).

Archival data collection. Previously, in conjunction with a college-wide major and program assessment, instructors in the Health and Human Performance department were asked to gather and assess data from all sections of PHED 215 during the fall semester of 2012. Students from all five Fall 2012 PHED 215 sections received informed consent forms (Appendix B), giving permission for their class information and test results to be used for college assessment and any future study regarding betterment of PHED 215. Via the informed consent process, students of PHED 215 were told the purpose of the study, to assess the classes within the Exercise Science major and liberal arts program, and the expected role of the participants. Students were made aware their final grade would not be affected by their study participation or lack thereof, they would not be given compensation for their participation, and their anonymity would be protected.

In addition, at the beginning of the semester, a physical activity readiness questionnaire (PAR-Q) and health status questionnaire (HSQ) was filled out by each student to assure they were able to safely participate in a physical fitness class.

Data were stored in a locked cabinet, in a locked office in the Exercise Science department of the college. Each student was given a number, thus protecting their anonymity. Data were accessed by the researcher, and will be destroyed after three years following dissertation final approval. Raw data will be available upon request of the researcher.

Role of the researcher. The researcher is a member of the Health and Human Performance Department of the college in the investigation and one of the instructors of PHED 215. As part of a college-wide program assessment, PHED 215 was one of several classes to be evaluated for possible inclusion in the assessment of the Exercise Science major. Now, the researcher would like to further evaluate the class via analyzation of the archival data collected from PHED 215. This study will address strengths and weaknesses of PHED 215, thereby increasing the effectiveness of the class and furthering knowledge in regards to utilizing PHED 215 as a chronic disease risk factor intervention for college students.

Summary

This chapter included the study's (a) research design and rationale, (b) methodology, including archival data procedures, (c) instrumentation, (d) threats to validity, and (e) ethical procedures. The results of this study will follow in Chapter 4.

Chapter 4: Results

Introduction

Purpose of the Study

Chronic disease and its risk factors are threats to the health of young adults. Therefore, the purpose of this quantitative study was to explore the effect of a health and fitness class (PHED 215) on college students by evaluating secondary data. I examined the effect of PHED 215, the independent variable, on the following six dependent variables: (a) chronic disease risk, (b) cardiorespiratory fitness, (c) body fat percentage, (d) self-motivation, (e) exercise self-efficacy, and (f) physical activity stage of change.

Research Questions and Hypotheses

The research questions and the corresponding hypotheses of this study are listed below:

Research Question 1: Is there an association between PHED 215 and chronic disease risk level?

H10 There is no association between PHED 215 and chronic disease risk level.

H1a: There is an association between PHED 215 and chronic disease risk level.

Research Question 2: Is there an association between PHED 215 and cardiorespiratory fitness level?

H20: There is no statistically significant difference between the means of cardiorespiratory fitness level before and after participation in PHED 215..

H2a: There is a statistically significant difference between the means of cardiorespiratory fitness level before and after participation in PHED 215.

Research Question 3: Is there an association between PHED 215 and body fat percentage?

H30: There is no statistically significant difference between the means of body fat percentage before and after participation in PHED 215.

H3a: There is a statistically significant difference between the means of body fat percentage before and after participation in PHED 215.

Research Question 4: Is there an association between PHED 215 and self-motivation level?

H40: There is no statistically significant difference between the means of self-motivation level before and after participation in PHED 215..

H4a: There is a statistically significant difference between the means of self-motivation level before and after participation in PHED 215.

Research Question 5: Is there an association between PHED 215 and exercise self-efficacy level?

H50: There is no statistically significant difference between the means of exercise self-efficacy level before and after participation in PHED 215.

H5a: There is a statistically significant difference between the means of exercise self-efficacy level before and after participation in PHED 215.

Research Question 6: Is there an association between PHED 215 and progressive movement through the TTM stages of change?

H60: There is no statistically significant difference between the means of stages of change before and after participation in PHED 215.

H6a: There is a statistically significant difference between the means of stages of change before and after participation in PHED 215.

The following chapter includes (a) data collection, (b) baseline descriptive and demographic characteristics of the sample, (c) results, and (d) summary of the chapter.

Data Collection

Time Frame

In this study, I utilized archival data, which included health and fitness information from all students taking PHED 215 in the fall semester of 2012. Students were tested on various fitness components within the first 2 weeks of the 16-week semester (Week 1- Week 2), and retested the last 2 weeks of the 16-week semester (Week 15- Week 16). The first testing took place in early September 2012, while the posttest occurred in December 2012.

The secondary data I used was collected as part of normal educational practice for general education assessment of PHED 215. IRB approval was given by the college to utilize this secondary data on June 5, 2013 (Appendix A) and IRB approval for this study was given by Walden University on October 3, 2014 (approval #10-03-14-0096073).

Descriptive and Demographic Characteristics of the Sample

All subjects were college students enrolled in PHED 215 during the fall semester of 2012. I obtained secondary data which included records on 66 subjects. Two subjects with the age of 17 and of 43 were excluded from the data analysis. Thus, the total number of subjects of this study was 64. Among the 64 subjects, 26 (41%) were female and 38 (59%) were male.

Table 6 shows the age distribution of the study subjects. Seven subjects did not disclose the age information. Among the 57 subjects with age information available, the age ranged from 20 to 28. The average age was 22.04 with a standard deviation of 1.36. The average of the female subjects (n = 23) was 21.78 with a standard deviation of 1.09, and the average of the male subjects (n = 34) was 22.21 with a standard deviation of 1.51.

Table 6

Age of the Study Subjects

Age	Frequency (%)
20	4 (7)
21	19 (33)
22	15 (26)
23	13 (23)
24	5 (9)
28	1 (2)

Proportionality of Sample to Larger Population

Caution should be taken when generalizing the results of this study to a larger population. The following variables may threaten external validity and thus results from this study may not be generalizable to a larger group of subjects: (a) the small PHED 215 class size of approximately 15 students per section, so results may only be applicable in a similar setting in regards to class size; (b) the small, Midwestern college setting, so results may not apply to a different setting; a (c) pretest and posttest maturation affect; (d) and ideal initial level of disease risk, cardiorespiratory fitness, self-motivation, exercise self-efficacy, and stage of change, which would diminish post-test effect of PHED 215 on these aforementioned variables.

Results

Introduction and Methods

Descriptive statistics, such as mean and standard deviation (overall and by gender) for age and pretest and posttest measures of waist circumference, BMI, body fat %, heart rate recovery score, self-motivation, and self-efficacy, are presented. Note that for pair of pretest and posttest measures, only subjects with both (pretest and posttest) measures were included in the analysis.

Bowker's test of symmetry (Agresti, 2002) was used to answer Research Question 1. A *p* value less than 0.05 indicated significance at the 0.05 level. The paired *t* test was used to answer Research Questions 2-6. Assumptions underlying the paired *t* test are the data (differences between pretest and posttest scores) from a normal distribution and are independent. Normality was examined though.

Skewness. The sample skewness measures the tendency of the deviations to be larger in one direction than in the other. Skewness is a measure of symmetry. Observations that are normally distributed should have a skewness near zero (as normal distribution is symmetric). A negative skew indicates that the tail on the left side of the probability density function is longer than the right side and the bulk of the values lie to the right of the mean (skewed to the left). A positive skew indicates that the tail on the right side is longer than the left side and the bulk of the values lie to the left of the mean (skewed to the right).

Kurtosis. The sample kurtosis measures the peakedness of the distribution and the heaviness of its tail (relative to a normal distribution). Observations that are normally distributed should have a kurtosis near zero. A high kurtosis distribution has a sharper peak and fatter tails, while a low kurtosis distribution has a more rounded peak and thinner tails.

The Shapiro-Wilk test of normality. The Shapiro-Wilk test procedure is a goodness-of-fit test for the null hypothesis that the values of the analysis variable are a random sample from the normal distribution. A p value less than 0.05 of the Shapiro-Wilk test leads to the rejection of the null hypothesis of normality.

When the normality assumption may be violated, the Wilcoxon signed-rank test (the nonparametric alternative of the paired t test) is recommended (Hollander & Wolfe, 1999). The Wilcoxon signed-rank test assumes observations are independent of each other and are from the same population. All data analyses were conducted using Statistical Analysis Software (SAS; Statistical Analysis Software Institute Inc., 2012).

Analysis Results and Interpretations

A total of 56 subjects had both pretest and posttest measures of disease risk. Table 7 shows the frequency and percentage of pretest and posttest disease risk for the

56 subjects. As the number of subjects was small for some categories, categories of low risk and increased risk were combined, and categories of high risk, very high risk, and extremely high risk were combined.

