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Exercise Participation during Weight Loss on a High Protein – Low Carbohydrate Diet Plan in Females Aged 15-25 Years

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A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctorate of Education in Educational Leadership

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by

Margaret Mobley-Meulman

August 2013

Dr. Catherine Glascock, Chair

Dr. Bethany Flora

Dr. Don Good

Dr. Michael Ramsey

Keywords: Exercise, Weight Loss, Bariatrics, Nutrition, Diet, High Protein, Low Carbohydrate, Body Composition

ABSTRACT

Exercise Participation during Weight Loss on a High Protein – Low Carbohydrate Diet Plan in Females Aged 15-25 Years

by

Margaret Mobley-Meulman

Weight gain due to poor diet and lack of exercise is responsible for over 300,000 deaths each year (U.S. Department of Health and Human Services, 2010). Obese adults have an increased risk for serious health conditions including high blood pressure and cholesterol, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, and certain cancers (National Cancer Institute, 2012). Participation in exercise can help control weight, strengthen muscles and bones, and reduce the incidence of cardiac events, stroke, hypertension, type 2 diabetes, colon and breast cancers, osteoporotic fractures, gallbladder disease, obesity, depression, anxiety, and delay mortality (ACSM, 2009).

The purpose of this study was to determine the effectiveness of exercise participation during weight loss on a high protein-low carbohydrate diet plan during a 12-week span in females aged 15 to 25 years. Specifically, this research study was a comparison of markers of health such as weight, fat mass, percent body fat, and fat-free mass in females who consistently exercised during the diet (Exercisers) from those who did not participate in consistent exercise (Non-Exercisers). The population in this study was selected due to the transition from high school to college being a critical period because it is associated with many identity choices and lifestyle changes that can lead to weight gain (Anderson, Shapiro, & Lundgren, 2003).

The data indicate participation in regular exercise, while consuming a high protein-low carbohydrate diet plan, increases the loss of body weight, fat mass, and percent body fat when compared to participating in the diet plan alone. There was no significant difference in fat-free mass reduction between the groups. One implication for practice is recommending moderate to vigorous exercise for a minimum of 30 minutes at a time, totaling a minimum of 150 minutes per week, for females trying to achieve weight loss. Based from the results of this research study, in order to achieve a greater amount of body weight, fat mass, and percent body fat reduction one should consider incorporating exercise participation and high protein-low carbohydrate dieting into their weight loss plan.

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DEDICATION

I would like to dedicate my dissertation to the person who is the number one supporter in everything I do, my father James Mobley. He is the reason I was able to complete this degree. No matter what crazy idea I've had, and at times writing this felt like a crazy idea, he has always been there to support me. I will be forever grateful for the guidance and love he has shown to both me and my husband, Colin Meulman, in both our professional and personal lives. I am who I am, and have accomplished all that I have because of him. God could not have placed me with a better family nor a better father.

This is for you dad. Mom would be proud of us.

ACKNOWLEDGEMENMTS

Words cannot express the gratitude I have for all of those who supported and encouraged me during this process. I would like to thank each of you for the assistance you provided me during this educational endeavor. I will forever be indebted to each of you.

First, I would like to thank the faculty of East Tennessee State University for the opportunity to complete my master's and doctorate degrees at an excellent institution. I would like to thank the following professors serving on my committee: Dr. Catherine Glascock, Chair of Committee; Dr. Don Good; Dr. Bethany Flora; and Dr. Michael Ramsey. To each of you I am grateful for your mentoring, willingness to endure numerous emails, and assisting me all the way in Charlotte, North Carolina during this process. I am truly grateful for your willingness to undertake my research topic. The completion of this dissertation would not have been possible without the support from this committee.

Second, I would like to thank my husband, Colin Meulman, for his unconditional love when stress was high and no amount of productiveness seemed sufficient. Colin, you have been my better half since day one. When I was weak and wanted to give up, you kept me strong and encouraged me to push through. Thank you for believing in me and being there when I needed you the most. I could not have done this without you.

Third, I would like to thank my family and friends for their consistent words of encouragement and guidance during my educational career. Without the lifelong support from Jim Mobley, Colin Meulman, David Flanders, Allen J. Dennis Jr., Cheryl Mobley, Evelyn Brannen, Ruth Mobley, Otis Mobley, Danny Cantone, Amanda Greene, Josh Wright, Brandon Harper, Jackie Walling, Todd Walling, Jeff Meulman, Dora Meulman, Carol Capers, Jane

Flanders, Leigh Flanders, Lisa DeFranco, and Jeannie Kosakowski, I would have never had the courage to complete my doctorate degree.

Fourth, I would like to thank Medi Weightloss Clinics of Ballantyne, North Carolina. Thank you to the former medical director, Dr. Matthew Neulander, for sharing his knowledge and compassion for the field of bariatrics, and inspiring my interest in this research topic. Also thank you to Bill Stewart for providing me with the access to all the data I needed and for consistently encouraging me during this process. I lastly, and most importantly, would like to thank both current and former employees who assisted and encouraged me with this research study. You are all proof that a business is only as good as their staff.

Lastly, I would like to thank two important educational influences from my past, Elaine Mobley and Rick Coffey, without whom I would have never made it this far in my educational career. I will be forever grateful for my mother, Elaine, for consistently encouraging me in school, and in life, to work hard and strive to reach my goals. Although our time together was cut short, I learned more from her in 14 years than many learn in a lifetime. I am who I am because of her, and I will be forever blessed for having her as a part of my life. I would also like to thank my former teacher, mentor, and coach, Rick Coffey. He is the reason I became interested in exercise physiology and began to pursue higher education. I have become a better person, student, teacher, and coach because of the lessons I learned during my time with him. He is the ultimate example of how teachers can touch and change the lives of their students forever. The impact of parents and teachers should never be underestimated.

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CHAPTER 1

INTRODUCTION

The epidemic of obesity threatens the historic progress America has made in increasing the quality and years of healthy life (U.S. Department of Health and Human Services, 2010). Two-thirds of the American adult population, and between 16% and 33% of children and adolescents are obese (Flegal, Carroll, Ogden, & Curtin, 2010). Obesity death rates have steadily increased from an estimated 112,000 in 2005 (Flegal, Graubard, Williamson, & Gail, 2005) to approximately over 300,000 in 2010 (U.S. Department of Health and Human Services, 2010). Obese adults are at increased risk for many serious health conditions including high blood pressure, high cholesterol, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, as well as endometrial, breast, prostate, esophagus, kidney, thyroid, gallbladder, and colon cancers (National Cancer Institute, 2012). Children with a high body mass index (BMI) often become obese adults (Freedman et al., 2005). Health issues from childhood obesity are carried into adulthood, having a tremendous effect on the future of the health of adults at the level of a national epidemic (U.S. Department of Health and Human Services, 2010).

The transition from high school to college is a critical period because it is associated with many lifestyle changes that can lead to weight gain, such as changes in eating habits and increased alcohol intake. Research has shown weight gain does occur during the first year enrolled in college (Anderson, Shapiro, & Lundgren, 2003). Obesity rates have most rapidly increased in individuals aged 18 to 29 years (Mokdad et al., 1999). Obesity prevention is recommended for adults in their early 20s with special emphasis for young women who are already overweight (Williamson, Kahn, Remington, & Anda, 1990).

Participation in physical activity and exercise prevents occurrences of cardiac events; reduce the incidence of stroke, hypertension, type 2 diabetes mellitus, colon and breast cancers, osteoporotic fractures, gallbladder disease, obesity, depression, anxiety, and delay mortality (American College of Sports Medicine's Guidelines for Exercise Testing and Prescription, 2009). Exercise is also strongly recommended to lower elevated levels of total cholesterol, LDL-cholesterol and triglycerides, and to raise low levels of HDL-cholesterol (Mazzeo & Tanaka, 2001). The Center for Disease Control (2009) stated the many benefits of exercise included increasing life expectancy. Participation in exercise and physical activity can also help control weight and strengthen muscles and bones (U.S. Department of Health and Human Services, 2010). Saris, Blair, and Van Baak (2003) concluded that 45-60 minutes of moderate exercise per day is required to prevent the transition to overweight and obesity in adults, and prevention of weight regain may require 60-90 minutes of moderate exercise per day. However, health benefits result from as little as 30 minutes per day of moderate exercise. Studies in men and women of different races have shown risk reductions of 20% to 50% in coronary heart disease and cardiovascular disease incidence rates with moderate exercise when compared with sedentary behavior (Lee, Rexrode, & Cook, 2001). In addition to exercise participation, nutrition plays a large role in the overall health of an individual.

Higher protein diets have been shown to aid in retaining muscle mass during weight loss due to enhanced protein synthesis as well as creating a positive impact on the metabolic process. The subjects being used in this research study were all patients at a medical weight loss clinic located in Charlotte, North Carolina. The Charlotte weight loss clinic is a physician-supervised diet and weight loss program and generally promotes a higher protein-lower carbohydrate diet plan. The clinic has been assisting both adolescents and the adult population in meeting their weight loss goals and helping them maintain it long term. There are three clinics in the Charlotte area that have helped individuals lose approximately 150,000 pounds from 2007-2013. Patients of the Charlotte medical weight loss clinic have their weight measured using a Tanita scale and meet with a medical provider on a weekly basis to discuss their diet plan and exercise participation. A key component of weight management is sound dietary and exercise counseling (Galbreath, 2008). With the continuing rise of obesity in the United States, the importance of a healthy diet and exercise regimen is vital to the nation's health. Although obesity has a negative impact on every individual regardless of age or sex, by beginning to recognize when and how to treat obesity, it could help individuals gain control of their health and prevent metabolic diseases.

Statement of the Problem

The purpose of this study was to determine the effectiveness of exercise participation during weight loss on a high protein-low carbohydrate diet plan in females aged 15 to 25 years. The data were collected from the females who were patients at a medical weight loss clinic in Charlotte, North Carolina. Specifically, this research study was a comparison of markers of health such as weight, fat mass, percent body fat, and fat-free mass in individuals who exercised consistently during the weight loss program (Exercisers) from those who did not participate in consistent exercise (Non-Exercisers). The population in this study was selected due to the transition from high school to college being a critical period because it is associated with many lifestyle changes that can lead to weight gain. During this transition time individuals deal with identity choices that are often fully adopted into lifestyle practices that they will carry throughout the rest of their lives (Anderson et al., 2003).

Significance of the Study

This study is significant because it may lead to knowledge about the influence of exercise participation and its effect on not only weight loss during a high protein-low carbohydrate diet but also its effect on fat mass, percent body fat, and fat-free mass statistics. Information provided in this study will be useful for physicians, weight loss clinics, medical providers in the field of bariatrics, exercise physiologists, nutritionists, school guidance counselors, psychologists, and females interested or participating in personal weight loss. This study will also add to existing research concerning weight loss in young females and markers of health.

Research Questions

The following research questions guide this study. The questions are focused on weight loss and exercise participation and their effects on fat mass, percent body fat, and fat-free mass. The questions also address the differences in weight loss with minimal exercise participation.

Research Question #1: Is there a significant difference in weight loss in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

Research Question #2: Is there a significant difference in fat mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

Research Question #3: Is there a significant difference in fat-free mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

Research Question #4: Is there a significant difference in percent body fat reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

Definitions of Terms

The following definitions are provided in an effort to clarify terms and instruments used throughout the study.

Bariatrics – The branch of medicine that deals with the cause, prevention, and treatment of obesity (Reynolds, 2005).

Bioelectrical Impedance Analysis (BIA) – A noninvasive and easy to administer method for assessing body composition. This procedure is based from the idea that thevolume of fat-free tissue in the body will be proportional to the electrical conductivity of the body. The bioelectrical impedance analyzer passes a small electrical current into the body and then measures the resistance to that current. The theory behind BIA is that fat is a poor electrical conductor containing little water (14%-22%), while lean tissue contains mostly water (90%) and electrolytes and is a good electrical conductor. Thus, fat tissue is an impedance to electrical current. BIA measures total body water and uses calculations for percent body fat using some assumptions about hydration levels of individuals and the exact water content of various tissues (ACSM, 2009).

Body Composition - The relative percentage of body mass that is fat and fat-free tissue and is estimated with both laboratory and field techniques that vary in terms of complexity, cost, and accuracy (ACSM, 2009).

Body Mass Index (BMI) – Used to assess weight relative to height and is calculated by dividing body weight in kilograms by height in meters squared (ACSM, 2009).

Carbohydrates – The primary source of energy in the American diet and is divided into two classes: that which can be metabolized (sugars and starches) and dietary fiber (Powers & Howley, 2004).

Cardiovascular Exercises – Aerobic exercises such as running, swimming, biking, brisk walking, etc. (Powers & Howley, 2004).

Consultations – A key component of weight management is sound dietary and exercise counseling (Galbreath, 2008). Part of the medical weight loss clinics of Charlotte, North Carolina program is for patients to participate in weekly consultations and body composition measurements with a medical provider each week during the weight loss phase.

Exercise - A type of physical activity that is structured and promotes repetitive bodily movement in order to improve or maintain one or more components of physical fitness (Powers & Howley, 2004).

Fat-Free Mass (FFM) – The weight of the human body excluding fat mass, including muscles, bones, organs, fluids, etc. (ACSM, 2009).

Fat Mass – The fat weight of the human body (ACSM, 2009).

Flexibility Training Exercises– The stretching of muscles to increase flexibility and balance (Powers & Howley, 2004).

Medical Weight Loss Clinic of Charlotte – A physician-supervised diet, weight loss, and maintenance program located in Charlotte, North Carolina. The clinic promotes a high protein-low carbohydrate diet plan. All subjects used in this research study were previous patients of one of the three clinics located in Charlotte.

