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Exercise and patient populations: A community-based exercise intervention on cancer and Type 2 diabetes

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EXERCISE AND PATIENT POPULATIONS:
A COMMUNITY-BASED EXERCISE INTERVENTION ON CANCER AND TYPE 2 DIABETES

by

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DEDICATION

This Thesis is dedicated to my family. Though there are no words that I could ever say or write to capture how much I love and appreciate all of you, know that everything I have done and will continue to do will be for us. We have been through a lot these past five years, and you have seen every side of me. Thank you for loving me unconditionally and supporting me beyond measure.

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Abstract

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Cancer and diabetes are the second and seventh leading causes of death in the United States, respectively (Kochanek, Murphy, Xu, & Arias, 2017). When including prediabetes and the entire cancer continuum, both diseases affect over 150 million individuals in the United States each year (Bullard, Cowie, & Lessem, 2018; Siegel, Miller, & Jemal, 2019). Furthermore, there exists an alarming rise in patients presenting with both type 2 diabetes and obesity-related cancers concurrently, as both diseases share similar risk factors (Vigneri P, Frasca, Sciacca, Pandini, & Vigneri R, 2009). An aging adult population, physical inactivity and unhealthy eating habits are continuing to rise, and the prevalence of individuals with obesity-related cancers and type 2 diabetes are expected to increase in a parallel manner. Cancer and type 2 diabetes are projected to increase over the next 30 years by greater than 45%. (Smith B, Smith G, Hurria, Hortobagyu, & Buchholz, 2009; Rowley, Bezold, Arikan, Bryne, & Krohe, 2017).

Exercise can serve as a modifiable risk factor for multiple chronic diseases, including cancer and diabetes (Booth et al., 2012). Additionally, exercise can optimize the disease prognosis by subduing the physical and psychological hardships that often accompany a diseased state (Pederson et al., 2006). Despite the various health benefits and its role in the primary prevention of chronic disease, studies have found as many as 95% of US adults are considered

physically inactive by the US Department of Health and Human Services (Troiano et al., 2008). Even more troublesome, patients of these particular populations also fail to participate in regular physical activity despite its positive effect on disease management and prognosis. It is estimated that as little as 10% of the cancer community is active during their treatment and 60% of the diabetes community are physically inactive in the United States (Garcia & Thomson, 2014; Centers for Disease Control and Prevention [CDC], 2017). However, these rates are expected to be inaccurate as many studies quantify physical activity through self-reported questionnaires and are likely overestimated by patients (Schrack, Gresham, & Wanigatunga, 2017).

The relationships that exist between physical activity and multiple chronic diseases are extensively investigated worldwide (Pederson & Saltin, 2006). Such studies are often in well-funded, controlled, and tightly regulated interventions. Though effective at providing quality research and credible outcomes, the interventions fail to accurately represent the challenges and expected outcomes of cancer patients and individuals with diabetes participating in a community based intervention. Additionally, large high-quality clinical trials make it difficult to translate research interventions into routine clinical practice, as real-world health care systems often do not have extensive funds to provide exquisite care. Our study, a community-based intervention with limited funding, sought to bridge this gap in the research.

This 10-week exercise intervention focused on the physiological, physical, and psychological changes of 157 cancer survivors and 67 non-insulin dependent type 2 diabetes patients. Subjects participated in comprehensive biweekly exercise sessions that included aerobic, resistance, and flexibility training. All participants were evaluated on cardiometabolic risk factors, anthropometric measurements, physical functioning, and psychological well-being prior and succeeding the intervention.

Multiple findings were identified concerning retention trends, and changes in psychological health, anthropometric profiles, cardiometabolic risk factors, and physical functioning among both groups. The diabetes group underwent improvements in HbA1c and Quality of Life (QOL). The cancer group experienced improvements in physical functionality, fatigue, and insomnia. Factors that determined program retention within the cancer group were also determined. Our findings help to demonstrate the expected outcomes of an exercise trial in a community-setting. These outcomes will provide further insight on how to create exercise programs that are most effective for individuals with diabetes and cancer patients in a community setting with limited resources.