Table 7

Pretest and Posttest Disease Risk, N = 56

Disease risk	Pretest	Posttest
No additional risk	35 (62)	35 (62)
Low risk	4 (7)	2 (4)
Increased risk	2 (4)	5 (9)
High risk	7 (12)	6 (11)
Very high risk	6 (11)	5 (9)
Extremely high risk	2 (4)	3 (5)

Table 8 shows the frequency and percentage of pretest and posttest disease risk for the 56 subjects, after regrouping. Both overall disease risk and disease risk by gender are presented. To illustrate, overall, during pretest, among the 56 subjects, 35 (62%) had no additional disease risk, 6 (11%) had low/increased disease risk, and 15 (27%) had high/very high/extremely high disease risk; during posttest, among the 56 subjects, 35 (62%) had no additional disease risk, 7 (12%) had low/increased disease risk, and 14 (25%) had high/very high/extremely high disease risk. The remaining of the table can be illustrated using the same manner.

Table 8

Pretest and Posttest Disease Risk After Regrouping (N = 56)

Disease risk	Overall		Male		Female	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
No additional risk	35 (62)	35 (62)	21 (62)	21 (62)	14 (64)	14 (64)
Low risk/increased risk	6 (11)	7 (13)	3 (9)	4 (12)	3 (13)	3 (13)
High risk/very high risk/extremely high risk	15 (27)	14 (25)	10 (29)	9 (26)	5 (23)	5 (23)

Table 9 shows the means and standard deviations for pretest and posttest measures of cardiorespiratory fitness level, height, weight, BMI, waist circumference, body fat %, self-motivation score, exercise self-efficacy score, and PA stage, overall and by gender. To illustrate, cardiorespiratory fitness level is used as an example. Among the 64 subjects, only 54 subjects (34 men and 20 women) have the cardiorespiratory fitness levels available. Overall, the average pretest cardiorespiratory fitness level was 160.74 with a standard deviation of 31.48, and the average posttest cardiorespiratory fitness level was 152.70 with a standard deviation of 30.92.

For the 34 men, the average pretest cardiorespiratory fitness level was 161.56 with a standard deviation of 27.63, and the average posttest cardiorespiratory fitness level was 153.09 with a standard deviation of 26.77. For the 20 women, the average pretest cardiorespiratory fitness level was 159.35 with a standard deviation of 37.88, and the average posttest cardiorespiratory fitness level was 152.05 with a standard deviation of 37.71. The remaining of the table can be illustrated using the same manner.

Table 9

Descriptive Statistics

Variable	Overall			Male			Female		
	n	Pretest	Posttest	*n*	Pretest	Posttest	*n*	Pretest	Posttest
Cardio-respiratory fitness level (recovery index score)	54	160.74 (31.48)	152.70 (30.92)	34	161.56 (27.63)	153.09 (26.77)	20	159.35 (37.88)	152.05 (37.71)
Height (meters)	58	1.75 (0.12)	1.74 (0.12)	35	1.80 (0.12)	1.79 (0.12)	23	1.68 (0.07)	1.67 (0.07)
Weight (kg)	57	80.99 (22.50)	80.78 (21.74)	36	85.82 (22.14)	85.34 (20.90)	21	72.72 (21.12)	72.97 (21.39)
BMI	58	25.87 (6.27)	25.70 (6.00)	36	25.81 (5.84)	25.66 (5.49)	22	25.96 (7.06)	25.77 (6.89)
Waist circumfer-ence (in)	56	32.92 (6.25)	32.43 (5.49)	34	33.49 (6.52)	33.10 (5.68)	22	32.03 (5.86)	31.39 (5.13)
Body fat %	43	23.42 (11.36)	23.53 (10.96)	26	19.39 (10.26)	19.14 (9.60)	17	29.58 (10.38)	30.24 (9.61)
Self-motivation score	41	129.51 (16.45)	131.71 (19.11)	26	130.96 (16.61)	133.42 (19.87)	15	127.00 (16.44)	128.73 (17.98)
Self-efficacy score	41	67.05 (14.22)	65.62 (16.73)	26	71.53 (11.51)	70.56 (14.86)	15	59.27 (15.47)	57.06 (16.79)
PA stage	39	2.56 (1.37)	3.15 (0.93)	25	2.56 (1.36)	3.20 (0.96)	14	2.57 (1.45)	3.07 (0.92)

Note. Numbers in parentheses are standard deviations.

Health and Fitness Category Results

Research Question 1 (disease risk). Chronic disease risk was calculated by analyzing both BMI and waist circumference. As previously reported on Table 3, a majority (62%) of PHED 215 students had no additional disease risk both before and after PHED 215 (n = 35/56), while 11% (n = 6/56) of pretest and 13% (n = 7/56) of posttest students were in the low/increased risk group, and 27% (n = 15) of pretest and 25% (n = 14) of posttest students were in the high risk/very high risk/extremely high risk category.

Research Question 2 (cardiorespiratory fitness). Cardiorespiratory fitness was measured by the heart rate recovery score following a step test. As reported in Table 4, the average pretest and posttest cardiorespiratory fitness level for men (n = 34) was 161.56 and 153.09, respectively. While both of these scores fall within the average fitness category, the decrease is statistically significant. Female subjects (n = 20) also showed a significantly significant decrease in heart rate recovery score, from 159.35 to 152.05, moving from the average to the good cardiorespiratory fitness category from pretest to posttest.

Research Question 3 (Body Fat Percentage). Body fat percentage, which was measured by bioelectrical impedance, remained stationary between pretest and posttest for both men and women. According to Table 4, overall body percentage was maintained at 23% between pretest and posttest (23.42% to 23.53%), with men remaining around 19 % (19.39% to 19.14%), and women remaining relatively stagnant as well (29.59% to 30.24%). There is not one agreed upon norm for body fat percentage

(Howley & Thompson, 2012). However, according to Table 2, based on norms from Powers and Dodd (2009), the average male body fat percentage of 19% is within the optimal range (10-20%), and women subjects body fat percentage results in an overweight (26-29%) or obese (30% or above) classification.

Research Question 4 (self-motivation level). Self-motivation level did not change significantly between pretest and posttest. According to Table 4, the average self-motivation score of 129.51 increased slightly from 129.51 to 131.71 overall, resulting in a high self-motivation score. Self-motivation scores have been separated into quartiles: *low* (35-70), *moderate* (71-105), *high* (106-139), and *very high* (140-175).

Research Question 5 (exercise self-efficacy). Exercise self-efficacy remained relatively unchanged from pretest to posttest. According to Table 4, the average overall exercise self-efficacy score at pretest and posttest was moderate at 67.05 and 65.62, respectively. While men had a higher pre- and post-test score when compared to women, both genders exercise self-efficacy scores slightly, though not significantly, decreased from pre- to post-test, with men scoring 71.53 to 70.56, and women scoring 59.27 to 57.06. Exercise self-efficacy was scored in thirds between 0 to 100; the higher the score, the higher the level of exercise self-efficacy. A score of 0-33 coincided with *low* or cannot do at all, a score of 34-65 showed a moderate exercise self-efficacy score under the heading “moderately certain can do,” while a score of 66 – 100 corresponded to a high score, under the “certain can do” heading.

Research Question 6 (stages of change). Subjects moved significantly through the stages of change. Recall that a score was assigned for each stage: 0 =

precontemplation, 1 = *contemplation*, 2 = *preparation*, 3 = *action*, and 4 = *maintenance*. According to Table 4, the mean score increased from 2.56 to 3.15, indicating a move from the preparation (2) to action stage (3). When separated into genders, both men (2.56 to 3.20) and women (2.57 to 3.07) showed a similar change.

Figure 1 shows the pretest results of the cardiorespiratory fitness recovery index scores, by gender. Female index scores were spread out pretty evenly, with the highest number of subjects having index scores between 120-149, then 180-209. Approximately 40% of the male index scores were between 120-179.

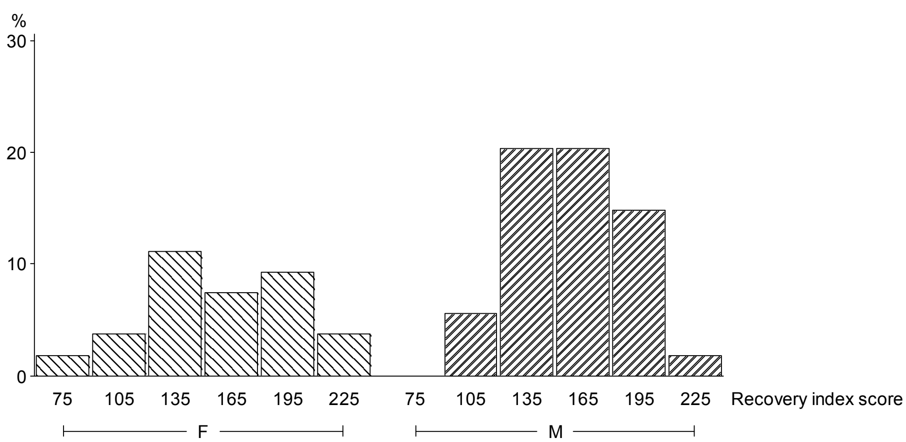

Figure 1. Bar charts of pretest recovery index scores by gender. (Note that the midpoints 75, 105, 135, 165, 195, and 225 represented recovery index scores within the range of 60-89, 90-119, 120-149, 150-179, 180-209, and 210-239, respectively.)