Obesity – A surplus of adipose tissue resulting from excessive energy intake relative to energy expenditure. Obesity is classified as having a BMI of either 30 or greater. Excessive weight is associated with an increased risk of mortality and morbidity, including coronary artery disease, hypertension, diabetes, and other illnesses. Obesity is a major public health concern in the United States with over 97 million Americans either overweight or obese (ACSM, 2009).

Overweight – A deviation in body weight from some standard or ideal weight in relation to height. Overweight is classified as having a BMI between 25.0-29.9. (ACSM, 2009).

Percent Body Fat – The percentage of an individual's weight that consists of fat mass. The average percent body fat in men ages 20-39 ranges between 8%-19%, elevated between 20%-24%, and high 25% or greater. In women ages 20-39 average ranges 21%-32%, elevated ranges 33%-38%, and high 39% or greater (ACSM, 2009).

Physical Activity – Bodily movement that is produced by the contraction of skeletal muscles and substantially increases energy expenditure (Powers & Howley, 2004).

Proteins – Important source of the diet because it contains the nine essential amino acids without which the body could not synthesize all the proteins needed for tissues, enzymes, and hormones. Good sources of protein include eggs, milk, fish, meat, poultry, cheese, and soybeans (Powers & Howley, 2004).

Strength Training Exercises – Anaerobic exercises such as weight training, yoga, Pilates, and exercises centered on increasing muscle tone and strength (Powers & Howley, 2004).

Tanita – A device designed to be used by healthy adults and children over the age of 5, and it uses a patented "foot to foot" pressure contact electrode BIA technique to measure fat-free mass, total body water, fat mass, and percent body fat (Nunez et al., 1997). It is used for monitoring of changes in individual's body composition related to differences in the ratio of fat tissue to lean and can assess the effectiveness of individuals nutrition and exercise programs, both for health and physical fitness (TANITA Corporation of America, 2010).

Limitations and Delimitations

There are limitations and delimitations in this research study. One limitation is the use of the Tanita scale for body mass readings. The Tanita statistics are limited to the accuracy of patients following the proper protocol prior to measurement. Patients were not required or able to follow all protocols listed in the Tanita manual at each measurement. However, it is assumed the bioelectrical impedance readings were comparable to those of other readings from each subject who did not follow protocol. External validity is another potential limitation because patients have a tendency to embellish on the truth concerning their exercise participation. It is assumed the majority of patients stated valid information concerning their diet and exercise participation each week during their consultation with a medical provider. A delimitation to this study is population external validity because generalizability is restricted to the three medical weight loss clinics of the Charlotte area. The research conducted may not be generalizable to other populations.

Overview of the Study

The study consists of five chapters. Chapter 1 contains the introduction, statement of the problem, significance of the study, research questions, definitions of terms, limitations and delimitations, and overview of the study. Chapter 2 is the review of literature and focuses on weight loss, exercise, high protein-low carbohydrate dieting, and measures of weight loss and physical activity. Chapter 3 describes methods used in collecting data. Chapter 4 reveals results of the data analysis. Chapter 5 consists of the summary of findings, conclusions, recommendations for practice, and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

The literature review includes information relevant to obesity, weight loss, benefits of weight loss, high protein-low carbohydrate dieting, exercise, and recommendations for exercise. Chapter 2 is divided into three main sections: 1. Weight loss; background of obesity, weight gain in teen and college aged students, benefits and limits to weight loss, psychology and weight loss, and benefits and limits of high protein-low carbohydrate dieting. 2. Exercise; history of exercise, benefits and limits to exercise, and recommendations for exercise. 3. Measures of weight loss and Exercise; Bioelectrical Impedance Analysis, and patient consultations.

Background of Obesity

Obesity is defined as excess body fat or body weight as measured by body fat percentage or body mass index (BMI). BMI is used to assess weight relative to height and is calculated by dividing body weight in kilograms by height in meters squared. Obesity related health problems increase beyond a BMI of 25.0. Having a BMI of 25.0 to 29.9 is classified as overweight and a BMI greater than 30.0 is classified as obese. A BMI 35.0 or higher puts an individual at an even greater risk for disease and health complications (ACSM, 2009). BMI fails to distinguish between body fat, muscle mass, bone, or fluids. Some growing or athletic children or adults will have a BMI in the overweight or obese range without having an excess of body fat (Romero-Corral et al., 2006). Body fat percentage can also be used as a health risk predictor of obesity. According to the ACSM (2009), average percent body fat in men ages 20-39 ranges between 8%-19%, elevated between 20%-24% and high 25% or greater. In women ages 20-39 average ranges 21%-32%, elevated ranges 33%-38%, and high 39% or greater. Body fat percentage can be measured using such methods as skinfold measurements, bioelectrical impedance analysis (BIA), hydrodensiometry (underwater) weighing, and plethysmography.

Several causes to obesity include consuming too many calories, not getting enough exercise, genetics, metabolism, behavior, environment, and culture (U.S. Department of Health and Human Services, 2010). At any stage in life, increased consumption of excess calories from fats and sugars is associated with obesity. Fast foods and junk foods tend to be higher in calories than essential nutrients that are needed for health. Sugary beverages such as soda and energy drinks contribute to excess calorie intake and often replace nutritious foods needed in the diet (Division of Nutrition and Physical Activity, 2006). The advances in modern technology have also aided in the obesity epidemic by replacing participation in physical activity. The amount of time adults and teenagers are spending in front of the television or computer screen contributes to a sedentary lifestyle. In particular, the more time spent watching television the more likely adults and teens are to eat while doing so and the more likely they are to eat high-calorie foods (Coon & Tucker, 2002). As exercise participation decreases, stress levels often increase, which contributes to obesity. Chronic stress adversely affects blood pressure and cholesterol and may lead to an increase in caloric intake (Bjorntorp, 2001).

The obesity epidemic threatens the historic progress America has made in increasing the quality of life and life expectancy of the average American (U.S. Department of Health and Human Services, 2010). Two thirds of the American adult population (Flegal et al., 2010) and nearly one in three children are overweight or obese (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Obese adults are at increased risk for many serious health conditions, including high blood pressure, high cholesterol, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, and respiratory problems. There is also an increased risk of endometrial, breast, prostate, and colon cancers (National Institute of Health, 1998). Children with a high BMI are more likely than those with a normal BMI to have insulin resistance, high blood pressure, and unhealthy levels of fats or other lipids (Nathan & Morgan, 2008). Besides illness, obesity in adults and children can lead to social stigmatization and psychological problems. Furthermore, obese children often become obese adults (Freedman et al., 2005).

Weight Gain in Teen and College-Aged Students

A high BMI among children and adolescents continues to be a public health concern in the United States. Children with a high BMI often become obese adults and obese adults are at risk for many chronic conditions (Freedman et al., 2005). According to U.S. Department of Health and Human Services (2010), if the rise of childhood obesity continues, it will have an impact into their adulthood as well as a tremendous effect on the future of the National healthcare. Obesity is among the easiest medical conditions to recognize but most difficult to treat. Between 16% and 33% of children and adolescents are obese, and unhealthy weight gain due to poor diet and lack of exercise is responsible for over 300,000 deaths each year. The annual cost of obesity is estimated at nearly $100 billion. Overweight children are much more likely to become overweight adults unless they adopt and maintain healthier patterns of eating and exercise (U.S. Department of Health and Human Services, 2010).

The No Child Left Behind Act (NCLB) became a public law in 2002, stating criteria by which the state evaluates a school's performance. The NCLB standardized testing model brought about great concern, causing hesitancy among educators in allowing more time for exercise, which would result in less classroom time (Lee et al., 2007). A report in 2010 by the Center for

Disease Control (CDC) revealed that participation in exercise has declined with age. Results of this study showed that only 18% of high school students participated in 60 minutes of daily exercise. The percentage of high school students who attended daily physical education classes decreased from 42% in 1991 to 25% in 1995, and in 1999 only 22% of 12th grade students had daily physical education. A decrease in physical activity results in an increase in the chance to become overweight and obese (Schulz & Schoeller, 1994).

Teenagers typically have a high degree of interest in their body conformation and are generally dissatisfied with their size and shape. Research dating back to the 1960s suggests that even in the past both male and female teenagers were willing to carry out action programs to change their body weight or shape (Huenemann, Shapiro, Hampton, & Mitchell, 1966). The transition from high school to college is a critical period because it is associated with lifestyle changes that can lead to weight gain, changes in eating habits, and increased alcohol intake. The freshman year of college is a critical period for teens because weight gain does occur during the first year enrolled (Anderson et al., 2003). According to Mokdad et al. (1999) obesity rates have most rapidly increased in individual's ages 18 to 29 years. Research by Williamson et al. (1990), revealed that obesity prevention should begin among adults in their early 20s and that special emphasis is needed for young women who are already overweight.

Overweight is a significant problem among college-aged adults and terms such as "the freshman 15" attest to the popularity of the belief that the beginning year of college to be associated with weight gain (Anderson et al., 2003). The average weight gain recorded during the first semester of college ranges from 4.2 to 7.8 pounds (Hoffman, Policastro, Quick, & Lee, 2006); as many as one third of students gain 10 pounds or more, and 20% gaining 15 pounds or more (Lloyd-Richardson, Bailey, Fava, & Wing, 2006). The percentage of individuals classified as overweight can increase from 21% to 32% in the first semester at college (Anderson et al., 2003). Even a small increase in weight can place an individual in the overweight category that can also increase the chance of developing a metabolic syndrome (Gow, 2009). The following metabolic developments in college-aged students have been recorded: abnormal waist circumference, impaired fasting glucose, impaired fasting glucose tolerance, impaired fasting insulin, hypertriacylglycerolemia, low HDL cholesterol, and high blood pressure (Huang et al., 2004).

There are several factors contributing to weight gain in college students. Approximately 47% of college students live on campus (The American Health Association, 2005) and frequently eat commercially prepared meals. The "all you can eat" dining halls provided by universities most strongly contribute to weight gain (Levitsky & Youn, 2004). The concept of portion size may become blurred with the unlimited servings available. In addition, multiple servings of high-fat energy dense foods may replace healthier options. Another factor is snacking, and according to Levitsky and Youn (2004), consumption of junk food increased meal frequency, and the number of snacks accounted for 47% of weight gain for first-year students. Snacking also increases during stressful periods such as mid-terms and finals (Oliver & Wardle, 1999). The increase in sugary and caffeinated beverages such as coffee and energy drinks also lead to weight gain. Studies have found college students to consume 8.8 ± 5.2 sugary beverages each week, and consumption of high calorie, gourmet coffee beverages 2.5 times per week (Huffman & West, 2007). At the age of 21, and even prior to becoming of legal age, alcohol consumption increases during the college years for most individuals. Alcohol has no nutritional value and only increases calorie consumption. The highest decline in physical activity appears during adolescence (ages 15-18) and young adulthood (ages 20-25) (Stephens, Jacobs, & White, 1985). In a college sample by Douglas et al. (1997), only 38% of students participated in regular vigorous exercise, and 20% participated in regular moderate exercise. Physical inactivity is another component for weight gain in college students.

Benefits and Limits to Weight Loss

Weight loss has been reported to improve blood pressure, lipid levels, and glucose tolerance among overweight persons with hypertension, dyslipidemia, and diabetes (MacMahon, Macdonald, Bernstein, Andrews, & Blacket, 1985). It also has been found to reduce medication requirements among both hypertensive and diabetic patients (Collins & Anderson, 1995). These diseases, along with repercussions such as end-stage renal disease resulting from type 2 diabetes, have been reported to account for approximately 85% of total obesity-attributable medical care costs (Wolf & Colditz, 1994). These findings have led to the conceptualization of obesity as a chronic disease condition rather than a just problem caused by poor food choices and insufficient exercise participation. As with other chronic diseases, obesity may require lifelong treatment, but it is preventable and can also be reversed in many circumstances.

According to the ACSM guidelines (2009) when setting a goal weight, an individual aged 20-39 should initially aim to obtain a BMI of 25.0 and a body fat percentage 8%-19% (for men) and 21%-32% (for women). However, even minimal weight loss can have an impact on one’s health. According to research by Oster, Thompson, Edelsberg, Bird, and Colditz (1999), a 10% weight loss can improve quality of life for those with chronic diseases caused by obesity such as hypertension, hypercholesterolemia, type 2 diabetes, coronary heart disease (CHD), and stroke. Depending on current age, sex, and initial BMI, weight loss would reduce the expected number of years of life with hypertension by 1.2 to 2.9 and the expected number of years with type 2 diabetes by 0.5 to 1.7; estimated reductions for hypercholesterolemia from 0.3 to 0.8 years. Lifetime risks of CHD declined by 12 to 38 cases per 1,000, and risk reductions for stroke ranged from 1 to 13 cases per 1,000. This research also suggested that a sustained 10% weight loss would increase life expectancy by 2 to 7 months among men and by 2 to 5 months among women. Estimated gains in life expectancy are greatest for younger persons and persons with the highest initial BMIs (Oster et al., 1999).

In 1948 the World Health Organization (2004) first defined health as not only the absence of disease but also the presence of physical, mental, and social wellbeing. Quality of life (QOL) is defined as the physical, psychological, and social domains of health that are influenced by an individual's experiences, beliefs, expectations, and perceptions of health (Testa & Simonson, 1996). Quality of life issues have become steadily more important in the practice of health care and research since 1948. Obese youth report lower health related QOL compared with nonoverweight youth of the same age. Their distress levels are also similar to children and adolescents with cancer (Schwimmer, Burwinkle, & Varni, 2003). Childhood obesity directly affects the parents perceptions of health related QOL. Several studies have discovered parents of overweight children to be more likely to report poorer health related QOL than parents of nonoverweight children (Wake, Salmon, Waters, Wright, & Hesketh, 2002). Health related QOL can be improved with weight reduction by making significant improvement to the physical aspect of QOL (Fine, Coldtz, & Coakley, 1999). A study by Kolotkin, Crosby, Williams, Hartley, and Nicol (2001) examined women and men aged 18 and older and their QOL changes with weight loss over a span of a year. This study reported improvements in physical function, self-esteem, sexual life, public distress, and work. Weight loss can improve both the mental and social well-being in an individual's QOL (Kolotkin et al., 2001).