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Chapter 1: Introduction

Rates of physical inactivity have increased dramatically in the U.S. Only 20% of US adults engage in regular physical activity (An, Xiang, Yang, & Yan, 2016). In a diseased population, consisting of individuals who often face disproportionately more psychological and physical difficulties in comparison to healthy populations, the amount of physical activity performed is expected to be significantly lower. There exists a clear association between chronic physical inactivity and the prevalence of chronic diseases, as the rates in both have continued to increase in a parallel manner (Lee et al., 2012).

Studies have shown physical inactivity and its associated diseases are often heightened in areas of increased rates of crime, economic insecurity, and a population with limited education (Romero, 2005). The location in which this study is conducted, San Joaquin County, is recognized for all of these factors. Consequently, 1 in 5 adults residing in this county fail to participate in any sort of leisurely physical activity. Additionally, more than 75% of adults residing in this county are either overweight or obese (San Joaquin County Community Health Needs Assessment [CHNA], 2016). Diabetes and cancer have become significant public health concerns for San Joaquin County, as both chronic diseases directly affect the majority of the adult population and reside on the top leading causes of death for the county.

More than half of the adult population either have diabetes or have developed prediabetes in San Joaquin County (CHNA, 2016). Considering the limited safe areas to exercise and lack of high income earners affecting the affordability of healthy food options, developing healthy practices for the prevention and management of diabetes is exceptionally difficult for individuals with diabetes within this county. As a result, diabetes is the fourth leading cause of death in this area. San Joaquin County is recognized for having one of the highest rates in California of diabetes mortality at 28.9 deaths per 100,000 population, a number significantly higher than the average California rate (CHNA, 2016).

Cancer is the first leading cause of death in San Joaquin County (CHNA, 2019). Research has established multiple cancers are associated with physical inactivity and obesity. Such cancers include; breast, prostate, and colon - all of which reside on the most common causes of cancer in San Joaquin County (CHNA, 2019). Though research has not established a direct relationship, one could infer the presence of these obesity-related cancers are likely associated with the increased rates of overweight and obese individuals within San Joaquin County.

Multiple exercise interventions worldwide have observed the impact habitual exercise has in prevention and prognosis of chronic diseases. These interventions have contributed to the overwhelming consensus that physical activity is the best preventative measure for certain chronic diseases, effective at managing symptoms, and advantageous in decreasing the odds of disease recurrence. Additionally, these interventions are often well funded and managed, producing high retention rates, and credible results. However, there exists a gap in the research observing the effectiveness of exercise interventions in a community setting with limited funds and resources. This existing gap in the literature has resulted in a difficult challenge to translate findings from research trials into clinical practice. There is a prominent demand to determine practical and affordable interventions that are deliverable in real-world health care systems.

This present study focuses on the dynamics of an exercise intervention in a community setting for individuals with diabetes and cancer patients. As many individuals of diseased communities throughout the US are not enrolled in well-regulated and funded interventions we often read of in publications, it is important to determine the effectiveness of exercise interventions in a community setting. In doing so, the researchers hope to provide insight into all dynamics of a community setting intervention and to shed light on the reality of exercise interventions for diseased populations. Ultimately, the researchers hope to provide suggestions to increase activity levels within diseased populations and improve the efficiency of exercise interventions in combating diseases on a community level, with intentions to contribute to the larger-scale challenge of combating the chronic disease epidemic our country is facing.

Overview

In Chapter 2, the review of literature encompasses the vast relationship that exists between exercise and diabetes and cancer, including the history, physiology, and mechanisms in which exercise contributes to prevention and management. Also addressed in the review are multiple psychological and physical factors that are of concern during a diseased state, as well as the mechanism in which exercise improves such areas. Lastly, the review addresses the current preventative methods and interventions that exist in the literature.