Figure 2 describes the posttest cardiorespiratory recovery index scores, by gender. Over 10% of females scored between 105-134, and 135-164. Over 25% of male scores were between 135-164.

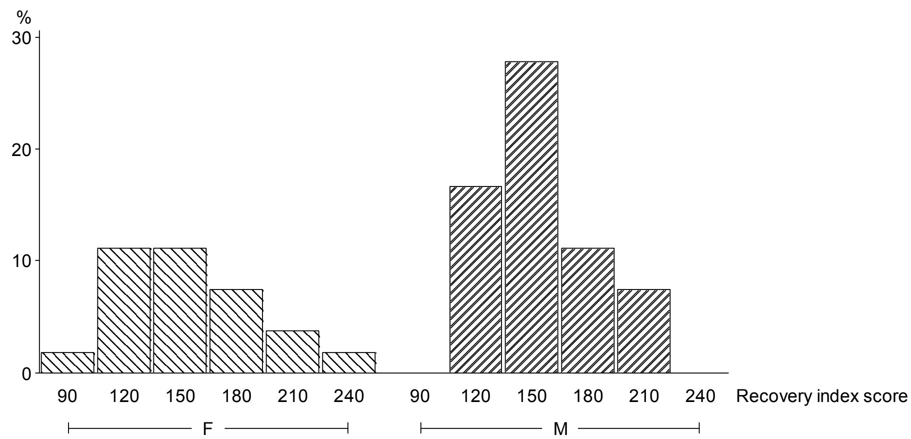

Figure 2. Bar charts of posttest recovery index scores, by gender. (Note that the midpoints 90, 120, 150, 180, 210, and 240 represented recovery index scores within the range of 75-104, 105-134, 135-164, 165-194, 195-224, and 225-254, respectively.)

Figure 3 displays the pretest height of the subjects, by gender. The highest proportion (approximately 25%) of females were between 1.62-1.73 meters tall, while almost 30% of males were 1.74-1.85 meters tall.

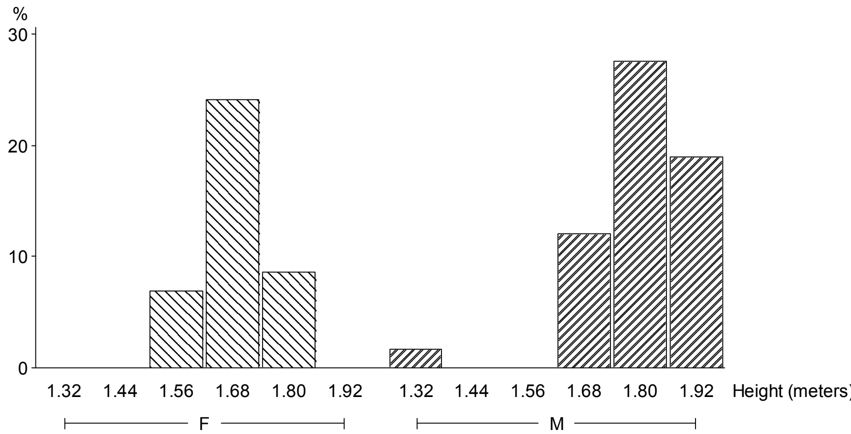

Figure 3. Bar charts of pretest height, by gender. (Note that the midpoints 1.32, 1.44, 1.56, 1.68, 1.80, and 1.92 represented height within the range of 1.26-1.37, 1.38-1.49, 1.50-1.61, 1.62-1.73, 1.74-1.85, and 1.86-1.97, respectively.)

Figure 4 shows the posttest height of the subjects, by gender.

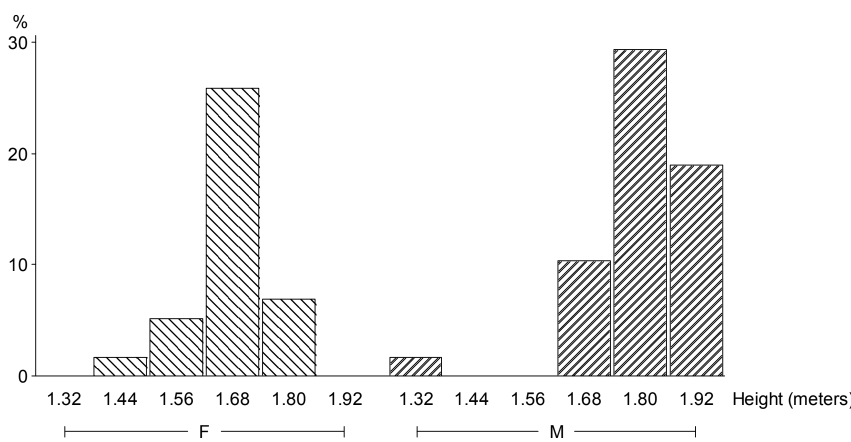

Figure 4. Bar charts of posttest height, by gender. (Note that the midpoints 1.32, 1.44, 1.56, 1.68, 1.80, and 1.92 represented height within the range of 1.26-1.37, 1.38-1.49, 1.50-1.61, 1.62-1.73, 1.74-1.85, and 1.86-1.97, respectively.)

Figure 5 displays the pretest weight of the subjects, by gender. Most of the female subjects weighed 60-79 kg (over 20%), while close to 30% of males weighed 60-79 kg.

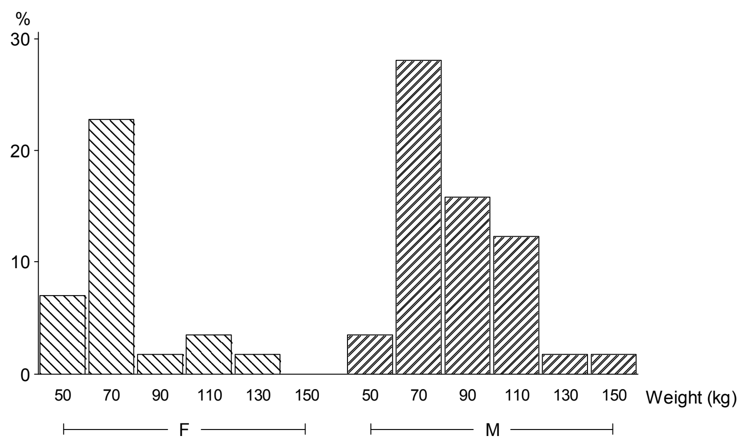

Figure 5. Bar charts of pretest weight (kg), by gender. (Note that the midpoints 50, 70, 90, 110, 130, and 150 represented weight within the range of 40-59, 60-79, 80-99, 100-119, 120-139, and 140-159, respectively.)

Figure 6 shows the posttest weight of the subjects, by gender. Similar to the pretest, over 20% of females weighed 60-79kg, while about 25% of males weighed 60-79 kg and about 20% weighed 80-99 kg.

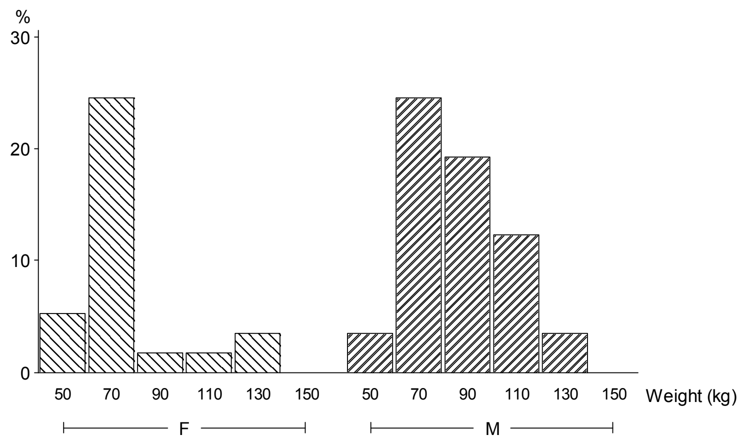

*Figure 6***.** Bar charts of posttest weight (kg), by gender. (Note that the midpoints 50, 70, 90, 110, 130, and 150 represented weight within the range of 40-59, 60-79, 80-99, 100-119, 120-139, and 140-159, respectively.)

Figure 7 shows the pretest BMI of the subjects, by gender. Most females (almost 30%) had a BMI of 20-29; a majority (about 35%) of men had a BMI of 20-29.