Increases in weight with age are greater in women with lower socioeconomic status (Williamson et al., 1990). There have been several hypothesis articulated for the reasoning behind socioeconomic status and weight control practices. Overweight adolescence and young adults are often discriminated against in terms of socioeconomic advancement. Data suggest that obesity negatively influences both educational opportunity and employment. It also suggests that obese women are less likely than nonobese women to marry (Gortmaker, 1993). Lower socioeconomic status reduces educational opportunities and results in lower levels of nutritional knowledge and behavioral skills needed to control weight, and it may also act as a barrier to exercise participation. Economic constraints also restrict behavioral influences such as healthy food options, safe recreational exercise, and less social support from family and friends for healthy diet and exercise behavior (Jeffery & French, 1996).

While weight loss yields important benefits, few individuals achieve weight loss and maintain it long term. On average, two thirds of the weight that is lost by patients who complete weight loss programs is regained within 1 year, and almost all of it is regained within 5 years (Anderson, Konz, Frederich, & Wood, 2001). The lack of consistent long-term success in maintenance of weight loss has led researchers and weight loss programs to continue to find ways to improve weight maintenance. The main component in achievement of weight loss is an adjustment in diet, which usually results in a caloric deficit (Hill, 1993). Although exercise might not be an essential ingredient in a weight loss program, it is critical in a maintenance program. Studies suggest successful weight maintenance requires a combination of regular exercise and monitoring of nutritional calories (Wadden & Letizia, 1992). Exercise might assist an individual in maintaining a higher lean body mass and resting metabolic rate (RMR) and result in an optimal percent body fat even at a higher body weight (Powers & Howley, 2004). Research suggests individuals are more likely to lose and maintain weight if they restrict dietary intake and increase their activity level, rather than dieting with no increase in physical activity or vice versa. In addition, weight maintainers have been found to weigh themselves at least once per week and also count nutritional calories (Klem, Wing, McGuire, Seagle, & O'Hill, 1997). Although counting nutritional calories may help individuals maintain their weight loss, it has been reported to have a negative effect because of the amount of time it takes to read labels and record calories on a daily basis (Garner & Wooley, 1991). In conclusion, several research studies concur it is usually less difficult to lose weight than it is to maintain it long term, and researchers continue to explore ways to increase the success of weight maintenance.

Psychology and Weight Loss

Although obesity is the most common chronic physical illness in society, depression is the most prevalent psychological condition. Symptoms of depression correlate significantly with reported body image dissatisfaction (Friedman, Reichmann, Costanzo, & Musante, 2002). An obese individual can suffer from stigmatization, discrimination, and psychosocial disturbance which may create or stimulate a depressive illness (Stunkard & Wadden, 1992). Failed attempts to lose weight may create thoughts of guilt, hopelessness, and poor self-esteem (Wooley & Garner, 1991). Depression in children and teenagers tends to exaggerate weight change tendencies; leaner teens become lean adults and heavier teens become heavier adults when compared with the nondepressive (Barefoot et al., 1998). Those who are severely obese, especially younger women with poor body image, are at high risk for depression (Dixon, Dixon, & O'Brien, 2003). Depression has been reported to significantly improve with significant weight loss from either bariatric surgery or behavioral dietary interventions (Bryan & Tiggemann, 2001).

Eating disorders in young females continue to be a problem globally, and research suggests the age of disordered eating is decreasing (Kaltiala-Heino, Rissanen, Rimdela, & Rantanen, 1999). The female adolescent years are often associated with weight and body shape concerns. A thin body is considered desirable. A survey by McCreary Centre Society (1999) in Vancouver found at the age of 18 years 80% of girls of normal height and weight reported they wanted to weigh less. Although such attitudes are common, for some cases they can be associated with an increased risk for clinical eating disorders. Disordered eating behaviors are associated with an increased risk of other health compromising behaviors such as smoking, alcohol and drug use, depression, and suicide (Neumark-Sztainer, Story, Dixon, & Murray, 1998). Age and BMI are independently associated with disordered eating behaviors, suggesting a correlation between disordered eating and being overweight (Neumark-Sztainer & Hannan, 2000). Dietary restraint, intense exercise, diet pills, and use of laxatives to achieve weight loss are associated with an increased risk for obesity (Stice, Cameron, Killen, Hayward, & Taylor, 1999). Binge eating has been shown to result in weight gain and increased risk of obesity, suggesting that disordered eating and increased BMI to be mutually exacerbating (Mussell et al., 1995). A research study in Ontario surveyed 1,739 adolescent females aged 12-18 years regarding their eating, dieting, and nutrition habits. The data reported 27% of girls to be bingeing or purging. Dieting was the most prevalent weight loss behavior. Disordered eating behaviors were found to increase gradually throughout adolescence. In girls aged 12-13, 12% reported binge-eating and 7% reported self-induced vomiting to lose weight. By the age of 15 years, disordered eating attitudes and behaviors were as frequent as those reported in older high-risk groups such as college and university students. The study also indicated that most teenage girls with disordered eating behaviors, even those who induced vomiting or took diet pills, were not evaluated or treated for these problems. It is ideal for girls to be screened for eating disturbances before entering middle school and preventive interventions targeted through high school and college (Jones, Bennett, Olmsted, Lawson, & Rodin, 2001).

The lack of individuals being able to maintain their weight loss represents a significant problem in the behavioral treatment of obesity (Kramer, Jeffery, Snell, & Foster, 1986). After the termination of weight loss therapy, patients gradually abandon behavioral techniques, experience relapse, and regain much of the weight they had lost during treatment (Perri, Shapiro, Ludwig, Twentyman, & McAdoo, 1984). A study by Perri et al. (1987) suggests that a posttreatment program of biweekly therapist-led problem solving sessions to produce significantly greater maintenance of weight loss compared with a peer-support program and a no-contact condition. The effectiveness of the therapist contacts appeared to be derived from greater participant adherence to self-control strategies. Following the conclusion of the maintenance program, these clients began to regain weight and to experience the same pattern of relapse as clients in the peer-support and control conditions. The results of the study suggest that effective solutions to the maintenance problem will require consistent interventions that enhance individuals' motivation and sustain their long-term adherence. It is unlikely that any single short-term technique can accomplish this goal. Comprehensive programs spanning a year or more and incorporating a variety of posttreatment strategies such as ongoing therapist contacts, high frequency exercise, and group contingencies for adherence may be necessary to produce clinically meaningful effects in the long-term management of obesity.

Benefits and Limits of High Protein-Low Carbohydrate Dieting

Adequate protein intake is crucial in maintaining integrity, function, and health in humans by contributing amino acids that served as precursors for essential molecules that serve as building blocks for cell components (Galbreath, 2008). High protein diets have shown to improve weight loss, maintain muscle mass, and improve blood markers in all ages. Research supports certain diagnoses may respond more favorable to high protein nutrition plans. It is important to note that most research in weight loss and maintenance has been done on the adult population between ages 20-60 years.

Noakes, Keogh, Foster, and Clifton (2005) performed a research study comparing high protein (HP) diet to a high carbohydrate (HC) diet. Approximately 100 participants with a body mass index of 32 ± 6 and ages 49 ± 9 years completed the study. Participants were randomly assigned to one of two dietary interventions for 12 weeks. Both diets produced weight loss of 7.3 ± 0.3 kg. The participants with high triacylglycerol lost more fat mass and had a greater decrease in triacylglycerol concentrations with the HP diet than the HC diet. Fasting LDL cholesterol, glucose, insulin, free fatty acid, and C-reactive protein concentrations decreased with weight loss. Serum vitamin B12 increased by 9% with the HP diet and decreased 13% with the HC diet. Folate and vitamin B6 increased with both diets. Bone turnover markers increased 8%-12% and calcium excretion decreased by 0.8mmol/d. Creatinine clearance decreased from 82 ± 3.3 to 75 ± 3.0 mL/min. This research study supported that HP diets produce weight loss and improve risk factors for diabetes and heart disease.

Layman et al. (2005) performed a randomized 4-month weight loss trial using a Diet × Exercise block design. Diet treatments consisted of either a low carbohydrate ratio (PRO group) or a high carbohydrate ratio (CHO group). Exercise treatments consisted of a control group participating in light walking activity or an exercise group (EX) that required walking a minimum of 5 days a week plus two sessions per week of resistance training. The subjects were 48 overweight and obese women aged 40-56 years and were divided into two diet groups with and without exercise. The PRO diet provided dietary protein at 1.6 g/kg per day (~30% of calories) with a carbohydrate:protein ratio less than 1.5 and dietary lipids at approximately 30% of calories. The CHO diet provided dietary protein at 0.8 g/kg per day (15% of calories) with a carbohydrate:protein ratio greater than 3.5 and dietary lipids at approximately 30% of calories. The results showed the diet higher in protein and moderate in carbohydrates had an advantage for weight reduction, body composition, and plasma triacylglycerol.

Yancy, Olsen, Guyton, Bakst, and Westman (2004) performed a study to compare the effects of a low-carbohydrate, ketogenic diet program with those of a low-fat, low-cholesterol, reduced calorie diet. Participants were aged 18-65 years with a body mass index of 30-60 and elevated lipid panel (total greater than 200, LDL greater than130, triglycerides approximately 200). Participants were randomly assigned to complete a 24-week program of either low-carbohydrate diet (less than 20g of carbohydrates daily) plus nutritional supplementation, exercise recommendation, and group meetings, or low-fat diet (less than 30% calories from fat, less than 300 mg of cholesterol daily, and a deficit of 500 to 1000 kcal/day) plus exercise recommendation and group meetings. A greater portion of the low-carbohydrate diet group completed the study. Weight loss was greater in the low-carbohydrate diet group than in the low-fat diet group. Both groups lost substantially more fat mass (-9.4kg with the low-carbohydrate diet vs. -4.8kg with the low-fat diet) than fat-free mass (-3.3kg vs. -2.4kg, respectively). The low-carbohydrate diet had greater decreases in serum triglyceride levels (-0.84 mmol/L vs. -0.31 mmol/L) and greater increases in HDL levels (+0.14 mmol/L vs. -0.04 mmol/L). Changes in

LDL did not differ statistically between diets. The study showed that low-carbohydrate diets when compared with a low-fat diet had a positive effect on the lipid panel of participants, overall weight loss, and also ability to complete a 24-week diet program.

The relationship between dietary protein and renal function has been studied for over half a century (King & Levey, 1993). In recent years Knight, Stampfer, Hankinson, Spiegelman, and Curhan (2003) assessed protein intake with a semi-quantitative food frequency questionnaire and compared changes in estimated glomerular filtration rate over an 11 year span in individuals with pre-existing renal disease. The analysis showed an association between increased consumption of animal protein and a decline in renal function suggesting that high total protein intake may accelerate renal disease leading to a progressive loss of renal capacity. However, no association between protein intake and change in glomerular filtration rate was found in a different cohort of 1,135 women with normal renal function. Such a finding led the authors to conclude that there were no adverse effects of high protein intakes on kidney function in healthy women with normal renal status.

Dietary protein restriction is a common treatment plan for patients with renal disease and The National Kidney Foundation has extensive recommendations with regard to protein intake guidelines (Franz & Wheeler, 2003). Such recommendations are not indicated for individuals with normal renal function nor are they intended to serve as a prevention strategy to avoid developing chronic kidney disease. Despite the clarity of these guidelines, their mere existence has resulted in concern regarding the role of dietary protein in the onset or progression of renal disease in the general population (Beto & Bansal, 2004).

Conflicting findings regarding the role of dietary protein in kidney stone formation limit the development of universal guidelines with regard to a recommended protein intake for individuals at increased risk for kidney stones (Meschi et al., 2004). A study by Nguyen, Kalin, Drouve, Casez, and Jaeger (2001) found that high intake of animal protein adversely affected markers of stone formation in those afflicted with a stone causing disorder, while no changes were observed in healthy individuals. It has been suggested that one must have a preexisting metabolic dysfunction before dietary protein can exert an effect relative to stone formation (Meschi et al., 2004).

Although excessive protein intake remains a health concern in individuals with preexisting renal disease and kidney stone formation, the literature lacks significant research demonstrating a link between protein intake and the initiation or progression of renal disease or stone formation in healthy individuals. Evidence also suggests that protein-induced changes in renal function are likely a normal adaptive mechanism well within the functional limits of a healthy kidney (Beto & Bansal, 2004). At present, there is not sufficient proof to warrant public health directives aimed at restricting dietary protein intake in healthy adults for the purpose of preserving renal function. However, the participation in high-protein diets for those with renal disease is not highly recommended, especially for an extended period of time (Franz & Wheeler, 2003).

History of Exercise

Exercise has been an integral part of human daily activity ever since the dawn of civilization. Primitive people relied upon their physical skills to hunt, kill game, and defend against predators (Langley & Hawkins, 2004). Recreational exercise became an integral part of the colonial period during which activities such as sport, dance, and actively telling stories were engaged. Recreational exercise varied from colony to colony depending on their religion and beliefs. For example, dancing was a part of religious celebration in some colonies while others saw it as a sin (Wuest & Bucher, 2009).