In Chapter 3, the study procedures and description of data collection is described. The process of the initial and post evaluation is also addressed. Chapter 4 will present the results of the study, while Chapter 5 will interpret and discuss the results.

Statement of the Problem

Physical inactivity has become a major health crisis for both healthy and diseased populations throughout the United States. San Joaquin County is facing multiple health crises involving physical inactivity and obesity, as more than 85% of the adult population is overweight or obese. Chronic diseases affect the vast majority of the county's inhabitants.

As rates of chronic diseases associated with physical inactivity continue to increase exponentially throughout the United States, proper treatment and preventative measures are failing to contain the epidemic. Many studies focus on large-scale policy changes or tightly regulated exercise interventions for diseased populations, but few focus on the community level interventions that exist for diabetes and cancer patients.

Purpose of Study

The purpose of this study was to create a body of knowledge concerning multiple aspects of exercise intervention programs for diabetes and cancer patients in a community setting. The information gained will serve as a reference that can be used to determine optimal approaches to increase physical activity levels for diseased populations with intentions to prevent the development of diseases, mitigate associated symptoms of the diseases, and prevent the recurrence of diseases. Additionally, this study will also shed light on the importance of community interventions, the crisis occurring with physical inactivity in communities, and how the dynamics of community interventions, with limited resources, compares to exercise intervention with multiple funds and resources.

Research Questions

- How effective is a community-based intervention in improving psychological well-being, physical functioning, and cardiometabolic risk factors in cancer patients and individuals with type 2 diabetes?
- What physical and psychological states are cancer patients and individuals with type 2 diabetes of San Joaquin County in?
- What factors determine if a participant will willingly participate and complete the ten weeks of exercise?
- How do community-based exercise interventions compare to clinical trials for individuals with type 2 diabetes and cancer?

Research Hypotheses

1. Completing the entire intervention will improve the participants' psychological health, physical functioning, and cardiometabolic risk factors significantly in both groups.
2. Individuals with diabetes will experience decreases in their HbA1c and increases in their QOL.
3. Cancer patients will experience improvements in fatigue, insomnia, and depression.

Assumptions

This study assumes the following:

1. Observations at the initial evaluation will not produce a change in participation.
2. The participant’s knowledge of the study will not cause a change in physical activity behaviors.
3. The participants did not experience a drastic, life-changing event throughout the ten-week intervention that may affect the psychological testing in the post-evaluation assessments.

Limitations

The researchers recognize limitations exist throughout this study that may interfere with the accuracy of the results. The limitations the researchers have identified are the sampling methods, the subject’s characteristics, the self-reported activity levels of participants, and the study duration.

In both populations, participants joined the program through means of convenience sampling. All participants joined through a volunteer basis. Most patients reported hearing of the exercise program through friends, family members, or their primary physician. Additionally, all participants reside in San Joaquin County. Our study design and results may not be generalized to a different population or location.

The population enrolled are all local community members of San Joaquin County. The social and economic factors of the individuals enrolled may not accurately represent the entire cancer or diabetes communities in different locations, and thus the findings from this study may not be applicable to all cancer patients or individuals with diabetes. The researchers did not exclude any subjects based on age, cardiometabolic risk factors, demographic variables, anthropometric measurements, health history, etc.

In both the cancer and diabetes groups patients self-reported their activity levels before beginning the initial evaluation. Patients who verbally attesting to being regularly active were not included in the study. The researchers did not have a specific criteria that defined the patient as 'regularly active' or not, so all patients who reported not being regularly active were included. This is important to consider, as a participant who has been regularly active prior to the study may be closer to their physical capacity and may not have experienced much change throughout the intervention.

10 weeks of exercise may not be enough time for cancer patients and individuals with type 2 diabetes to experience significant changes in physiological, psychological, and metabolic health. This limitation can specifically affect the diabetes group and the measurement of change in HbA1c. Considering HbA1c is the measurement of blood glucose over the past 3 months, the study duration may not express an accurate representation of exercise and its impact on HbA1c.