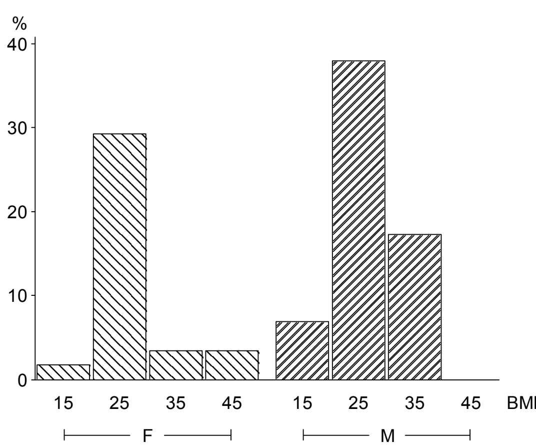

Figure 7. Bar charts of pretest BMI, by gender. (Note that the midpoints 15, 25, 35, and 45 represented BMI within the range of 10-19, 20-29, 30-39, and 40-49, respectively.)

Figure 8 displays the posttest BMI of the subjects, by gender. Most (30%) female posttest BMI scores were 20-29, along with most male BMI scores (about 40%).

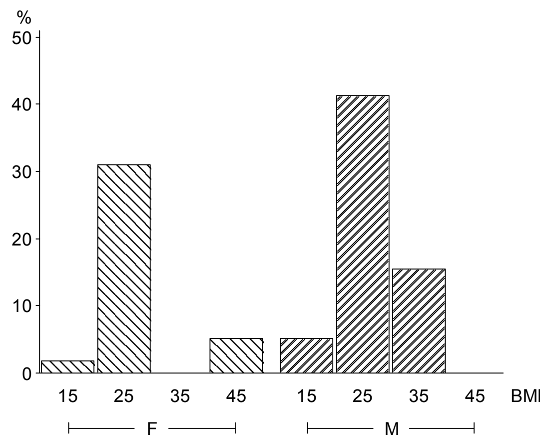

Figure 8. Barcharts of posttest BMI, by gender. (Note that the midpoints 15, 25, 35, and 45 represented BMI within the range of 10-19, 20-29, 30-39, and 40-49, respectively).

Figure 9 describes the pretest waist circumference of the subjects, by gender. The highest proportion of females had a waist circumference between 24-29 inches, followed by 30-35 inches, while the highest proportion of males had a waist circumference of 30-35 inches, followed by a waist circumference of 36-41 inches.

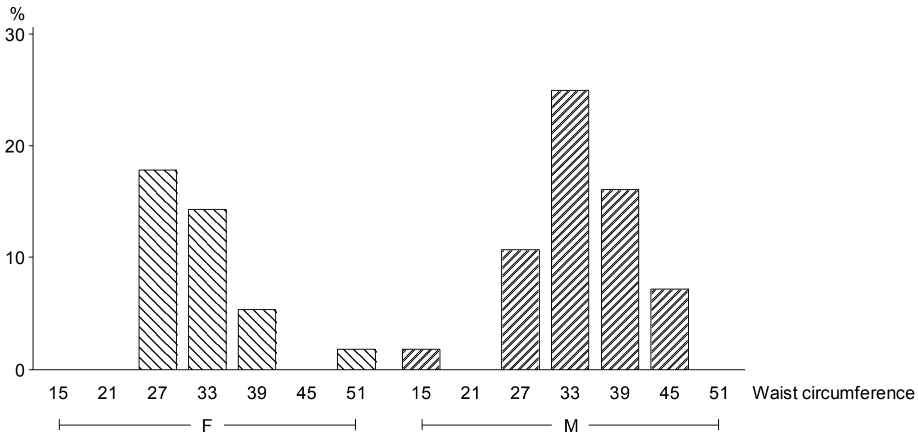

Figure 9. Bar charts of pretest waist circumference (inches), by gender. (Note that the midpoints 15, 21, 27, 33, 39, 45 and 51 represented waist circumference within the range of 12-17, 18-23, 24-29, 30-35, 36-41, 42-47 and 48-53, respectively.)

Figure 10 displays the posttest waist circumference (inches), by gender. Almost 20% of females had a waist circumference of 30-35 inches, and almost 30% of men had a waist circumference of 30-35 inches.

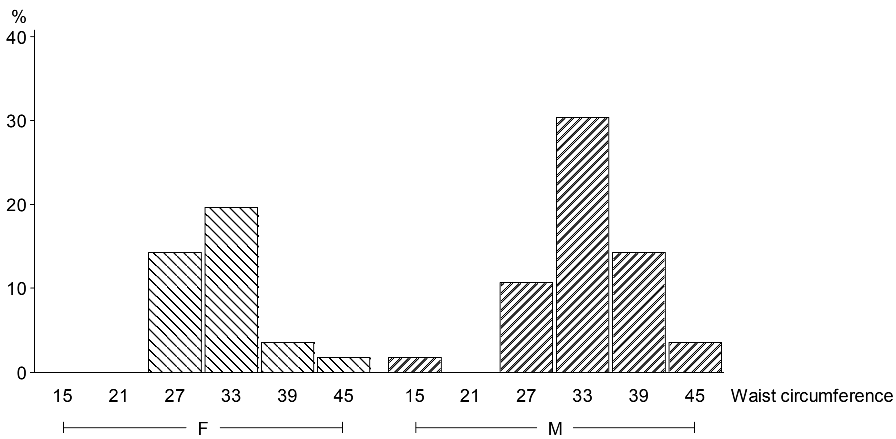

Figure 10. Bar charts of posttest waist circumference (inches), by gender. (Note that the midpoints 15, 21, 27, 33, 39, and 45 represented waist circumference within the range of 12-17, 18-23, 24-29, 30-35, 36-41, and 42-47, respectively.)

Figure 11 shows the pretest body fat %, by gender. Approximately 18% of women had a body fat % of 20-27%, while approximately 18% of males had a body fat percentage within the range of 4-11%, and about 16% of males had a body fat percentage of 12-19%.

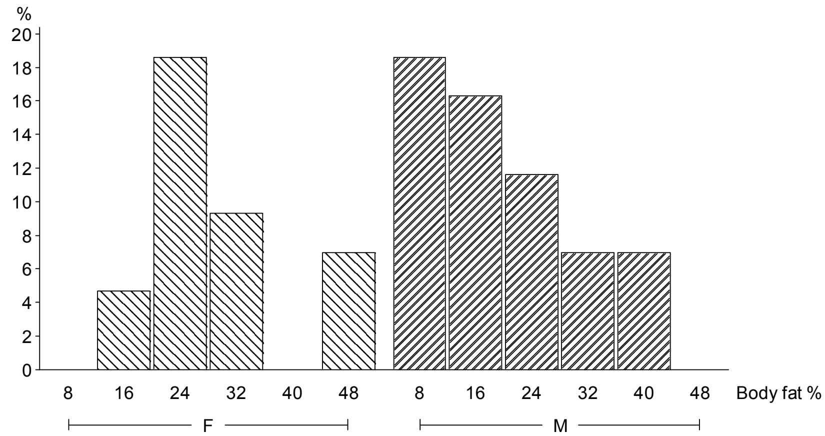

Figure 11. Bar charts of pretest body fat %, by gender. (Note that the midpoints 8, 16, 24, 32, 40, and 48 represented body fat % within the range of 4-11, 12-19, 20-27, 28-35, 36-43, and 44-51, respectively.)

Figure 12 shows posttest body fat percentage, by gender. Approximately 16% of females had a body fat percentage of 28-35, with male posttest body fat percentage more evenly spread, with most (18%) between 4-11%.

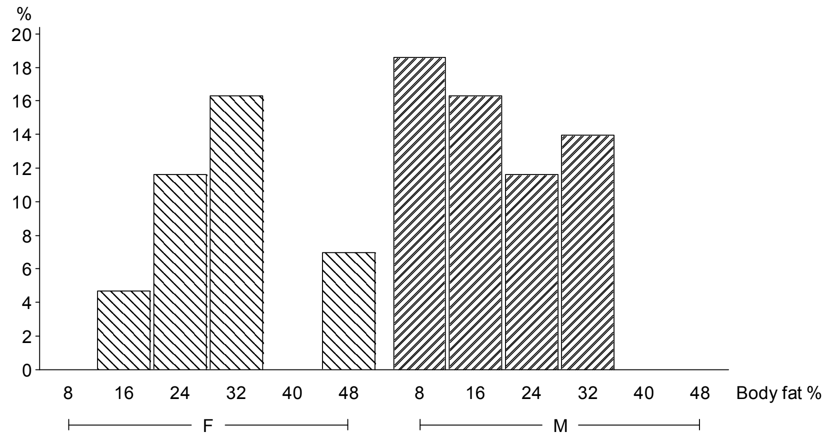

Figure 12. Bar charts of posttest body fat %, by gender. (Note that the midpoints 8, 16, 24, 32, 40, and 48 represented body fat % within the range of 4-11, 12-19, 20-27, 28-35, 36-43, and 44-51, respectively.)

Figure 13 displays self-motivation score, by gender. Most males and females had a score of 120-139 (20% and over 30%, respectively).