Among the earliest known culture to incorporate exercise into their lifestyle were the ancient Chinese. Popular activities included wrestling, soccer, polo, water games, and flying kites. Cong Fu (Chinese gymnastics) was even practiced as early as 2700 B.C. The Chinese believed that physical inactivity could result in diseases so they used kneeling, bending, and stretching as preventive and therapeutic exercise. The citizens of ancient India (2500 B.C.) participated in activities such as tumbling, wrestling, running races, and dancing. Yoga, a formal program of postural and breathing exercises, was first practiced in ancient India. Unlike the Chinese and ancient Indians, the Egyptians, Persians, and Syrians (2000 B.C.) maintained a philosophy that life was to be enjoyed. This included participation in a variety of exercises. Military training was highly physical and young Persian boys (as early as age 6) were required to take part in horseback riding, hunting, javelin throwing, running, and similar activities deemed important for males (Langley & Hawkins, 2004).

Of all the ancient civilizations, none had more dramatic influence on the development of exercise and sport than ancient Greece (2500 B.C. – 400 A.D.). Due to this influence, this era has been called the Golden Age of sport and physical education. The citizens of Athens held a deep appreciation for the human body and often celebrated its beauty in drawings, sculptures, and writings. Philosophers and scientists such as Aristotle and Archimedes are still recognized for their studies and writings about the mechanics of human movement. Young Athenian males participated in physical education as a part of their daily education. Paidotribes, physical education instructors, taught young boys in the palaestra, a gymnasium-type building. Specialized coaches known as gymnasts trained older boys, aged 14-16 years, in the gymnasia (sport centers). The Athenians proclaimed that a complete person was one who possessed "a sound mind in a sound body" (Langley & Hawkins, 2004). In contrast to Athens, Sparta's greatness resulted from dedication to military excellence. Spartans were extremely fit and skilled in military tactics. Today, "Spartan" has become synonymous with a lifestyle of rigorous physical and mental training, and many athletic teams in schools and colleges have chosen Spartans as their nickname or mascot. The ancient Greeks are also noted for their funeral games, which were sporting competitions carried out in honor of the deaths of their citizens. These competitions gave towns and cities the opportunity to showcase their best athletes. The winners received praise and adulations from their fellow citizens, and a wreath of laurel or olive leaves was placed upon them. This wreath continues to symbolize athletic excellence in today's culture. The widespread popularity of the funeral games led to the organization of sport festivals, eventually creating the Olympic Games. The first Olympic Games were held in 776 B.C. They were held in tribute to the Greek god Zeus and featured competition in sports such as running, throwing, jumping, boxing, and wrestling. To compete in the games an athlete had to be male, train for a minimum of 10 months, be a free man, maintain a perfect physique and good moral character, have no criminal record, compete within the rules, and sign (along with his father, brothers, and trainer) the athletes oath. Once entered, the athlete was forced to compete, with no allowanced for illness or injury. The Olympic Games were officially brought to an end by Roman law in 393 A.D. (Langley & Hawkins, 2004).

The rise of the Roman Empire (500 B.C.-476 A. D.) was characterized by a great military civilization and an "all work and no play" mentality. However, as Rome's control grew, extravagant living, love for luxury, and pursuit of physical pleasure entered the Roman way of life. Their thirst for entertainment turned away from exercise participation in favor of spectator sports. The carnal nature of the Roman Empire created a desire for bloody and violent games. These games consisted of fights between trained gladiator slaves, and the winner often was ordered to kill his opponent for the spectator's enjoyment. The Roman Empire also gave birth to one of the world's first sports medicine specialist, a physician known as Galen. Galen was one of the earliest known people to recognize and write about the health and therapeutic benefits of exercise and rest (Langley & Hawkins, 2004).

Following the fall of the Roman Empire in 476 A.D., the world entered the turbulent period known as the Middle Ages (5^{th}-15^{th} centuries). Europe flourished in the Age of Feudalism between the 9^{th}-14^{th} centuries. During this time most boys were either trained for work in the church or knighthood. Training for knighthood involved learning skills such as boxing, fencing, and swimming. At the age of 14 boys were able to become squires, during which time was spent perfecting the skills to be used in hunting, scaling walls, swordsmanship, and riding. At the age of 21 the squires who were deemed worthy were inducted into knighthood. Their responsibility was then not only to provide protection of the land but also to participate in jousting tournaments. Cultural rebirth was celebrated with the age of Renaissance. Among the ideas that characterized this period were the unity of the body, mind, and spirit, the relationship of physical health and learning, and the benefits of rest and recreational activities to relieve the stress of studies and work (Langley & Hawkins, 2004). After the Renaissance Europeans began to promote physical education to emerging nations, which would eventually spread to the United States where many of the European physical activity programs would be adopted (Dalleck & Kravitz, 2011).

In the late 1700s Johann Bernhard Basedow founded a school for boys in Dessau, Germany. The educational philosophy of this school was centered on the philosophy of naturalism and developing the whole individual, which included the addition of physical exercise, especially gymnastics (LaVague-Manty, 2006). Basedow's ideas grew away from the typical strict ways of learning and centered on the enjoyment of learning while meeting the needs of the students. Other schools began mirroring the idea of incorporating physical exercise into the daily curriculum. This led the way to today's current physical education in the schools. Archibald Maclaren (1820-1884) made significant contributions in physical education because he believed it promoted health. He thought that the mind and the body were inseparable, and strongly believed physical education should be part of a school's curriculum. The main activities in physical education were gymnastics, fencing, running, dancing, and marching. Other European individuals who had a profound impact on developing physical education programs were Henrick Ling (1776-1839), Friedrich Ludwig Jahn (1778-1852), and Johann Christoph (1759-1839) (West & Butcher, 2009).

In the 1800s increased opportunities for engaging in physical activities such as gymnastics and swimming became available in schools and colleges. The demand for exercise grew, and the Young Men's Christian Association (YMCA) was created in the 19th century. The first YMCA in the United States was created in 1851 by Thomas Valentine Sullivan in Boston, Massachusetts, and focused on developing the whole person through physical training and unity of the mind, body, and spirit (Wuest & Butcher, 2009). The YMCA became successful at its mission by strengthening communities. The organization partnered with local businesses to provide sponsorships that gave everyone in the community the opportunity to learn through programs offered. Some of the programs included swimming, recreation, competitive and youth sports. Educational classes are also offered that help children and adults learn to read. Today, the YMCA is located in over 10,000 neighborhoods in the United States (Young Men's Christian

Association, 2011). Another significant part of the history of exercise is the rebirth of the Olympic Games in 1896, which continues to bring citizens of different countries together for participation in physical exercise and sport (West & Butcher, 2009).

Prior to the 19th century exercise and certain types of physical activity were predominately reserved for men. However in the mid-1800s Elizabeth Blackwell focused on efforts to promote exercise participation for women. Blackwell had experience in extensive medical training and knew of the great physiological and anatomical benefits of exercise for both men and women. She educated school administrators on the importance of offering daily physical education for both genders. She stated that a lack of physical activity was a leading cause of many girls to have impaired health before maturity (Park, 1978). Catherine Beecher was another pioneer for women's participation in exercise. She introduced women to the world of callisthenic exercises, which were exercises that used a person's own body weight as the mechanism for resistance. Beecher's focus was on educating women and implementing exercise, and she also played a significant role in the establishment of women's colleges in the 1830s (The Beecher Tradition, 2011). Another female pioneer was Adele Parot, a teacher and gymnastics leader. Parot played an important role in implementing the need for mandatory physical education in California in the 1860s. Dudley Sargent and Mary Hemenway were also important figures in physical education by helping create gymnastics in schools for both boys and girls (Park, 1978).

Although physical education was supported in the academic criteria in the early 20th century, it was soon removed from the schools because of budget cuts during the depression. At the time of WWII, President Eisenhower took a formal approach to exercise because of the rising numbers of unhealthy Americans. Eisenhower wanted to make sure all children and youth had the opportunity to be physically conditioned. Eisenhower's encouraged a physical fitness movement that prompted the growth for fitness organizations such as the YMCA (Vaughan, 1973). Although the 20th century showed an increased interest in sports, there remained an alarming number of health concerns related to exercise and poor nutrition (Johnson & Dehpande, 2000). Life expectancy in the United States declined, and although obesity levels remained steady in the 1960s-1970s, there was a 50% increase each decade throughout the 1980s-1990s (Olshansky et al., 2005).

At the beginning of the 21st century the focus on exercise shifted from sports and competition to engagement for recreational and health concerns. Due to the rise in obesity, researchers started producing studies showing positive correlations between quality of life and exercise. Programs such as Coordinated School Health and the Surgeon General's Report were created in an effort to address health issues and create opportunities for exercise. Childhood obesity has become an increasing epidemic. Children have developed a sedentary lifestyle worsened by watching television and playing video games (Johnson & Deshpande, 2000). Although state governments have developed physical education and activity requirements for schools to follow, some schools have eliminated or severely decreased the exercise programs because of the increase demand to improve grades and standardized testing scores (American Council on Exercise, 2009). The American Council on Exercise (2009) revealed the importance of exercise participation in the schools through a study of 12,000 adolescents. This study showed active adolescents to be 20% more likely to earn an "A" letter grade than their sedentary classmates. Another research study performed by Castelli, Hillman, Buck, and Erwin (2007) suggests that exercise was directly related to academic success. Even with results revealing the importance of being physically active, in 2006 only 3.8% of United States elementary schools offered daily physical education (Greene, 2011).

Benefits and Limits of Exercise

In 1980 the Public Health Service listed physical fitness and exercise as one of the 15 areas of concern related to improving the country's overall health (Powell & Paffenbarger, 1985). It was becoming clear to American citizens that physical inactivity was a major public health concern. In 1996 the Surgeon General's Report on Physical Activity and Health was published (U.S. Department of Health and Human Services, 1996). This report stated that physical inactivity was killing U.S. adults; 60% of U.S. adults did not engage in the recommended amount of physical activity, and 25% were not active at all. This report continues to be produced by the Surgeon General to continue to inform American citizens on the nation's health concerns.

The present interest in exercise and health was stimulated in the early 1950s by two intriguing findings: 1) autopsies of young soldiers killed during the Korean War showed that significant coronary artery disease had already developed, and 2) American children performed poorly on a minimal muscular fitness test when compared to European children (Van Dalen & Bennett, 1971). Americans began to recognize benefits to exercise, and President Kennedy expressed his concerns about the nations fitness in an article published in Sports Illustrated titled "The Soft American" (1960): For the physical vigor of our citizens is one of America's most precious resources. If we allow it to dwindle and grow soft, we will destroy much of our ability to meet great and vital challenges that confront our people. We will be unable to realize our full potential as a nation. (p.17)

Based on a large body of evidence from epidemiological studies and clinical investigations, regular exercise has many positive effects on a person's overall health and quality of life. Such positive effects include the following (Powers & Howley, 2004):

1. lowers the risk of dying prematurely and from heart disease
2. reduces the risk of developing diabetes and high blood pressure
3. helps maintain weight and healthy bones, muscles, and joints
4. helps lower blood pressure in those with high blood pressure
5. promotes psychological well-being

Physical activity and exercise prevent occurrences of cardiac events; reduce the incidence of stroke, hypertension, type 2 diabetes mellitus, colon and breast cancers, osteoporotic fractures, gallbladder disease, obesity, depression, anxiety; and delay mortality (ACSM, 2009). Exercise is also strongly recommended to lower elevated levels of total cholesterol, LDL-cholesterol, and triglycerides. It will also raise low levels of HDL-cholesterol (Mazzeo & Tanaka, 2001). A report from the Center for Disease Control (2009) stated that routine exercise increased life expectancy. Pellegrini and Smith (1998) described exercise as not only being connected to physical aspects but also being connected to the well-being of the whole individual. Brown et al. (2003) agreed with Pellegrini and Smith (1998) that individuals who met daily recommendations for exercise participation were associated with having a better overall quality of life. A study by Aberg et al. (2009) found a connection between cardio fitness and cognition in youth. Exercise showed to strongly affect brain plasticity and protect against dementia. Exercise also improved memory. Slemend, Miller, Hui, Reister, and Johnston (1991) tested and surveyed 159 children and found the more active the child, the higher the child's bone mass, which ultimately resulted in stronger bones. Ratey and Hagerman (2009) found exercise to be directly connected with physiological benefit by promoting the release of proteins into the bloodstream, which increases the production of brain chemicals. This production triggers a creation of new neurons, which results in increased focus and feeling of calmness among those who are physically active.

Researchers have also observed many reasons individuals choose to be inactive or sedentary. Sedentary activities that are often chosen over exercise are watching television, reading, and working on the computer. Computer use, gaming systems, cell phones, and the continuing rise of technology have created a barrier to participation in physical activity (Must & Tybor, 2005). Salmon (2003) revealed other barriers keeping individuals from participating in exercise such as high cost, lack of sleep, lack of access to exercise facilities, time constraints, weather conditions, and barriers that mainly contribute to sedentary lifestyle, such as being overweight. Must and Tybor (2005) found overweight and obese children to have more pain associated with exercise, more isolation, and fewer friends. Overweight and obese children and adults are more likely to engage in sedentary activities because of their weight. For instance, Vanderwater, Shim, and Caplovitz (2004) found obesity to likely be caused by the use of electronics such as video games, television, and computers. Locard et al. (1992), found children who engaged in more than 4 hours of television time per day to be twice as likely to be obese.

Recommendations for Exercise

Physical activity is defined as "bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure (p.3)" (ACSM, 2009). Exercise is a type of physical activity and is defined as planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness. Physical fitness is an attribution people possess or achieve that relates to the ability to perform physical activity. Health related physical fitness is associated with the ability to perform daily activities with vigor, and the possession of traits and capacities that are associated with a low risk of premature development of diseases. The health related components of fitness include cardiovascular endurance, muscular strength and endurance, flexibility, and body composition.