Definition of Terms

1. ACSM: American College of Sports Medicine
2. BMI: Body Mass Index. Calculated by dividing weight in kilograms by height (squared) in meters.
3. Cancer: Uncontrollable growth and spread of abnormal cells.
4. Chronic disease: Slow in progress and long continuance.
5. Exercise: A subcategory of physical activity that is planned, structured, repetitive, and purposive in the sense that the improvement or maintenance of one or more components of physical fitness is the objective.
6. Health: A human condition with physical, social and psychological dimensions, each characterized on a continuum with positive and negative poles.
7. Obesity: An excess of body fat mass.

8. Physical Activity: Any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level.
9. Physical Inactivity: Physical activity levels less than those required for optimal health and prevention of premature death.
10. Type 2 Diabetes: Metabolic disease characterized by hyperglycemia as a result of deceased insulin sensitivity and secretory defects.

Chapter 2: Review of Literature

Introduction

"All parts of the body, if used in moderation and exercised in labors to which each is accustomed, become thereby healthy and well developed and age slowly; but if they are unused and left idle, they become liable to disease, defective in growth and age quickly" -Hippocrates, the father of modern medicine

The prevalence of sedentary individuals has reached the highest levels in human history, as more than 85% of US adults are failing to meet the World Health Organization (WHO) recommended amount of daily physical activity (Troiano et al., 2008). Two decades ago, the CDC recognized physical inactivity as a risk factor of chronic diseases (Booth, Roberts, Thyfault, Reugsegger, & Toedebusch, 2017). Now in the 21st century, physical inactivity has been classified as the leading causes of morbidity, disability, and premature mortality in the U.S, responsible for over 35 unhealthy conditions and taking the lives of over 70% of all deaths in the US each year (An et al., 2016; Booth, Roberts, & Laye, 2012).

Studies have found the onset of cardiovascular disease, type 2 diabetes, breast and colon cancer, and depression are exacerbated with physical inactivity (Booth et al., 2017). These unhealthy populations are especially of concern as diseases are often associated with physical and psychological difficulties, and will likely influence further disability, resulting in physical inactivity and sedentary behaviors (Durstine, Gordon, Wang, & Luo, 2013). The widely accepted understanding that physical activity can serve as a primary and secondary intervention for chronic diseases began with monumental studies conducted by the pioneers of health, exercise, and physiology.

In 1953, epidemiologist Jerry Morris observed the consequences of chronic physical inactivity in a work setting (Morris, Heady, Raffle, Roberts, & Parks, 1953). Morris compared bus drivers to bus conductors of double-deck buses. The conductors regularly climbed up and down the stairs throughout their workday, in comparison to the bus drivers who spent the majority of their day sitting. After following up with the participants years later, Morris found that the active bus conductors were roughly 30% less likely to develop coronary heart disease in comparison to the inactive bus drivers. Furthermore, the active bus conductors who did develop a cardiovascular condition did so at an older age and experienced a greater chance of survival in comparison to the inactive bus drivers. Thus proving physical activity not only prevents the development of chronic diseases, but also the outcome of the disease when developed. Morris' findings began the movement towards the promotion of exercise as an essential aspect of chronic disease prevention, and a potential mediator of disease symptoms and consequences (Blair et al., 2010).

The physiological consequences of chronic physical inactivity are further exemplified in the historic *1968 Dallas Bed Rest Study* by Saltin. Saltin and his colleagues had five healthy college adult males undergo 20 days of pure bed rest. Following the 20 day intervention, participants VO2 max, heart size, maximal cardiac output, and maximal stroke volume all decreased ranging from 11% to 29% (Saltin, Mitchell, Johnson, & Wildenthal, 1968). A 30-year follow-up study has recently been published, in which the researchers determined the physical deterioration experienced in the 20-day intervention were more extreme than 30 years of aging

(McGuire et al., 2001). Furthermore, studies have shown the metabolic changes in response to continuous bed rest can occur in as little as three days (Katzmarzyk, 2010).