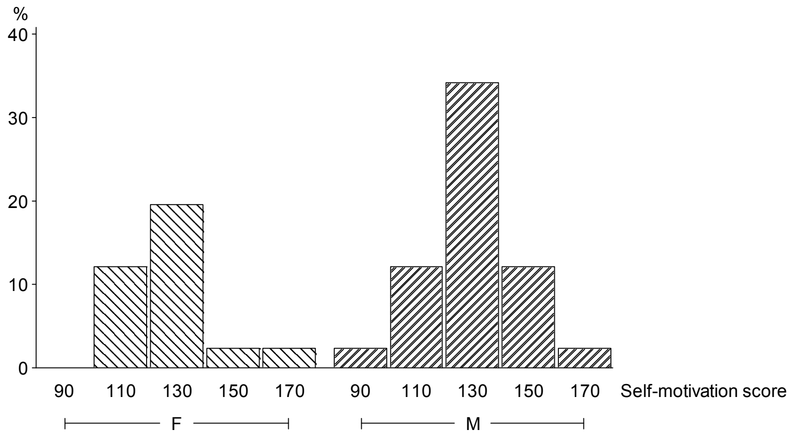

Figure 13. Bar charts of pretest self-motivation score, by gender. (Note that the midpoints 90, 110, 130, 150, and 170 represented self-motivation scores within the range of 80-99, 100-119, 120-139, 140-159, and 160-179, respectively.)

Figure 14 displays posttest self-motivation scores, by gender. Most females (approximately 18%) had a score of 100-119, while most (approximately 28%) of male self-motivation scores remained similar to the pre-test self-motivation scores.

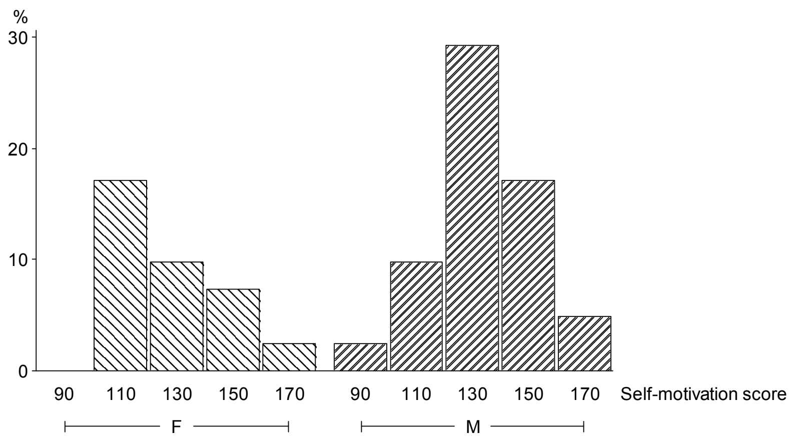

Figure 14. Bar charts of posttest self-motivation Score, By Gender. (Note that the midpoints 90, 110, 130, 150, and 170 represented self-motivation scores within the range of 80-99, 100-119, 120-139, 140-159, and 160-179, respectively.)

Figure 15 shows pretest exercise self-efficacy scores, by gender. Most (over 10%) of females scored between 48-59, while most (over 20%) of males scored between 60-71.

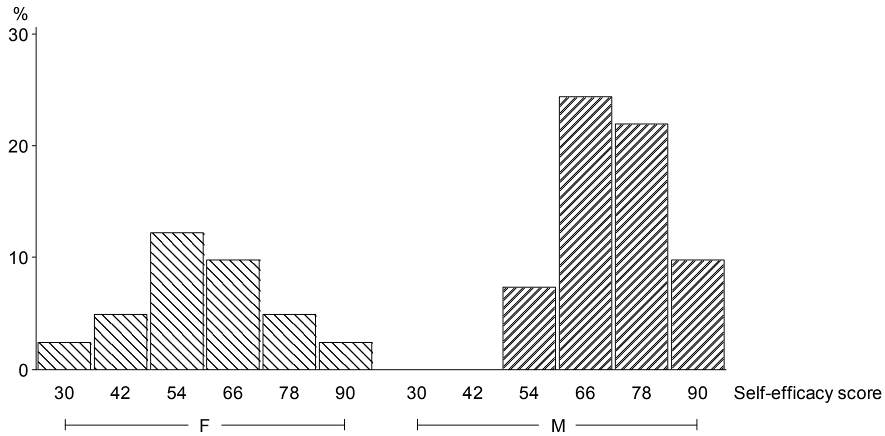

Figure 15. Bar charts of pretest exercise self-efficacy score, by gender. (Note that the midpoints 30, 42, 54, 66, 78 and 90 represented self-efficacy scores within the range of 24-35, 36-47, 48-59, 60-71, 72-83, and 84-95 respectively.)

Figure 16 displays posttest exercise self-efficacy scores, by gender. Almost 20% of females scores between 42-53, and most (almost 20%) males scored between 42-53 as well.

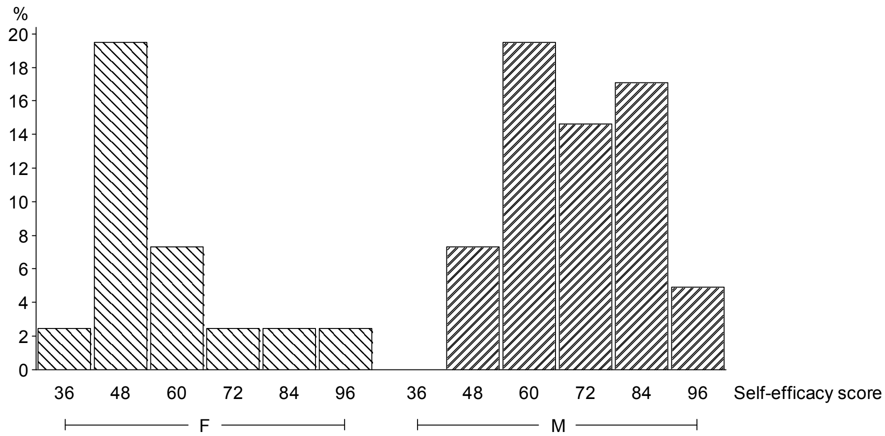

Figure 16. Bar charts of posttest exercise self-efficacy score, by gender. (Note that the midpoints 36, 48, 60, 72, 84, and 96 represented self-efficacy scores within the range of 30-41, 42-53, 54-65, 66-77, 78-89, and 90-101 respectively.)

Figure 17 shows pretest PA stage of change, by gender. Approximately 15% of females were in stage 4 (maintenance), while approximately 8% of females were in stage 1 (contemplation) and stage 2 (preparation), respectively. Most (almost 30%) males were in stage 4 (maintenance), with over 20% in stage 1 (contemplation) and approximately 15% in stage 2 (preparation).

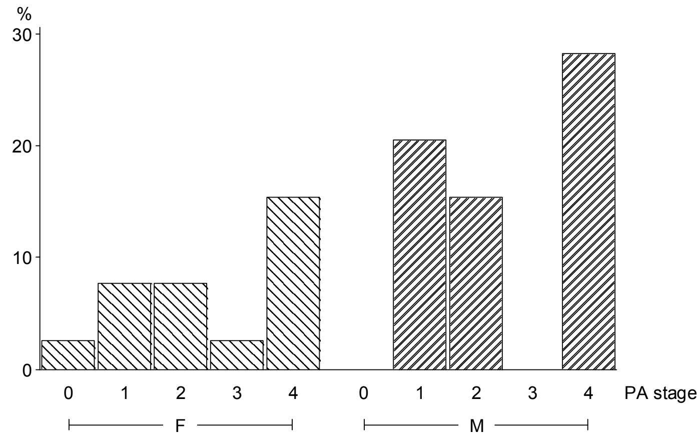

Figure 17. Bar charts of pretest PA stage, by gender. (Note that the midpoints 0, 1, 2, 3 and 4 represented PA stage of 0, 1, 2, 3 and 4 respectively.)

Figure 18 displays posttest PA stage, by gender. Approximately 15% of females were in stage 4 (maintenance), while over 30% of males were in stage 4 (maintenance).

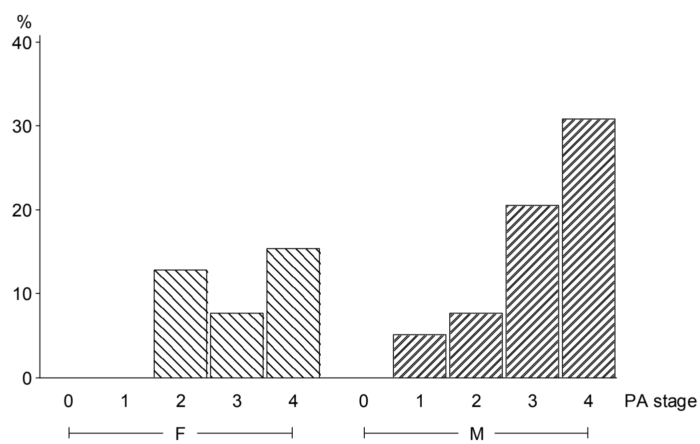

Figure 18. Bar charts of posttest PA stage, by gender. (Note that the midpoints 0, 1, 2, 3 and 4 represented PA stage of 0, 1, 2, 3 and 4 respectively.)