The Surgeon General's Report (2010) recommends at least 150 minutes of moderate-vigorous exercise per week for adults, 60 minutes of daily vigorous exercise for children and teenagers. Recommendations for exercise in order to see health benefits are at least 30 minutes of moderate exercise for more than 5 days per week, or at least 20 minutes of vigorous exercise on at least 3 days per week (U.S. Department of Health and Human Services, 2010). Table 1 displays the classifications of exercise intensity according to the ACSM (2009):

Table 1

Exercise Intensity and Heart Rate Reserve

Physical Activity Intensity	**Heart Rate Reserve Maximum HR (220-Age) – Resting HR**
Very Light	< 20
Light	20 – 30
Moderate	40-59
Hard (Vigorous)	60-84
Very Hard	≥ 85
Maximal	100

In 2001 ACSM updated its Position Stand on weight loss and prevention of weight gain for adults and concluded that overweight adults should increase their exercise to approximately 45 minutes per day (200-300 minutes per week) to assist in weight loss and prevent weight gain. The following year the Institute of Medicine (IOM) recommended 60 minutes per day of moderate exercise to prevent weight gain and for additional weight-independent health benefits (Food and Nutrition Board, Institute of Medicine, 2002). Saris et al. (2003) concluded that 45-60 minutes of moderate exercise per day is required to prevent the transition to overweight and obesity in adults, and prevention of weight regain may require 60-90 minutes of moderate exercise per day.

These reports listed above emphasize an additional volume of exercise greater than the recommendation by the Surgeon General's report. These recommendations are necessary in order to prevent the onset of obesity, affect weight loss in overweight adults, and prevent weight regain in formerly obese adults (ACSM, 2009). However, health benefits can be gained with 30 minutes per day of moderate exercise. Studies in men and women of different races have shown risk reductions of 20% to 50% in coronary heart disease and cardiovascular disease incidence rates with moderate exercise when compared with sedentary behavior (Lee et al., 2001). The accumulation of 30 minutes per day of moderate exercise can be accomplished in short bouts throughout the day. However, greater benefits occur at higher duration and/or intensity of exercise participation (ACSM, 2009).

The ACSM recommends cardio-respiratory fitness training most days of the week such as walking, jogging, running, swimming, cycling, rowing, and dancing. The combination of adequate flexibility and strength allows individuals to do the activities of daily living comfortably and safely. Strength training is recommended 2-3 days per week, and flexibility stretching 3-7 days per week. Maintenance of muscle mass has implications related to weight control and integrity of the skeletal system (Powers & Howley, 2004).

Bioelectrical Impedance Analysis

Basic body composition is expressed as the relative percentage of body mass that is fat and fat-free tissue and is estimated with both laboratory and field techniques that vary in terms of complexity, cost, and accuracy. Measurements of height, weight, circumferences, and skinfolds are several methods used to estimate body composition. Skinfold measurements are more difficult than other procedures but provide a better estimate of body fatness than those based on height, weight, and circumferences. Techniques of bioelectrical impedance analysis (BIA) is used for general health fitness testing, and the accuracy of BIA is similar to skinfolds as long as proper protocol is followed and the equations programmed into the analyzer are valid and accurate for the populations being tested (ACSM, 2009).

The medical weight loss clinics of Charlotte, North Carolina use a Tanita scale for measurements of BIA. The Tanita is designed to be used by healthy adults and children over the age of 5 who engage in active, moderately active or inactive lifestyles. It can be used in the screening of certain adult diseases and conditions related to body weight and composition as well as monitoring and prevention of conditions caused by excessive deposits of fat tissue, such as diabetes. It also can be used for monitoring of changes in individuals body composition related to differences in the ratio of fat tissue to lean and can assess the effectiveness of individual's nutrition and exercise programs both for health and physical fitness (TANITA Corporation of America, 2010). The Tanita is simple to use and requires no specialized facilities to take measurement. The measurement can be taken quickly and easily, causing minimal inconvenience to the patient, and is ideal for facilities collecting measurements for a large quantity of patients on a daily basis.

The Tanita uses a patented “foot to foot” pressure contact electrode BIA technique to measure fat-free mass, total body water, fat mass, and percent body fat (Nunez et al., 1997). Fat-free mass is comprised of muscle, bone, tissue, water, and all other fat-free mass in the body. Total body water reflects the amount of water in the body and is part of the fat-free mass. Fat mass is the actual fat in pounds in the body, and body fat percentage is the amount of body fat as a proportion of total body weight (TANITA Corporation of America, 2010).

The BIA technique is based on the fact that lean tissues have a high water and electrolyte content and thus provide a good electrical pathway (Heyward, 1996). Fat mass contains a lower percentage of body water and thus is a poor conductor of the electrical signal. By inducing a low energy, high frequency, electrical signal (50 kHz, 90 μA), a measurement of the baseline resistance to the flow of electrical current can be made. This current is passed through the anterior electrode on the scale platform, and the voltage drop is then measured on the posterior electrode. The resistance measurement relates directly to the volume of the conductor that is used to determine total body water, fat-free mass (lean body mass), and fat mass. Percent body fat is calculated on the Tanita by combining impedance and weight measurements with height, gender, and age information (TANITA Corporation of America, 2010).

To collect body composition in the BIA method, the Tanita sends out a very weak electric current to measure impedance (electrical resistance) of the body that fluctuates in accordance with the distribution of body fluid using water as an electrical conductor. Therefore, for the purpose of research the measurement conditions must be kept constant. Measurement under the changing conditions of temperature and total body water distribution, or blood flow volume of extremities due to exercising, taking a bath, intake of fluids, etc., affects the measurement result because the electric resistance in the body also changes. Because there are many factors that can influence the accuracy of these measurements, the following proper protocol should be followed (Tanita Corporation of America, 2010):

1. Avoid intense exercise 12 hours before the test
2. Avoid eating or drinking (especially caffeinated products) 4 hours before the test
3. Avoid alcohol 12 hours before the test
4. If possible, empty bladder prior to testing
5. If possible, avoid all diuretics for 7 days before testing
6. Do not excessively overeat or drink the day before measurement
7. Measurement of females during menstruation may result in inaccurate readings
8. Measurement of pregnant women may result in inaccurate readings
9. Always hold both arms straight down when taking measurements
10. Make sure the soles of feet are free of excess dirt, as this may also act as a barrier to the mild current
11. Do not take measurements while using transmitters such as cellular phones that may affect readings
12. Measurements should be made at the same time under similar conditions in order to get a more accurate picture of the measurements over time
13. Keep the electrodes clean by wiping them with disinfectant
14. Do not drop the unit and avoid locations with constant vibration
15. Do not put this equipment in direct sunlight, close to heaters, or near direct draughts from air conditioners

Taking measurement at the same time of day should yield optimal results. If consistent test conditions are maintained, results will be consistent and reproducible. Many successful weight loss and maintenance programs rely on long-term commitment and motivation. Measuring body composition consistently over a period of several months may provide helpful insight to the progression of a program. According to the TANITA Corporation of America (2010) trending over a period of time is the most effective way to incorporate body composition analysis in a health assessment, or a weight management environment. However, situations may arise where individuals can not adhere to every pretest condition. Reliable results are still possible because the skew should be consistent in subsequent tests. In other words, if a patient returns to normal daily behavior, the impedance should return to coincide with past readings at another future measurement.

Patient Consultations

A key component of weight management is sound dietary and exercise counseling (Galbreath, 2008). Part of the medical weight loss clinics of Charlotte, North Carolina program is for patients to weigh-in and have consultations with a medical provider each week during the weight loss phase. Part of the consultation consists of the discussion of weekly exercise participation. In order to track the success of patients, the medical provider records each patient's nutrition plan and exercise activity in the clinic's computer system. Patients at the medical weight loss clinic are asked to record daily nutrition and exercise participation in a journal or phone application. However, not all patients record each week during the program. Because the medical provider cannot physically observe patients during daily eating and exercise habits, discussions are built on a foundation of trust that patients are telling the truth during the weekly consultations. One of the main factors affecting reliability of any consultation or interview is receiving false information provided by the subject to the examiner (Fisher, Kristen, Mann, &

Vrij, 2007). If a patient's nutritional information and exercise activity does not consistently correspond to the numbers provided by the Tanita scale, the provider is to discuss truthful accountability with the patient. In most, but not all, cases patients want to maintain a successful weight loss and are willing to provide correct information to the medical provider. The data recorded in the clinic's computer system are based on the information received by each medical provider during the patient's weekly consultation.

Summary

The incidence of obesity is increasing rapidly. Unhealthy weight gain due to poor diet and lack of exercise is responsible for over 300,000 deaths each year (U.S. Department of Health and Human Services, 2010). Two thirds of the American adult population (Flegal et al., 2010), and nearly one in three children are overweight or obese (Ogden et al., 2010). Obese adults are at increased risk for many serious health conditions, and some are preventable and even reversible through proper diet and exercise changes. High protein and low to normal carbohydrate diets have shown to make improvements in weight loss, maintaining muscle mass, and improving blood markers in all ages. The Center for Disease Control (2009) and the ACSM (2009) both recommend participation in exercise in order to prevent many diseases and improve an individual's overall quality of life. Healthy nutritional changes may be the main component in weight loss, but participation in exercise is vital in weight maintenance. Although a higher participation in exercise is recommended for weight maintenance versus weight loss, the ACSM guidelines (2009) recommend cardiovascular training most days of the week, strength training two-three times per week, and flexibility training three-seven times per week.

The transition from high school to college has been identified as a time period for an increased chance of weight gain (Gow, 2008). In 2010 the Center for Disease control reported that participation in exercise has declined with age. Results of this study showed only 18% of high school students participated in 60 minutes of daily exercise. If proper nutrition and exercise habits are not practiced in high school, the change of weight gain during the freshman year of college increases. Research by Williamson et al. (1990) suggests obesity prevention should begin among adults in their early 20s and that special emphasis is needed for young women who are already overweight.

Research efforts for effective treatment strategies are focusing on diet and exercise programs, the components of which have been investigated in intervention trials in order to determine the most effective recommendations for weight loss and maintenance. The primary objective of a weight loss trial has been the reduction in body fat leading to a decrease in risk factors for metabolic syndrome. However, a decline in fat-free mass (lean tissue) can frequently be observed. Given that fat-free mass represents a key component in the magnitude of resting metabolic rate, a decrease in lean tissue could hinder the progress of weight loss. Therefore, the loss of fat mass while maintaining fat-free mass is desirable on a weight loss program (Stiegler & Cunliffe, 2006). Diet interventions with a higher protein, lower fat and carbohydrate intake have shown significant outcomes in reduction in fat mass and retention of fat-free mass. Exercise participation, especially strength training, has been shown to improve fat-free mass and fat mass numbers in those participating in weight loss (Galbreath, 2008).

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study is to determine the effectiveness of exercise participation during weight loss on a high protein-low carbohydrate medical weight loss diet plan in females aged 15 to 25 years. Specifically, the researcher sought to compare markers of health such as weight, fat mass, percent body fat, and fat-free mass in individuals who exercised consistently during the weight loss program with those who did not participate in consistent exercise. The subjects in the study were previous patients at the medical weight loss clinics of Charlotte, North Carolina. Only existing data from the former patients were analyzed and collected for this study.

This study is a quantitative study that examines weight loss on a 12-week, high protein-low carbohydrate weight loss diet plan, and the differences in females who exercised consistently during the program and those who did not participate in regular exercise. Participants' body weight, fat mass, percent body fat, and fat-free mass were analyzed using measurement of a Tanita scale. The Tanita scale uses bioelectrical impedance analysis for monitoring of changes in individuals body composition. Exercise participation was documented during the participants' weekly consultations. Those classified as "Exercisers" during the weight loss program had to meet the minimum exercise requirements of moderate to vigorous exercise 30 minutes at a time, totaling 150 minutes per week. Those classified as "Non-Exercisers" during the weight loss program only exercised a maximum of 60 minutes total per week. It is important for college-aged students, and those working to help improve the health of college-aged students, to better understand the impact exercise participation has on body composition statistics during a weight loss program so maximum results can be achieved and even maintained long term.

Research methods designed and used for this study are discussed in Chapter 3. Within this section the following are provided: research questions, instrumentation, population, data collection, data analysis, and summary.

Research Questions and Null Hypotheses

The following research questions and corresponding null hypotheses guide this study. The questions are focused on weight loss and exercise participation and its effect on fat mass, percent body fat, and fat-free mass in females aged 15-25 years. The questions also address the differences in weight loss with minimal exercise participation.

Research Question #1: Is there a significant difference in weight loss in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program?

H_0 1: There is no significant difference in weight loss in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program.

Research Question #2: Is there a significant difference in fat mass reduction in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program?

H_0 2: There is no significant difference in fat mass reduction in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program.

Research Question #3: Is there a significant difference in fat-free mass reduction in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program?

H_0 3: There is no significant difference in fat-free mass reduction in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program.

Research Question #4: Is there a significant difference in percent body fat reduction in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program?

H_0 4: There is no significant difference in percent body fat reduction in females who participated in consistent exercise (exercisers) when compared to females who did not consistently exercise (non-exercisers) during the weight loss program.

Instrumentation

The Tanita body composition scale was used to measure subject's weight, fat mass, percent body fat, and fat-free mass. Tanita uses a patented foot to foot pressure contact electrode Bioelectrical Impedance Analysis technique (Nunez et al., 1997). The BIA technique is based on the fact that lean tissues have a high water and electrode content and thus provide a good electrical pathway (Heyward, 1996). Fat mass contains a lower percentage of body water and thus is a poor conductor of the electrical signal. By inducing a low energy, high frequency electrical signal (50 kHz), a measurement of the baseline resistance to the flow of electrical current can be made. This current is passed through the anterior electrode on the scale platform, and the voltage drop is then measured in the posterior electrode. The resistance measurement relates directly to the volume of the conductor that is used to determine total body water, lean body mass, and finally fat mass. Percent body fat as calculated by Tanita is a highly researched proprietary formula combining impedance and weight measurements with height, gender, and age information. Measurements from the Tanita were taken and recorded on each subject once per week for 12 weeks. Although the Tanita scale has been shown to produce valid body composition readings, the statistics are limited to the reliability of patients following the proper protocol prior to measurement. Patients were not required or able to follow all protocols listed in the Tanita manual at each measurement. However, it is assumed the bioelectrical impedance readings were comparable to those of other readings from each subject who did not follow protocol.