Similar results are observed when reducing physical activity levels, in comparison to completely discontinuing physical activity altogether. Recent studies on physical activity reductions commonly observe poor physiological changes in response to reducing daily step counts (Booth et al., 2012). For example, a study conducted by Olson and colleagues found physiological improvements when reducing steps from 10,000 or 6,000 to 1,500 in healthy, non exercising adult males for 3 weeks. Participants experienced decreases in insulin sensitivity and increases in visceral fat- both of which are risk factors to multiple diseases and of particular concern for individuals with diabetes (Olsen, Krogh-Madsen, Thomsen, Booth, & Pederson, 2008). Multiple studies have found similar results when reducing steps for active men (Krogh-Madsen et al., 2009). Thus demonstrating the body will react poorly to decreasing the amount of physical activity levels, regardless if an individual has a history of being active. Other alterations in metabolism as a result of decreasing physical activity that have been identified in response to reducing steps are decreases in VO2 max and decreases in lean body mass (Booth et al., 2017).

Step reducing studies represent an accurate, problematic health issue that most Americans face today, as it is estimated the average step count has decreased as much as 70% (Booth et al., 2012). It is clear that there are vast differences between the environment in which humanity began in comparison to the lifestyle pursued now. The increases in labor-saving jobs, mobile transportation, fast food chains, etc. have given rise to an area of physiology known as epigenetics.

One of the most well-known studies concerning the role of epigenetics and physical inactivity is observed in the incidence of the Pima Indians. Epigenetics encompasses changes in gene expression without changes in the DNA coding sequence. The Pima Indians were relocated 1,000 years ago (Schulz et al., 2006). A community was established in Mexico and Arizona. The Arizona Pima Indians adopted the Western World lifestyle and began to expend 500-600 fewer calories per day than their Mexican counterparts. Consequently, the Arizona Pima Indians began to develop obesity and type 2 diabetes at increasing rates (Schulz et al., 2006). Their Mexican counterparts did not present similar health profiles, as they continued to expand similar amounts of energy and consumer similar foods as beforehand. Today, the Arizona Pima Indians are recognized as a community with one of the highest rates in type 2 diabetes worldwide (Booth et al., 2017).

In conclusion, there are overwhelming amounts of evidence that the body reacts poorly to physical inactivity. As a consequence of physical inactivity, the length of one's life and the quality of those years are affected. Despite the compelling evidence that exists in support of exercise and recent efforts set forth to combat the current sedentary epidemic, healthy and diseased populations worldwide are struggling greatly to remain physically active. As a consequence, the prevalence of lifestyle related diseases have escalated, cancer and type 2 diabetes being two of the most common.

Diabetes

More than one in eight US adults have diabetes, affecting more than 30 million individuals (CDC, 2017). However this number does not include the predicted 84.1 million adults with prediabetes in the United States, and is still expected to be underestimated (CDC, 2017 and Zimmet, 2017). Furthermore, though diabetes is ranked as the seventh leading cause of death in the US, this placement is also expected to be underestimated, as various consequences of diabetes are life-threatening and indirectly contribute to premature death (CDC, 2017 and Stokes & Preston, 2017).

Individuals with diabetes often face health difficulties concerning physical and psychological disability, loss of vision, heart disease, kidney disease, and nerve damage (Engelgau et al., 2004). The predicted 7.2 million undiagnosed individuals with diabetes often become diagnosed once these complications have already developed and begin to interfere with daily living (CDC, 2017; Harris & Eastman, 2001). A recent epidemiologic study sought to better characterize the impact of diabetes and its associated consequences on mortality. The researchers concluded that a more proper placement of diabetes on the list of leading causes of death is third place, following cardiovascular disease and cancer, respectively (Stokes & Preston, 2017). The scope of the review will focus mostly on T2D, as it is closely related to physical inactivity and is the most common type of diabetes, accounting for more than 90% of all cases in the United States.