Analysis of Research Questions

Research Question 1. Research Question 1 stated: Is there an association between PHED 215 and chronic disease risk level? Analysis showed that there is no association.

Table 10 is the two-way table of pretest disease risk and posttest disease risk. Among the 56 subjects with both the data for pretest disease risk and posttest disease risk available, 35 (62.50%) had no additional disease risk, 6 (10.71%) had low/increased disease risk, and 15 (26.79%) had high/very high/extremely high disease risk, for pretest. Similarly, among the 56 subjects with both the data for pretest disease risk and posttest disease risk available, 35 (62.50%) had no additional disease risk, 7 (12.50%) had low/increased disease risk, and 14 (25.00%) had high/very high/extremely high disease risk, for posttest.

Bowker's test (Agresti, 2002) for table symmetry was performed to determine if there was an association between PHED 215 and chronic disease risk level, i.e., if there was a difference between pretest disease risk and posttest disease risk. Table 10 summarizes the disease risk results, which indicated that there was no statistically significant difference between pretest disease risk and posttest disease risk (p = 0.9536). In particular, of the 56 subjects, 55 (98.21%) had the same disease risk in the pretest and posttest (62.50% with no additional risk, 8.93% with low/increased risk, and 23.21% with high/very high/extremely high risk). Thus, it is concluded that there was no association between PHED 215 and chronic disease risk level.

Table 10

Two-Way Table of Pretest and Posttest Disease Risk (RQ1)

		Posttest disease risk			
		No additional risk	Low risk/increased risk	High risk/very high risk/extremely high risk	Total
Pretest disease risk	No additional risk	35 (62.50)	0	0	35 (62.50)
	Low risk/increased risk	0	5 (8.93)	1 (1.79)	6 (10.71)
	High risk/ very high risk/ extremely high risk	0	2 (3.57)	13 (23.21)	15 (26.79)
	Total	35 (62.50)	7 (12.50)	14 (25.00)	56

Note. Numbers in parentheses are percentages.

Research Question 2. Research Question 2 stated: Is there an association between PHED 215 and cardiorespiratory fitness level? Analysis showed that there is an association.

Of the 64 subjects, 54 had data of cardiorespiratory fitness level for both pretest and posttest. The mean cardiorespiratory fitness level was 160.74 (*SD* = 31.48) and 152.70 (*SD* = 30.92) for pretest and posttest, respectively. The results of the paired t-test suggested that there was a statistically significant difference in cardiorespiratory fitness level between pretest and posttest ($t(53) = -3.04$, $p = 0.0037$). The normality assumption of the paired t-test was checked via skewness, kurtosis and Shapiro-Wilk test. The results of the Shapiro-Wilk test suggested the data (differences between posttest and pretest) may not be from a normal distribution (*p* = 0.0003). The normality assumption of the paired t-test may not hold true. Thus, the Wilcoxon signed-rank test was recommended. The results of the Wilcoxon signed-rank test also suggested that there was a statistically significant difference in cardiorespiratory fitness level between pretest and posttest (p = 0.0001). It is concluded that there was an association between PHED 215 and cardiorespiratory fitness level. In particular, the cardiorespiratory fitness level in pretest (*M* = 160.74, *SD* = 31.48) was higher than the cardiorespiratory fitness level in posttest (*M* = 152.70, *SD* = 30.92).

Research Question 3. Research Question 3 stated: Is there an association between PHED 215 and body fat percentage? Analysis showed there is not an association.

Of the 64 subjects, 43 had data of body fat % for both pretest and posttest. The mean body fat % was 23.42 (*SD* = 11.36) and 23.53 (*SD* = 10.96) for pretest and posttest, respectively. The results of the paired t-test suggested that there was no difference in body fat % between pretest and posttest (*t*(42) = -0.26, *p* = 0.7945). The normality assumption of the paired t-test was checked via skewness, kurtosis and Shapiro-Wilk test. The results of the Shapiro-Wilk test suggested the data (differences between posttest and pretest) were from a normal distribution (*p* = 0.8317). The normality assumption of the paired t-test held true. It is concluded that there was no association between PHED 215 and body fat percentage.

Research Question 4. Research Question 4 stated: Is there an association between PHED 215 and self-motivation level? Analysis showed that there is not an association.

Of the 64 subjects, 41 had data of self-motivation level for both pretest and posttest. The mean self-motivation level was 129.51 (*SD* = 16.45) and 131.71 (*SD* = 19.11) for pretest and posttest, respectively. The results of the paired t-test suggested that there was no statistically significant difference in self-motivation level between pretest and posttest ($t(40) = 1.41$, $p = 0.1675$). The normality assumption of the paired t-test was checked via skewness, kurtosis and Shapiro-Wilk test. The results of the Shapiro-Wilk test suggested the data (differences between posttest and pretest) may not be from a normal distribution ($p = 0.0042$). The normality assumption of the paired *t*-test may not hold true. Thus, the Wilcoxon signed-rank test was recommended. The results of the Wilcoxon signed-rank test also suggested that there was not a statistically significant difference in self-motivation level between pretest and posttest ($p = 0.1758$). It is therefore concluded that there was no association between PHED 215 and self-motivation level.

Research Question 5. Research Question 5 stated: Is there an association between PHED 215 and self-efficacy level? Analysis showed there is not an association.

Of the 64 subjects, 41 had data of self-efficacy level for both pretest and posttest. The mean self-efficacy level was 67.05 (*SD* = 14.22) and 65.62 (*SD* = 16.73) for pretest and posttest, respectively. The results of the paired t-test suggested that there was no difference in self-efficacy level between pretest and posttest ($t(40) = -0.75$, $p = 0.4560$). The normality assumption of the paired t-test was checked via skewness, kurtosis and Shapiro-Wilk test. The results of the Shapiro-Wilk test suggested the data (differences between posttest and pretest) were from a normal distribution ($p = 0.1543$). The normality assumption of the paired t-test held true. It is concluded that there was no association between PHED 215 and self-efficacy level.

Research Question 6. Research Question 6 stated: Is there an association between PHED 215 and progressive movement through the TTM stages of change? Analysis showed that there is an association.

Of the 64 subjects, 39 had data of PA stage for both pretest and posttest. The mean PA stage was 2.56 (*SD* = 1.37) and 3.15 (*SD* = 0.93) for pretest and posttest, respectively. The results of the paired t-test suggested that there was a statistically significant difference in PA stage between pretest and posttest ($t(38) = 2.85$, $p = 0.0070$). The normality assumption of the paired *t*-test was checked via skewness, kurtosis and Shapiro-Wilk test. The results of the Shapiro-Wilk test suggested the data (differences between posttest and pretest) may not be from a normal distribution ($p = 0.0059$). The normality assumption of the paired *t*-test may not hold true. Thus, the Wilcoxon signed-rank test was recommended. The results of the Wilcoxon signed-rank test also suggested that there was a statistically significant difference in PA stage between pretest and posttest ($p = 0.0061$). It is concluded that there was an association between PHED 215 and PA stage. In particular, the PA stage in pretest (*M* = 2.56, *SD* = 1.37) was lower than the PA stage in posttest (*M* = 3.15, *SD* = 0.93). Recall that the scores of PA stage are as follows: scored 0 (*precontemplation*), 1 (*contemplation*), 2 (*preparation*), 3 (*action*), and 4 (*maintenance*). Thus, the analysis results suggested that participants were more active after the PHED 215 class.

Table 11 details the analysis results of Research Question 2 - Research Question 6. Table 11 includes means, paired *t* statistic, *p* values, as well as information on skewness and kurtosis.

Table 11

Analysis Results (RQ2-RQ6)

Variables	N	Pretest Mean (*SD*)	Posttest Mean (*SD*)	Mean Difference (post-pre)	*t*	*P*	Skewness	Kurtosis	*SW*	*P* (Wilcoxan)
Body fat percentage	43	23.42 (11.36)	23.53 (10.96)	0.11	0.26	0.7945	0.20	0.11	0.8317	0.9212
Cardiorespiratory fitness level	54	160.74 (31.48)	152.70 (30.92)	-8.04	-3.04	0.0037*	1.48	5.17	0.0003	0.0001*
Self-motivation score	41	129.51 (16.45)	131.71 (19.11)	2.20	1.41	0.1675	0.67	2.65	0.0042	0.1758
Self-efficacy score	41	67.05 (14.22)	65.62 (16.73)	-1.42	-0.75	0.4560	0.51	1.77	0.1543	0.2510
PA stage	39	2.56 (1.37)	3.15 (0.93)	0.59	2.85	0.0070*	-0.32	0.46	0.0059	0.0061*

Note. N = sample size. *SD* =standard deviation. *t* = paired t-statistic. *p* = p-value for paired t-test. *SW* = p-value of the Shapiro –Wilk test. *p*(Wilcoxon) = *p*-value of the Wilcoxon signed-rank test. * indicated significance at the 0.05 level.