During the weight loss program, patients are required to have weekly consultations with a medical provider. Part of the weekly consultations consists of the discussion of exercise participation. In order to track the success of patients, the medical provider records each patient's nutrition plan and exercise activity in the clinics computer system. Patients were asked to record daily nutrition and exercise habits in a journal. The medical providers cannot physically observe patients during the day and are obligated to trust patients were telling the truth during weekly consultations in regard to both nutrition and exercise habits. External validity is a potential limitation because patients have a tendency to embellish on the truth concerning their exercise participation. It is assumed the majority of patients stated valid information concerning their diet and exercise participation each week during their consultation with a medical provider. If a patients nutritional information and exercise activity does not consistently correspond with the numbers provided by the Tanita scale, the provider is to discuss truthful accountability with the patient.

Population

The medical weight loss clinics of Charlotte, North Carolina was selected for the study because of access to patient interaction and information. Approximately 80 females aged 15-25 years were analyzed for the study. There were 40 subjects who did not exercise consistently during the weight loss program and placed in the "exercise" group and 40 who did participate in consistent exercise and placed in the "non-exercise" group. All subjects were put on a weight loss diet consisting of high protein-low carbohydrate nutrition and were required to weigh-in at the clinic on the Tanita scale, and meet with a medical provider to discuss their nutrition and exercise participation once per week for 12 weeks. After each consultation all information from the Tanita measurement and information collected by the medical provider were documented in the clinics computer system.

The sampling technique included two types of nonprobability sampling, reliance on available subjects and criterion sampling. Because only subjects of the medical weight loss clinics of Charlotte were used, the study relied only on the subjects who previously enrolled and willingly participated in the weight loss program. Stratified sampling of the female subjects into groups occurred based on their exercise participation after completing 12 weeks on the diet plan.

Data Collection

Approval was attained from the East Tennessee State University's Institutional Review Board before data were collected. Approval was also granted by the Medical Supervisor and owners of the weight loss clinics in Charlotte, North Carolina. All data were collected in the spring of 2013 from patients who previously participated in the weight loss program. The researcher, employed by the medical weight loss clinic, was given no identifiable patient information. Ethical reporting from the researcher is projected. Data analysis is presented in Chapter 4.

Patients of the weight loss clinics receive a physical by the supervising medical provider at the initial visit to the clinic, prior to receiving their nutrition plan. Prior to beginning the program, patients also sign a waiver to be treated by the medical providers. The patients agree to come in weekly to the clinic to be weighed and consulted by a medical provider. They also agree to write down their food intake and exercise participation in a journal. All patients participating in the study were placed on a high protein-low carbohydrate diet plan consisting of approximately 600-800 protein calories plus vegetable, fruit, and healthy fat servings. All subjects were measured and consulted for a minimum of 12 weeks.

Although patients were informed of the health benefits to exercise participation and were not required to exercise during the 12 weeks. Patients had the opportunity to choose their own exercise participation during their weight loss. Subjects selected as “Exercisers” for the study had to meet the minimum qualifications of completing moderate-vigorous structured exercise most days of the week for a minimum of 30 minutes at a time, totaling at least 150 minutes per week. Subjects selected as “Non-Exercisers” only exercised a maximum 60 minutes per week. Structured exercise for the study is defined as exercise designed to improve cardiovascular function, such as running, jogging, cycling, swimming, aerobic classes, etc.; or also designed to improve muscle strength, such as weight and resistance training, and plyometrics.

Before collecting data, all medical providers were trained in proper protocol for Tanita measurements and calibration. Tanita scales were calibrated once per week at the clinic for patient measurement consistency. The Tanita measurements were immediately recorded into the computer system once the measurement was taken from each subject. The statistics from patient's initial weight, fat mass, fat-free mass, and percent body fat readings from the Tanita scale were compared and contrasted with the final (12th) week readings. All subjects were informed of the proper protocol to follow prior to getting measured, as defined in Chapter 2. Measurements were taken ideally at the same time, on the same day, once per week. Medical providers were also instructed to look at patients journals once per week and accurately record their weekly nutrition and exercise participation into the computer system.

To protect patient privacy only data from previous patients were used for this study. The data were collected only by providers working at the medical weight loss clinics of Charlotte. All providers are required to follow proper Health Insurance Probability and Accountability Act (HIPAA) guidelines. The names and personal information of patients were never used in the study. Patient's gender, age, exercise frequency, and body composition numbers were the only data needed for this research study.

Data Analysis

After the patients completed the 12-week program, their exercise participation were categorized into one of two groups: "Exercisers" - females who exercised consistently during the weight loss program and "Non-Exercisers" – females who did not participate in consistent exercise. The "Exercisers" had to meet the minimum qualifications of completing moderate-vigorous structured exercise most days of the week for a minimum of 30 minutes at a time, totaling at least 150 minutes per week. The "Non-Exercisers" only exercised a maximum of 60 minutes per week.

The data were analyzed using the IBM-SPSS statistical package. Research questions are analyzed using series of independent t tests to determine if significant differences exist between the groups. All data were analyzed at the .05 level of significance.

Chapter Summary

The research design, participants, instruments, procedures, research questions, statistics, and summary are all presented in Chapter 3. In this quantitative study the researcher examined the effectiveness of exercise participation during a high protein – low carbohydrate weight loss program. In addition, the researcher compared differences in markers of health, such as weight, fat mass, percent body fat, and fat-free mass in females aged 15-25 years who exercised consistently during the weight loss program from those who did not exercise consistently during weight loss program.

CHAPTER 4

FINDINGS

The purpose of this study was to determine the effectiveness of exercise participation during weight loss on a high protein-low carbohydrate weight loss diet plan in females aged 15 to 25 years. Specifically, the researcher sought to compare markers of health such as weight, fat mass, percent body fat, and fat-free mass in individuals who exercised consistently during the weight loss program (Exercisers) with those who did not participate in consistent exercise (Non-Exercisers)

The data for the research study were previously collected at a physician weight loss clinic in Charlotte, North Carolina. Approval for use of these data was cleared by the owner and operator of the weight loss clinics and the Institutional Review Board of East Tennessee State University. The quantitative data indicators were weight, fat mass, percent body fat, and fat-free mass produced by measurements taken from the Tanita scale. The data were divided into two groups: “Exercisers” - females who exercised consistently and “Non-Exercisers” - females who did not exercise consistently. The females took part in the same nutrition plan but choose their own exercise participation during their first 12 weeks on the diet plan. Subject data collected from their initial Tanita measurements were compared and contrasted with the final (12th) week Tanita measurement.

The study sample consisted of females aged 15-25 years who participated in the medical weight loss program in Charlotte, North Carolina. Overall the study consisted of data collected from 80 participants; 40 Exercisers and 40 Non-Exercisers. The sample size was selected based from the number of patients at the clinic that met the proper gender and age range. The population in this study was selected due to the transition from high school to college being a critical period because it is associated with many lifestyle changes that can lead to weight gain (Anderson et al., 2003).

A series of independent t-tests were conducted to evaluate whether the mean amount of weight, fat mass, fat-free mass, and percent body fat differ between exercisers versus Non-Exercisers in females aged 15-25 years who participated in a high protein-low carbohydrate weight loss plan. The subjects' weight, fat mass, fat-free mass, and percent body fat were the test variables and the grouping variable were Exercise or Non-Exercise participation during the weight loss plan. The mean BIA data for the Exercise Group were -23.59 body weight, -19.37 fat mass, -4.08 fat-free mass, and -5.73% body fat. The mean BIA data for the Non-Exercise Group were -11.00 body weight, -7.83 fat mass, -3.43 fat-free mass, and -2.25% body fat.

Analysis of Research Questions

Research Question #1

Is there a significant difference in weight loss in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

> H_0 1: There is no significant difference in weight loss in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program.

An independent t-test indicated a significant difference in weight loss in Exercisers when compared to Non-Exercisers during the weight loss program, $t(78) = 7.26$, $p < .001$. Therefore, the null hypothesis was rejected. The Exercisers ($M = -23.59$, $SD = 8.97$) lost significantly more weight than the Non-Exercisers (M = -11.00, SD = 6.31). The 95% confidence interval for the difference in means was 16.05 to 9.14. Figure 1 shows the distributions for the two groups.

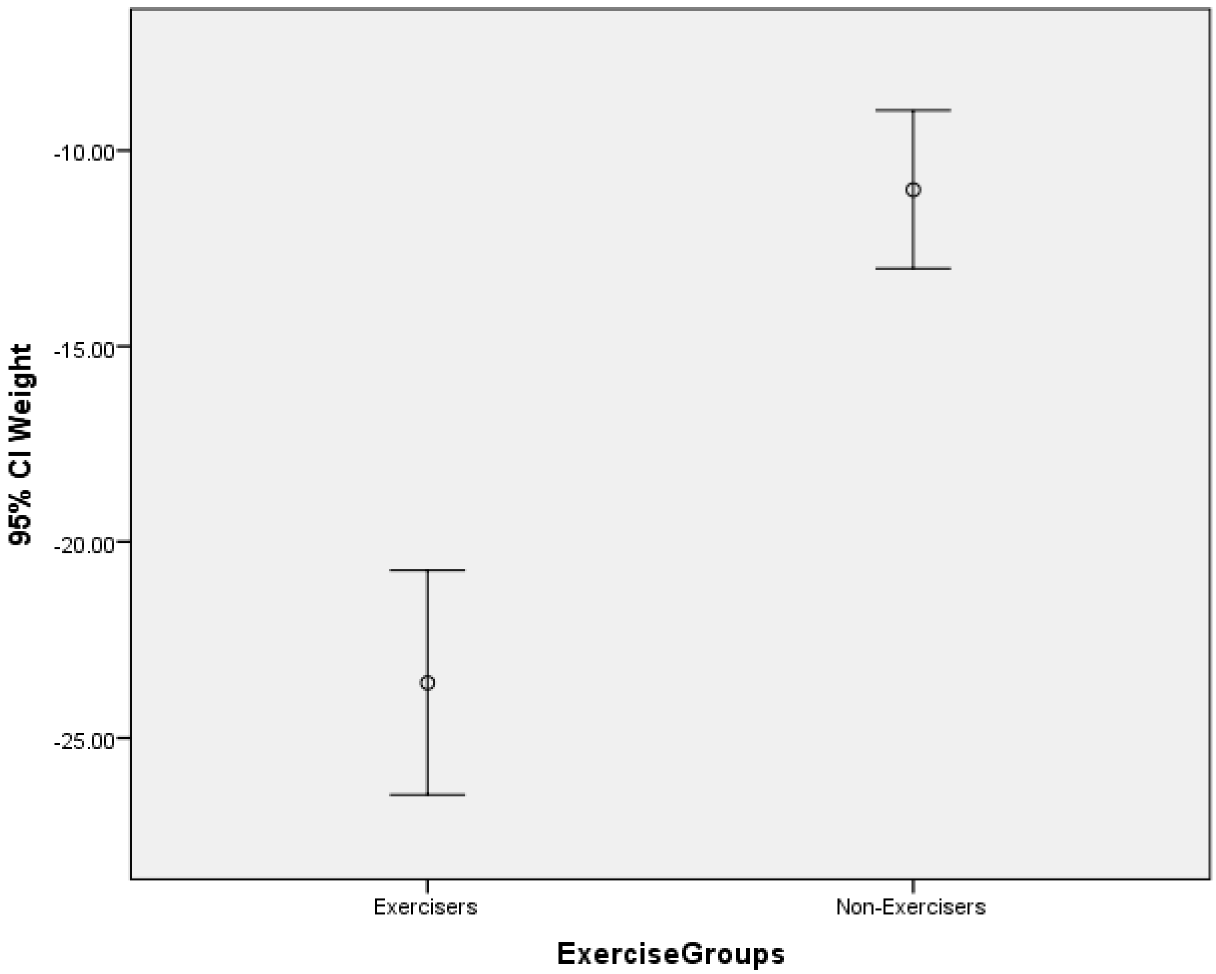

Figure 1. Distribution of Weight Loss in Female Exercise Groups

<u>Research Question #2</u>

Is there a significant difference in fat mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

H_0 2: There is no significant difference in fat mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program.

An independent t-test indicated a significant difference in fat mass loss in Exercisers when compared to Non-Exercisers during the weight loss program, $t(78) = 8.00$, $p < .001$. Therefore, the null hypothesis was rejected. Exercisers ($M = -19.35$, $SD = 7.22$) lost significantly more fat mass than Non-Exercisers ($M = -7.83$, $SD = 5.57$). The 95% confidence interval for the difference in means was 14.41 to 8.66. Figure 2 shows the distributions for the two groups.