Summary

The answers to following six research questions are summarized below:

Research Question 1: Is there an association between PHED 215 and chronic disease risk level? No association was found between PHED 215 and chronic disease risk level.

Research Question 2: Is there an association between PHED 215 and cardiorespiratory fitness level? Yes, the results of the Wilcoxon signed-rank test suggested that there was a statistically significant difference in cardiorespiratory fitness level between pretest and posttest ($p = 0.0001$). It is concluded that there was an association between PHED 215 and cardiorespiratory fitness level.

Research Question 3: Is there an association between PHED 215 and body fat percentage? No association was found between PHED 215 and body fat percentage.

Research Question 4: Is there an association between PHED 215 and self-motivation level? No association was found between PHED 215 and self-motivation level.

Research Question 5: Is there an association between PHED 215 and exercise self-efficacy level? No association was found between PHED 215 and exercise self-efficacy level.

Research Question 6: Is there an association between PHED 215 and progressive movement through the TTM stages of change? Yes, the results of the Wilcoxon signed-rank test suggested that there was a statistically significant difference in PA stage between pretest and posttest (p = 0.0061). It is concluded that there was an association between PHED 215 and PA stage.

This chapter detailed the results of the study and identified key findings. The following chapter will present discussion, conclusions, and recommendations of the study.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

Purpose and Nature of the Study

The purpose of this study was to evaluate the effect of collegiate lifetime health and fitness class (PHED 215) on the following: (a) chronic disease risk, (b) cardiorespiratory fitness, (c) body fat percentage, (d) self-motivation, (e) exercise self-efficacy, and (f) physical activity stage of change. Cardiovascular disease (CVD) risk factors such as physical inactivity and obesity affect college age students and could lead to a CVD revival in this age group (Gorina, Hoyert, Lentzner, & Goulding, 2006). Collins (2004) advises that healthy lifestyle choices made at a younger age could decrease CVD later in life; other researchers concur that an intervention utilizing a college setting could decrease obesity and increase physical activity (Desai, Miller, Staples, & Bravender, 2008). PHED 215 is an innovative and unique approach in terms of a college-level physical education class and could prove to be a viable CVD risk factor intervention site and model for future interventions.

Summary of Key Findings

Data analysis showed that PHED 215 had an effect on two of the six dependent variables, including cardiorespiratory fitness and physical activity stage of change. Cardiorespiratory fitness was measured via a heart rate recovery score following a step test, while physical activity stage of change was identified by a 4-item questionnaire. PHED 215 did not have a significant effect on four of the six dependent variables, including disease risk, body fat percentage, self-motivation level, or exercise self-efficacy.

Interpretation of the Findings

In conclusion, based on findings of this study, a health intervention in the form of a collegiate lifetime health and fitness class can make a positive impact on cardiorespiratory fitness and stage of change in college students. Increasing physical activity and cardiorespiratory fitness can have a tremendous impact on health, both short and long term (CDC, 2011). Furthermore, according to Mata et al., (2011), successful weight loss maintenance relies predominately on eating and exercise; therefore, if an intervention such as PHED 215 can successfully alter physical activity level, it could aid in weight loss maintenance as well.

I found no significant differences in disease risk, body fat percentage, self-motivation level, or exercise self-efficacy. Insight regarding the lack of significant findings of the aforementioned variables include the following. First, the approximate 14-week timeframe between pretest and posttest may not have been long enough for significant changes to occur. For example, both disease risk, which was calculated using BMI and waist circumference, and body fat percentage might require a longer period of time to change. Secondly, while body fat percentage did not decrease significantly, it did not significantly increase either; thus maintenance of body fat percentage can be seen as a small success, especially in light of the current high percentage of overweight and obese Americans (HHS 2010). Third, in regards to exercise self-efficacy, it is possible it did not increase due to the difficulty of the weekly exercise requirement of 150 minutes of moderate to vigorous cardiorespiratory exercise per week.

If a student attempted to meet the requirement and struggled or failed, then that lack of success could negatively effect self-efficacy since, according to Bandura (1997), self-efficacy is largely swayed by mastery experiences. Furthermore, Bandura (1997) states that if a person lacks self-efficacy for a behavior, they will perform that behavior ineffectually, even if they have adequate knowledge and training to perform the activity. So if a person came in to PHED 215 with a low level of self-efficacy, they could have then exercised ineffectually and caused their cardiorespiratory level and self-efficacy level to remain low or unchanged throughout PHED 215.

Limitations of the Study

This study had several limitations due to possible threats of internal validity, external validity, and response bias. Limitations are discussed in the following sections.

Generalizability

Generalizability is limited to defined parameters and delimitations in this study. For instance, since subjects are from a small college in the Midwest, the data can only be generalized within that population and setting. Also, students in PHED 215 had a variety of graded class requirements which included fitness tests, a weight lifting program, and a cardiorespiratory fitness program. Thus, results may only be generalizable to classes or interventions which mirror these graded requirements.

Possible Threats to Internal and External Validity

Internal validity refers to degree in which the independent variable is able to explain the outcome of the experiment; high internal validity shows elimination of rival explanations (Singleton & Straits, 2005). A few possible threats to internal validity include the subject's history, maturation, testing effects, instrumentation, statistical regression, selection, attrition, and an interaction among any of the aforementioned threats (Singleton & Straits, 2005). PHED 215 students may be affected by history—if they have taken a different health or physical education class in the past, their knowledge and fitness level may already be at a high level and so will not change a lot. PHED 215 is measuring maturity in a way, as physical and mental progress will hopefully occur during the class.

Another possible effect on maturity in regards to physical health and fitness would be if students were members of a fall sport, a winter sport, or a spring sport- their physical fitness level would increase and decrease according to their "in season" or "out of season" status. In addition, if students were taking classes that cover similar material simultaneously (Health or Exercise Science classes), that may influence results. In addition, stress levels and extra time spent studying may have an effect on posttest levels since the posttesting was completed toward the end of semester (and close to/during finals week).

Instrumentation may result in a decrease in internal validity as well. Due to the nature of the course, students were required to test themselves for some of the fitness and health tests, so they become self-sufficient and confident in health and fitness testing. However, instructors, sometimes along with trained assistants, led, taught, and observed students during their self-testing, and these actions will help decrease confounding in these areas.

Because randomization is not possible because archival data will be used, the pre-existing data will be analyzed via a preexperimental, one-group, pretest – posttest design. Due to the nature of a pretest – posttest design, testing effects may be another confounding factor against internal validity. Constancy of conditions across the group was stringent, and this will increase internal validity (Singleton & Straits, 2005, p. 159).

External validity "is basically a question of generalizability, or what the experimental results mean outside of the particular context of the experiment" (Singleton & Straits, 2005, p. 159). As far as external validity, results may only be applicable to similar settings (students from small, Midwestern college). This class may have more of an effect on those who are motivated to exercise and have prior knowledge- but tests on self-motivation, self-efficacy and their stage of change may shed some light in this regard. On the contrary, if someone already has a high level of self-motivation, self-efficacy, physical activity, and health and fitness levels, the class may not be able to show much effect. But because this is a lifetime fitness class, a healthy foundation may be laid, with lasting effects beyond the classroom.

Response Bias in the Archival Data

Students in PHED 215 may have attempted to shape their questionnaire responses in order to please their professor, or to obtain a higher score. However, response bias should not be an issue since students were not graded on bettering their pre- and post-scores or their proficiency of the health and fitness tests, but rather on their overall fitness knowledge and completion of the assigned tasks.

Reliability

Threats to reliability include researcher error, environmental changes, and participant changes. In regards to researcher error, a mistake in measurements could decrease reliability. While a few measurements (i.e., waist circumference and BMI) were made by students as part of the requirements of PHED 215, an instructor showed them how first and was always present to supervise and answer questions. Every effort was made to accurately assess all variables. Environmental changes were kept at a minimum by measuring pretest and posttest under identical conditions, including time of day, temperature (all tests were indoor), and setting of tests. However, pretest was done at the beginning of the semester and posttest was at the end of the semester, which occurred near finals and thus possibly a more stressful time for students, which may affect test results. While every effort was made to decrease participant differences, such as utilizing a matched pairs pretest/posttest format, some changes may have occurred during the semester that were uncontrollable (i.e., stress level, tiredness).

Recommendations

As previously stated, PHED 215 had a statistically significant impact on two dependent variables: cardiorespiratory fitness, and positive movement through the stages of change. While those results are encouraging, the following recommendations are made for further study. First, a longitudinal study following PHED 215 students could study the long term effect of PHED 215- to measure if PHED 215 can develop *lifetime* *skills* as the title of the class suggests. Second, a qualitative study on class reflection papers could gain insights of exercise adherence and change in attitude toward health and wellness, and gauge mindset and tendencies that might otherwise go undetected with quantitative analysis. Third, a replication of this study in other college settings, such as ones of different location and size, could evaluate if results are applicable in other locales. Fourth, other theories could be incorporated to analyze and strengthen PHED 215 or similar interventions.

For example, a construct of the self-determination theory such as intrinsic motivation could be measured to assess the effect of PHED 215 on long-term exercise. Intrinsic motivation has been associated with long-term exercise adherence if the activity is also inherently fulfilling (Gardner & Lally, 2013). In a randomized, controlled, yearlong weight control investigation, researchers found that increased self-determination and intrinsic exercise motivation predicted long term eating regulation ability (Mata et al., 2011). Given the goal of PHED 215 is to engrain lifelong positive health habits in regards to exercise and weight, using the self-determination theory could be very beneficial in this regard. Therefore analyzing intrinsic motivation could allow researchers to determine if PHED 215 can help students maintain the recommended physical activity level and resulting cardiorespiratory fitness classification after the carrot of earning a good grade in the class is removed.

Implications

Positive Social Change

A dramatic decrease in physical activity occurs between high school and young adulthood (HHS, 2000; Seo et al., 2007); therefore, the college setting is ideal for a physical activity intervention (HHS, 2000; Sparling & Snow, 2002). Physical activity interventions which occur at a postsecondary institution have the potential to successfully affect a large population of young adults (Seo et al., 2007; Wallace, Buckworth, Kirby, & Sherman, 2000). Cardiovascular disease had direct and indirect costs exceeding $300 billion in 2008 (Kaminsky, 2013), so preventive interventions targeting obesity and physical inactivity could decrease monetary impact by a great deal. PHED 215, by increasing cardiorespiratory fitness and physical activity in individual students, could have an even farther-reaching impact. In a policy statement, the American Heart Association recently announced that, “clearly, physical fitness and cardiorespiratory fitness in particular are an underpinning for academic achievement, job productivity, and overall maintenance of cardiovascular and general health, among other things” (Kaminsky, et al., 2013, p. 652). An intervention like PHED 215 could be utilized by other colleges, and in different settings such as businesses and community centers, thereby pushing the ripple of social change far and wide.

Theoretical Interpretations and Implications

In this study, I utilized the transtheoretical or stages of change Mmodel as the foundation to evaluate the effect of PHED 215 on college students. Statistical analysis indicated that PHED 215 did have an effect on the positive movement in the stages of change. While exercise self-efficacy did not increase significantly in this study, research has shown that self-efficacy can be a significant predictor of the stage of exercise behavior change (Wallace, Buckworth, Kirby, & Sherman, 2000). Knowledge of one's current stage of change can serve as a tool to help understand exercise behavior and pinpoint appropriately matched activities in order to increase or maintain the recommended amount of physical activity (Wallace & Buckworth, 2001). For instance, intrinsic motivation is highly endorsed in the maintenance stage of change and lowest in the contemplation stage (Buckworth, Lee, Regan, Schneider, & DiClemente, 2007). In addition, researchers found that exercise adoption and maintenance is related to intrinsic motivation (Buckworth et al., 2007). The transtheoretical model can serve as an effective framework to help understand exercise behavior among adolescents (Nigg, 2001) and other various populations (Wallace & Buckworth, 2001). Furthermore, as shown by this study, a theory-based intervention can be very beneficial in regards to guidance, measurement, and understanding of health behavior of college students.

Conclusion

This investigation evaluated the effect of PHED 215, a lifetime health and physical education class, on health related indices including chronic disease risk, cardiorespiratory fitness, body fat percentage, self-motivation, exercise self-efficacy, and positive movement through the stages of change. Both cardiorespiratory fitness and positive movement through the stages of change were found to have been significantly affected by PHED 215. In a recent American Heart Association (AHA) Policy Statement, cardiorespiratory fitness was lauded due to the tremendous potential it has to help decrease chronic disease, promote overall cardiovascular and general health, improve quality of life, and delay cardiovascular disease and mortality (Kaminsky, et al., 2013). Cardiovascular disease forces an extremely large monetary burden on the United States of approximately $300 billion in 2008, with projected increases up to $500 billion and $1200 billion in 2015 and 2030, respectively (Kaminsky, et al., 2013). A college setting, combined with an innovative intervention such as PHED 215, could prove to be an invaluable tool in the fight against the alarming rise of cardiovascular disease risk factors such as physical inactivity and obesity at the individual and society level. The call has been made for a heightened effort and alternative approaches to turn the tide against physical inactivity and obesity, and one of the answers just might come in the form of a college classroom.

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Appendix A: Permission Letter to Use Archival Data from [redacted]

College Institutional Review Board

[redacted]

[redacted]

[redacted]

To Whom It May Concern:

This letter is to certify the Assistant Professor Tiffany Young Klockziem has completed the necessary requirements from the Institutional Review Board at [redacted] for the proposal entitled 'Effect of a Lifetime Health and Fitness Class on College Students.' Original approval was granted for her study on June 5, 2013. She has permission to use the data through June 6, 2017. If you have any questions or concerns please feel free to contact me.

Sincerely,

[redacted]

[redacted]

Appendix B: Informed Consent

INFORMED CONSENT FORM

"The Effectiveness of PHED 215"

Purpose. The purpose of this investigation is to assess "Developing Life Skills" (PHED 215) for the purpose of general studies assessment. This information may also be used for future study regarding the effectiveness and improvement of PHED 215.

You are a member of PHED 215. As a participant in this class, you will complete questionnaires related to physical activity, and participate in fitness tests, and a cardiorespiratory and muscular fitness program. With your consent, these records will be used to assess PHED 215 by determining the present cardiovascular disease risk, general health, physical activity, self-motivation, and self-efficacy level of the class.

Risks. There are no foreseeable risks by providing access to my health records. As a member of PHED 215, every effort is always made to conduct the testing sessions in a manner that will minimize any possible risk to the student. At the beginning of the semester, a physical activity readiness questionnaire (PAR-Q) is given to assess risk, and a fitness center orientation is given as well.

Benefits. The benefits to you by being involved in this investigation include knowledge and awareness of your current level of cardiovascular disease risk factors, physical activity, self-motivation, and self-efficacy level. In addition, your knowledge of fitness principles and lifetime health could improve as well. By allowing access to your records, the effectiveness of PHED 215 will be evaluated, thereby improving the class and its positive impact on students.

In no way will your name be used in connection with the data. The information obtained during this investigation will be treated as privileged and confidential, and will not be released to anyone. The resultant information will be used for statistical analysis.

1. The exercise science department has requested my participation in a research study at this institution. The title of the research is "The Effectiveness of PHED 215."

2. "The purpose of the research is to evaluate PHED 215 as part of the general education program, and also determine the cardiovascular disease risk, health, fitness, physical activity level, self-motivation and self-efficacy levels of college students enrolled in a lifetime health and fitness class in XXXXXXX, XX."

3. "My participation in this study does not involve anything beyond the standard PHED 215 requirements of health and fitness testing and filling out health-related questionnaires. I am only being asked to give my consent to use the aforementioned PHED 215 records."

4. "I give my permission to use all of my PHED 215 health and fitness records and results, and understand that my anonymity will be protected.

5. "I understand there were no foreseeable risks or discomforts to me if I agreed to participate in the study."

6. "There are no feasible alternative procedures available for this study."

7. "I understand that the possible benefits of my participation in the research are knowledge and awareness of my current level of cardiovascular disease risk, and my health, physical activity level, self-motivation, and self-efficacy levels."

8. "I understand that the results of the research study may be published, but that my name or identity will not be revealed. In order to maintain confidentiality of my records, XXXXXXX XXXXXXXXXX will assign each subject a code to which no one else will have access to. All records will be safely locked in a file cabinet."

9. "I will not be compensated for my participation."

10. "If I have any questions concerning the study or my participation in it, it can be answered by Exercise Science staff, XXXXXXX XXXXX XXXXXXXXXX, at XXX-XXX-XXXX orXXXXXXX@XXX.XXX, or XX. XXXX XXXX, at XXX-XXX-XXXX or XXXXXXX@XXX.XXX.

11. “I understand that in case of injury, if I have questions about my rights as a subject/participant in this research, or if I feel I have been placed at risk, I can contact my PHED 215 professor. I can also contact the Chair of the Institutional Research Board (IRB) of XXXXXXXX, XX. XXXX XXXXXXX, at XXX-XXX-XXXX or XXXXXXX@XXX.XXX.”

12. “I have read the above information and I give permission for the use of my PHED 215 records. The nature, demands, risks, and benefits of the project have been explained to me. I knowingly assume the risks involved, and understand that I may withdraw my consent and thus discontinue the use of my records at any time without penalty or loss of benefit to myself. In signing this consent form, I am not waiving any legal claims, right, or remedies.”

Subject’s Signature________________________________Date____________

13. “I certify that the above individual has been informed of the nature and purpose, the potential benefits, and possible risks associated with participation in this research study, and will answer any questions that are raised.”

Signature of Exercise Science
Staff_____________________________Date____________