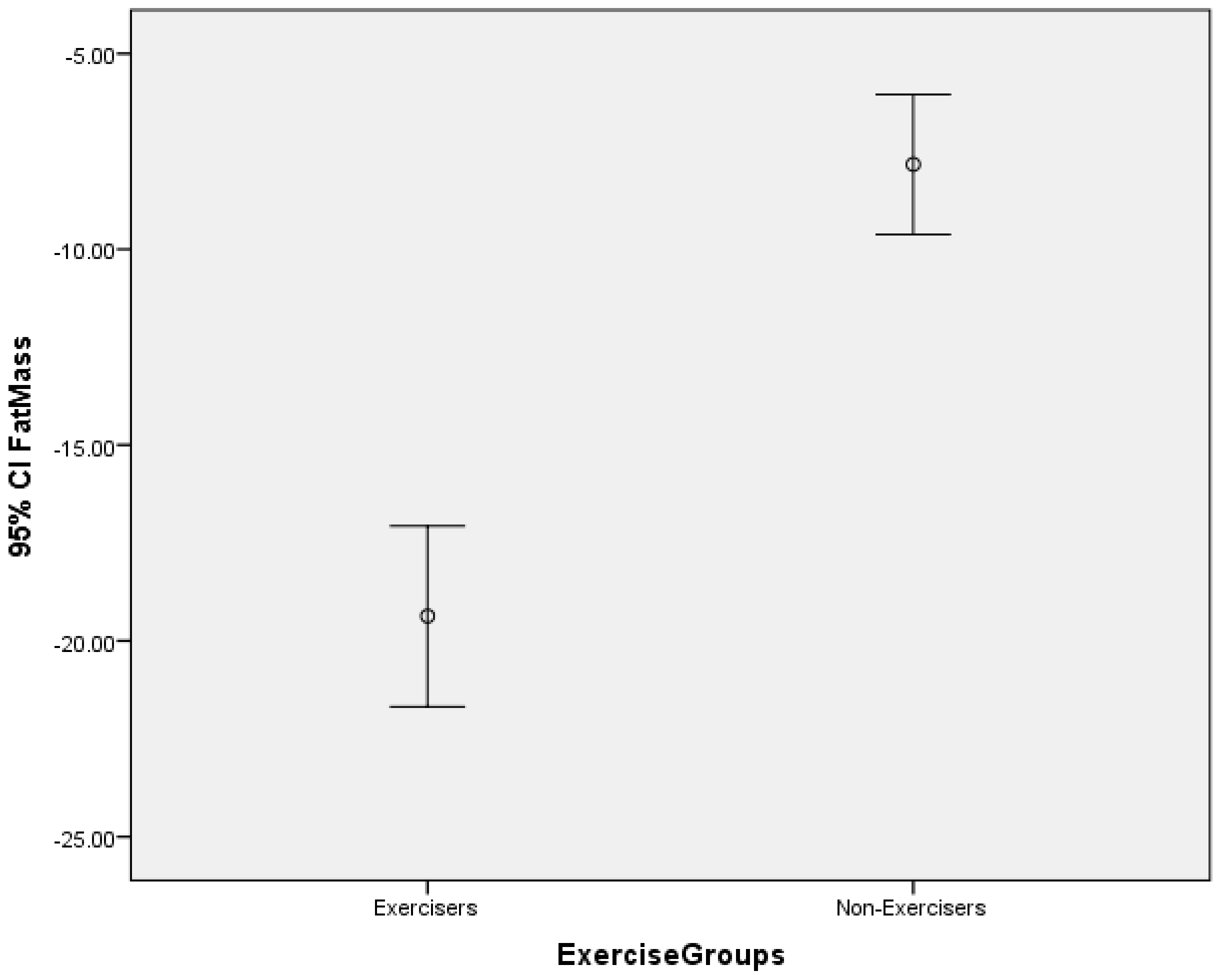

Figure 2. Distribution of Fat Mass Loss in Female Exercise Groups

Research Question #3

Is there a significant difference in fat-free mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

> H_0 3: There is no significant difference in fat-free mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program.

An independent t-test indicated no significant difference in fat-free mass loss in Exercisers when compared to Non-Exercisers during the weight loss program, t(78) = .694, p = .490, ns. Therefore, the null hypothesis was retained. Exercisers (M = -4.08, SD = 3.92) did not lose significantly more fat-free mass than Non-Exercisers (M = -3.43, SD = 4.53). The 95% confidence interval for the difference in means was 2.54 to 1.23. Figure 3 shows the distributions for the two groups.

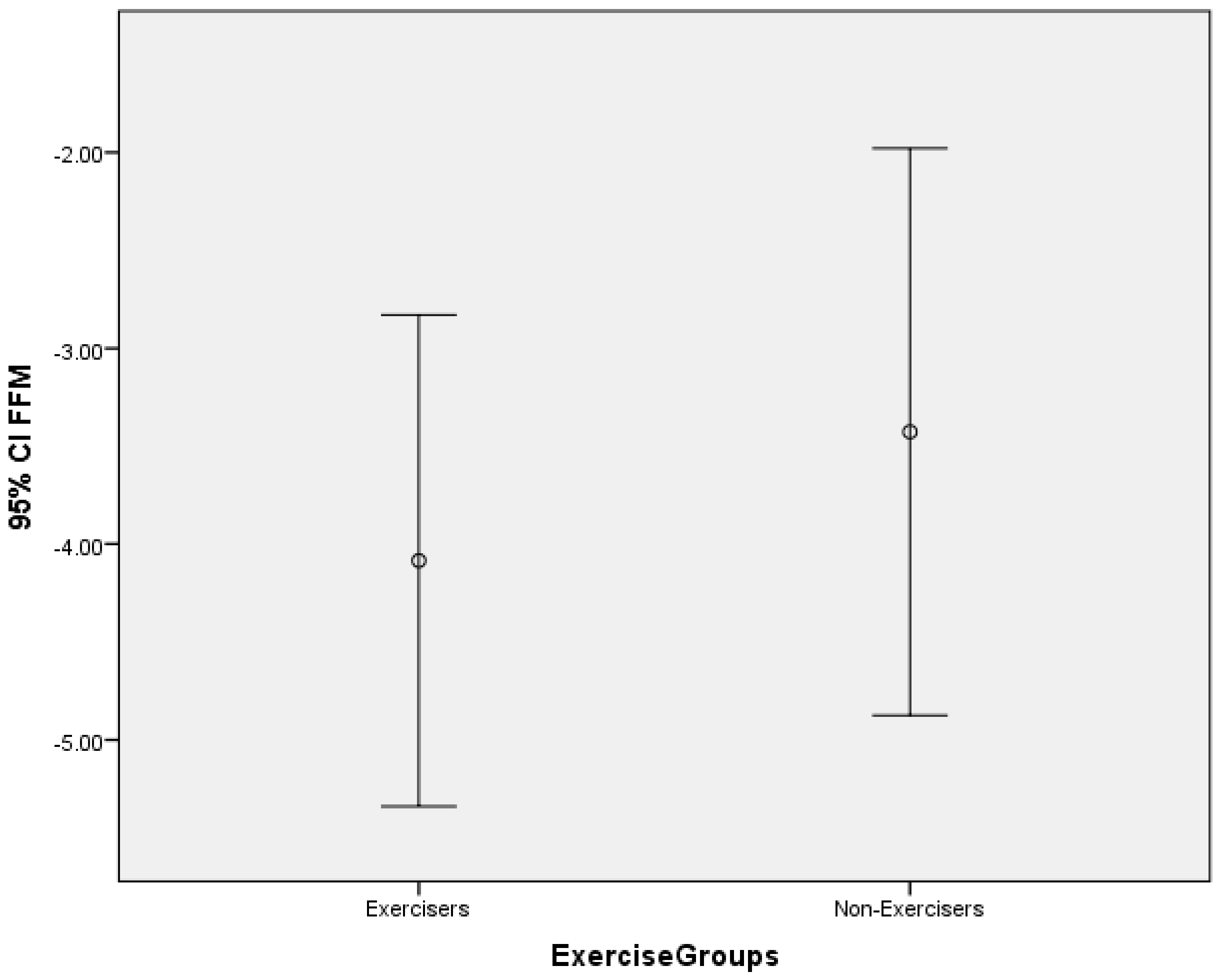

Figure 3. Distribution of Fat-Free Mass Loss in Female Exercise Groups

Research Question #4

Is there a significant difference in percent body fat reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

H_0 4: There is no significant difference in percent body fat reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program.

An independent t-test indicated a significant difference in percent body fat loss in Exercisers when compared to Non-Exercisers during the weight loss program, $t(78) = 7.52$, $p < .001$. Therefore, the null hypothesis was rejected. Exercisers ($M = -5.73\%$, $SD = 2.20\%$) lost significantly more percent body fat than Non-Exercisers ($M = -2.25\%$, $SD = 1.92\%$). The 95% confidence interval for the difference in means was 4.39% and 2.55%. Figure 4 shows the distributions for the two groups.

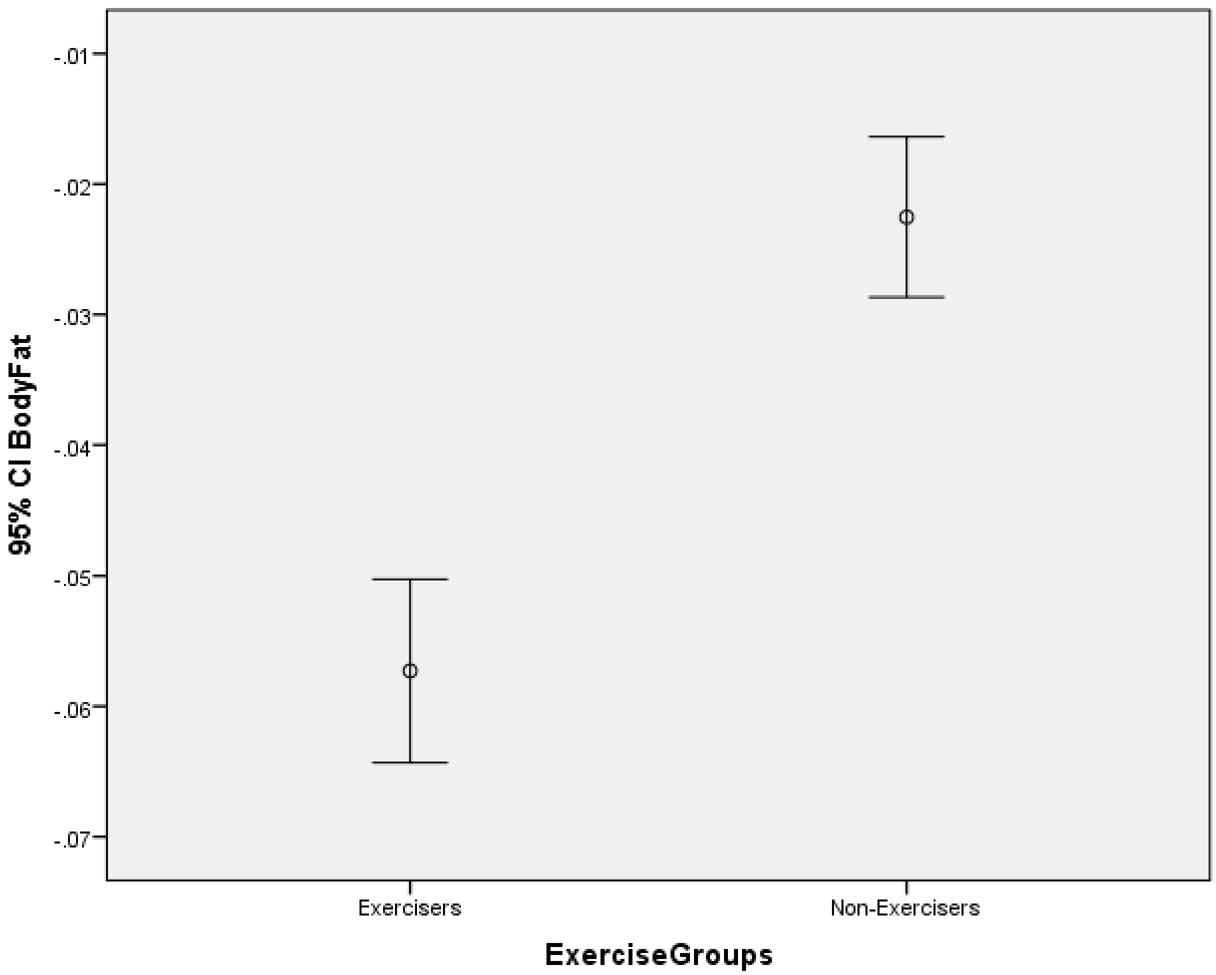

Figure 4. Distribution of Percent Body Fat Loss in Female Exercise Groups

The data were analyzed by running a t-test for independent means for research questions 1, 2, 3, and 4. Table 2 is a summary of t-tests for all subjects.

Table 2

Summary of t Tests for All Female Patients

BIA Measurement	Exercise Group	N	M	SD	t	P
Weight	Exercisers	40	-23.59	8.97	7.26	<.001
	Non-Ex.	40	-11.00	6.31		
Fat Mass	Exercisers	40	-19.37	7.22	8.00	<.001
	Non-Ex.	40	-7.83	5.57		
FFM	Exercisers	40	-4.08	3.92	.694	.490,ns
	Non-Ex.	40	-3.43	4.53		
Body Fat%	Exercisers	40	-5.73%	2.20%	7.52	<.001
	Non-Ex.	40	-2.25%	1.92%		

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS, RECOMMENDATIONS

Chapter 5 includes a summary of the study, findings of research questions, conclusions, and recommendations for future research for exercise participation in relation to weight loss measurements on a medical weight loss diet program as well as implications for future research. The purpose of this study was to determine the effectiveness of exercise participation during weight loss on a high protein-low carbohydrate diet plan in females aged 15 to 25 years. The data were collected from the females who were patients at a medical weight loss clinic in Charlotte, North Carolina. Specifically, this research study was a comparison of markers of health such as weight, fat mass, percent body fat, and fat-free mass in individuals who exercised consistently (Exercisers) during the weight loss program with those who did not participate in consistent exercise (Non-Exercisers). Only existing data from the former patients were analyzed and collected for this study.

Summary of the Study

This study is a quantitative study that examines weight loss on a 12-week, high protein-low carbohydrate diet plan, and the differences in females aged 15-25 years who exercised consistently during the program (Exercisers) and those who did not participate in regular exercise (Non-Exercisers). Participants' body weight, fat mass, fat-free mass, and percent body fat were analyzed using measurement of a Tanita scale. The Tanita scale uses bioelectrical impedance analysis for monitoring of changes in individual's body composition. Exercise participation was documented during the patients' weekly consultations. Existing data from former patients, 40 Exercisers and 40 Non-Exercisers, were analyzed and collected. The females in the Exercise Group had to meet the minimum exercise recommendations of 150 minutes of moderate-vigorous structured exercise per week. The females in the Non-Exercise Group ranged from no exercise to a maximum of 60 minutes per week. The analysis was based on four research questions. A *t* test for independent samples was used to identify the differences between the independent variables, Exercisers and Non-Exercisers, and the dependent variables, the loss of total weight, fat mass, fat-free mass, and percent body fat.

Summary of Findings

Four research questions guided this study and were evaluated at the .05 level of significance. A t test for independent samples was used to identify the independent and the dependent variables.

Research Question #1: Is there a significant difference in weight loss in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

An independent t test indicated a significant difference in weight loss in Exercisers when compared to Non-Exercisers during the weight loss program, $t(78) = 7.26$, $p < .001$. Therefore, the null hypothesis was rejected. Exercisers ($M = -23.59$, $SD = 8.97$) lost more weight than Non-Exercisers ($M = -11.00$, SD – 6.31). In 2009 ACSM concluded that overweight adults should increase their exercise to approximately 45 minutes per day (200-300 minutes per week) to assist in weight loss and prevent weight gain. The following year the Institute of Medicine (IOM) recommended 60 minutes per day of moderate exercise to prevent weight gain and for additional weight-independent health benefits (Food and Nutrition Board, Institute of Medicine, 2002). The results of this research question are consistent with previous research by Jakicic, Marcus, Gallagher, Napolitana, and Lang in 2003. Their study proposes that significant weight loss in overweight women was achieved through a combination of exercise and diet during 12 months. They found no significant difference in weight loss between exercise intensity and duration.

Research Question #2: Is there a significant difference in fat mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

An independent t-test indicated a significant difference in fat mass loss in Exercisers when compared to Non-Exercisers, $t(78) = 8.00$, $p < .001$. Therefore, the null hypothesis was rejected. Exercisers ($M = -19.35$, $SD = 7.22$) lost more weight than Non-Exercisers ($M = -7.83$, $SD – 5.57$). A previous study by Melanson, MacLean, and Hill (2009) is consistent with the results of this research question that exercise increases the capacity of muscle to oxidize fat mass. Their research went into further detail suggesting exercise intensity does not have an effect on daily fat mass reduction if caloric intake is unchanged. Furthermore participation in moderate doses of exercise will not burn greater amounts of fat mass unless changes are made to energy or fat intake.

Research Question #3: Is there a significant difference in fat-free mass reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

An independent t-test indicated no significant difference in fat-free mass loss in Exercisers when compared to Non-Exercisers, $t(78) = .694$, $p = .490$, ns. Therefore, the null hypothesis was retained. Exercisers ($M = -4.08$, $SD = 3.92$) did not significantly lose more fat-free mass than Non-Exercisers (M = -3.43, SD = 4.53). Initial weight loss could often be due to the loss of excess water. Diets generally result in a shortage of calories and force the body to use available, easily digestible calories; typically glycogen found in the muscle structure. The result is muscle and water loss, with little to no loss in fat mass (McArdle, Katch, & Katch, 2001). A report by Houston et al. (2008) highlighted the importance of protein intake for the preservation of fat-free mass. Their subjects in the highest protein consumption lost nearly 40% less fat-free mass than did subjects with low protein consumption. Patients taking part in the medical weight loss program for this research study did partake in a high protein-low carbohydrate diet plan in order to maintain as much muscle mass as possible while promoting weight loss from majority fat mass. Prior clinical studies and investigations continue to suggest that regular exercise has many positive effects on maintaining healthy muscles, bones, and joints (Powers & Howley, 2004).

Research Question #4: Is there a significant difference in percent body fat reduction in females who participated in consistent exercise (Exercisers) when compared to females who did not consistently exercise (Non-Exercisers) during the weight loss program?

An independent t-test indicated a significant difference in percent body fat loss in Exercisers compared to Non-Exercisers, $t(78) = 7.52$, $p < .001$. Therefore, the null hypothesis was rejected. Exercisers (M = -5.73%, SD = 2.20%) lost more percent body fat than Non-Exercisers (M = -2.25%, SD = 1.92%). Percent body fat is potentially dangerous to an individual's health. Therefore, it is not necessarily the amount of weight one has but the amount of body fat that is a better overall predictor of health. Body fat is vital to basic bodily functions, especially in women, such as regulating body temperature, storing vitamins, and cushioning joints, too much body fat can damage overall health. Reducing excess levels of body fat has shown in previous studies to reduce the risk of high blood pressure, heart disease, diabetes, and cancer (Gallagher et al., 2000).

Conclusions

The focus of this study was to determine the effectiveness of exercise participation during weight loss on a high protein-low carbohydrate diet plan in females aged 15 to 25 years. The data were collected from females who were patients at a medical weight loss clinic in Charlotte, North Carolina. Specifically, this research study was a comparison of markers of health such as weight, fat mass, percent body fat, and fat-free mass with individuals who exercised consistently during the weight loss program from those who did not participate in consistent exercise. Overall the outcomes of the hypotheses in conjunction with the literature review suggest that participation in moderate-vigorous structured exercise most days of the week for a minimum of 30 minutes at a time, totaling at least 150 minutes per week, along with a high protein-low carbohydrates diet plan, increases the amount of weight loss in females aged 15-25 years. Outcomes also suggest that females who exercised consistently during their diet plan lost more fat mass and percent body fat than those who did not exercise consistently.

Female Exercisers lost a mean of approximately 23.59 pounds, with 19.37 pounds from fat mass. They decreased their overall body fat percent by 5.73%. Female Non-Exercisers lost a mean of approximately 11.00 pounds, with 7.83 pounds from fat mass. They decreased their overall body fat by 2.25%. Findings from this study imply that along with a high protein-low carbohydrate diet plan, moderate-vigorous exercise for a minimum of 30 minutes at a time, totaling a minimum of 150 minutes per week, increased the amount of weight, fat mass, and percent body fat lost in 12 weeks. This suggests a slightly less amount of exercise time than recommended by ACSM Position Stand (2001), which concluded overweight adults should exercise approximately 45 minutes per day (200-300 minutes per week) to assist in weight loss and prevent weight gain. It is important to note that female Exercisers may have lost more fat mass due to their overall greater weight loss, and the percent body fat decreased as their overall fat mass decreased. It is unclear whether exercise alone or the combination of exercise and diet caused the greater amount of weight loss. Research by Melanson et al. (2009) support the results of this research study that exercise increases the capacity of muscle to oxidize fat mass loss. However, their research study went into further detail suggesting exercise intensity does not have an effect on daily fat mass reduction if caloric intake is unchanged.

Other clinical studies and investigations suggest regular exercise has many positive effects on maintaining healthy muscles, bones, and joints (Powers & Howley, 2004). This study supports such research, finding no significant difference in fat-free mass reduction between the exercise groups. All subjects examined in this study did partake in a high protein-low carbohydrate diet plan. The medical weight loss clinic of Charlotte, North Carolina prescribes such a diet plan for its patients in order to promote a healthy weight loss while maintaining as much muscle mass as possible. A study by Noakes et al. (2005) supported that high protein diets effectively produce weight loss and improving risk factors for diabetes and heart disease.

In conclusion participation in regular exercise while consuming a high protein-low carbohydrate diet plan increases the loss of body weight, fat mass, and percent body fat when compared to participating in the diet plan alone. It is assumed the patients used for this research study stated truthful information concerning their exercise participation each week during their consultation with a medical provider. Generalizability was restricted to the three medical weight loss clinics of the Charlotte area, and the research conducted may not be generalizable to other populations. The study targeted females aged 15-25 years due to the obesity rates rapidly increasing in individuals aged 18 to 29 years (Mokdad et al., 1999). The information provided in this study can be useful for physician weight loss clinics, medical providers in the field of bariatrics, exercise physiologists, nutritionists, school guidance counselors, psychologists, and females interested or participating in personal weight loss.

Recommendations for Practice

This research study found exercise participation to aid females in their diet and weight loss journey. Physicians, dietitians, exercise physiologists, and those trying to lose weight should consider the importance of adding and recommending exercise into a patient's weekly routine. A minimum of 30 minutes at a time, totaling a minimum of 150 minutes per week, is recommended from this study. Both groups lost weight, fat mass, and percent body fat during the high protein-low carbohydrate diet plan. Therefore, partaking in a higher protein-lower carbohydrate nutrition plan is recommended for weight loss. In order to achieve a greater amount of weight loss combining both exercise participation and high protein-low carbohydrate dieting should be recommended. It is important to note that high protein dieting and certain exercise participation is not recommended for all populations. Receiving clearance from a medical provider is recommended before participating in any strenuous diet or exercise plan.

Recommendations for Future Research

Below are recommendations for future research from findings and methods in this study. The following recommendations will serve to guide researchers seeking to expand on the topic:

1. It would be beneficial to conduct this study with a larger sample size to ensure adequate amounts of data for more reliable results. In order to collect a larger sample size, the research study would need to branch out to other medical weight loss clinics.
2. Collect data from other populations. The data were limited to only three medical weight loss clinics of Charlotte, North Carolina.
3. Collect data from subjects of different sex and age. Data in this study were gender and age specific.
4. Use a different instrument for BIA measurement. The Tanita scale was used for bioelectrical impedance measurement due to the high volume of patients at the medical weight loss facilities. Although the Tanita scale is accurate when used correctly (TANITA Corporation of America, 2010), there are other measurements for body fat percent.
5. Follow proper protocol for Tanita at each measurement. The patients of the medical weight loss facility were not able nor expected to follow proper protocol for each weekly measurement of the Tanita scale.
6. Use the observational method for recording exercise participation and nutrition accountability. The patients in this study verbally stated their weekly exercise participation to the medical provider. It was assumed the patients used for this research study stated truthful information concerning their exercise participation and nutrition plan each week during their consultation with a medical provider.
7. Measure the differences in exercise intensity and duration between subjects in the exercise group. For this study subjects in the exercise group only had to meet a minimum of moderate-vigorous exercise of 150 minutes per week. They were not divided into different exercise intensity and duration levels.

8. Measure the differences of protein intake between groups. All subjects were put on the same high protein-low carbohydrate diet plan (approximately 600-800 calories from protein).
9. Continue the study for an extended period of time. This study only examined patients for 12 weeks. An extended study is needed to see if the weight loss reductions would be continued as well as maintained long term.

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APPENDICES

APPENDIX A

Medical Weight Loss Clinic Consent Letter

MEDI
WEIGHTLOSS CLINICS℠
The one that works!℠

William Stewart
Managing Partner,
Medi-Weightloss of Ballantyne, LLC

To whom it may concern,

As the owner of Medi-Weightloss Clinics in the city of Charlotte, NC, I grant Margaret Mobley permission to use patient data collected at our Ballantyne, South Park, and North Lake locations for her dissertation research.

Sincerely,

Bill Stewart
Medi-Weightloss Clinics
7940 Williams Pond Lane, Suite 150
Charlotte, NC 28277
Office: (704) 752-7779
Cell: (704) 995-1168
Fax: (704) 752-7775

www.mediweightlossclinics.com

APPENDIX B

IRB Approval Letter

East Tennessee State University
Office for the Protection of Human Research Subjects Box 70565 Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

IRB APPROVAL – Initial Exempt

January 2, 2013

Ms. Margaret Mobley

RE: The Effectiveness of Exercise Participation During Weight Loss on a High Protein- low carbohydrate Diet Plan in Females Aged 15 to 25 Years".
IRB#: 1212.15e
ORSPA#: ,

On **December 21, 2012**, an exempt approval was granted in accordance with 45 CFR 46. 101(b)(4)). It is understood this project will be conducted in full accordance with all applicable sections of the IRB Policies. No continuing review is required. The exempt approval will be reported to the convened board on the next agenda.

- New Protocol submission, Permission Letter, Data Collection Form, References

Projects involving Mountain States Health Alliance must also be approved by MSHA following IRB approval prior to initiating the study.

Unanticipated Problems Involving Risks to Subjects or Others must be reported to the IRB (and VA R&D if applicable) within 10 working days.

Proposed changes in approved research cannot be initiated without IRB review and approval. The only exception to this rule is that a change can be made prior to IRB approval when necessary to eliminate apparent immediate hazards to the research subjects [21 CFR 56.108 (a)(4)]. In such a case, the IRB must be promptly informed of the change following its implementation (within 10 working days) on Form 109 (www.etsu.edu/irb). The IRB will review the change to determine that it is consistent with ensuring the subject's continued welfare.

Sincerely,
George Youngberg, M.D., Chair
ETSU/VA Medical IRB

VITA

MARGARET A. MOBLEY-MEULMAN

Personal Data:	Date of Birth: January 25, 1985 Place of Birth: Augusta, GA Marital Status: Married
Education:	East Tennessee State University, Johnson City, TN Educational Leadership and Policy Analysis, Post-Secondary/Private Sector, Ed.D. 2013
	East Tennessee State University, Johnson City, TN Exercise Physiology, M.A. 2008
	Lander University, Greenwood, SC Exercise Science, B.S. 2006
Professional Experience:	Exercise Physiologist, Medi Weightloss Clinics, Ballantyne, Charlotte, NC, 2010-2013
	Wellness Coach and Personal Trainer, Meulman Personal Training Pineville, NC, 2012-Present
Awards:	Cross Country Track Scholarship, Lander University, Greenwood, SC, 2003-2006
	Female Student Athlete Award, Lander University, Greenwood, SC, 2006
	Coaches Award, Lander University, Greenwood, SC, 2006