Diabetes is characterized by chronic hyperglycemia as a result of defective physiological structures in the body responsible for glucose and insulin management. Glucose is defined as sugar in the bloodstream; it is the main source of energy and derives from the foods we consume. Insulin is a hormone produced by the pancreas responsible for controlling blood sugar levels by storing glucose into cells as glycogen. Over time an individual with diabetes has released insulin several times and the overstimulation either causes the body’s organs (liver and muscle) to become insensitive to receiving insulin for glucose storage or the Islet Beta cells in the pancreas fail to produce enough insulin to clear blood glucose following a period of eating carbohydrates.

(Kahn, Cooper, & Del Prato, 2014). In either situation, glucose levels remain elevated for prolonged periods of time and over time will create many physiological health complications.

The development of diabetes is attributed to a combination of the patients' lifestyle and several biological and environmental factors (Chatterjee, Khunti, & Davies, 2017). The common patient profile of an individual diagnosed with type 2 diabetes in the United States often presents with an overweight body composition, excess adiposity in their abdominal region, above the age of 45, and did not pursue higher education. Individuals with a single parent diagnosed with type 2 diabetes are 40% more likely to also inherit the disease and 70% more likely to develop the disease if both parents are diagnosed with diabetes (Groop et al., 1996; Meigs, Cupples, & Wilson, 2000). Minorities experience diabetes at higher rates; American Indians/Alaskan Natives, non-Hispanic Blacks, and individuals of Hispanic ethnicities are most affected by type 2 diabetes (CDC, 2017). Minorities also exhibit worse glycemic control and experience diabetes related mortalities at higher rates than Non-Hispanic Whites (Kirk et al., 2005; Golden et al., 2012). However, this could be due to minorities failing to be proactive about preventing the onset of the disease, and failing to medicate themselves properly after being diagnosed (Spanakis & Golden, 2013). A sedentary lifestyle in combination with poor eating habits often leads to obesity, and can contribute to the onset of T2D (Nolan, Damm, & Prentki, 2011). Whether the development of diabetes is due to biological or environmental factors, physical activity is encouraged for either circumstance.

Physical Activity Recommendations for Diabetes

The American College of Sports Medicine Guidelines for Exercise Testing and Prescription book outlines the specific exercise recommendations for individuals with type 2 diabetes, following the FITT (frequency, intensity, time, type) principle. The recommendations for this population are the following:

1. Aerobic training: To be performed 3-7 days a week at moderate to vigorous intensity for 150 minutes. The type of aerobic training should be prolonged, rhythmic activities using large muscle groups.

2. Resistance training: To be performed a minimum of 2 nonconsecutive days, but preferably 3 at moderate to vigorous intensity. Early in training, at least 8-10 exercises with 1-3 sets of 10-15 repetitions to near fatigue per set. Later on in training, gradually progress to heavier weights using 1-3 sets of 8-10 repetitions. The type of load can be applied through resistance machines and free weights.

3. Flexibility training: To be performed for at least 2 days per week with stretching to the point of tightness or slight discomfort. Static stretches to be held for 10-30 seconds for 2-4 repetitions of each exercise. The type of stretching can be static, dynamic, and/or PNF stretching.

Exercise and Diabetes Prevention

Individuals with pre-diabetes express diabetic values that are above normal, but are not considered diabetes. This subpopulation is at an exceptionally higher risk of developing diabetes and is increasing in size at alarming rates, accounting for 35% of the American adult population (Bushman, 2014). It is estimated that every year, 5-10% of this population will either transition into a diagnosed individual with diabetes or will return to non-diabetic conditions with normal glycemic values (Tabák, Herder, Rathmann, Brunner, & Kivimäki 2012). Whichever side of the continuum the patient transitions into is often determined by lifestyle changes and commitment to his or her own health. Incorporating lifestyle changes that increase physical activity can serve as an effective method to either delay or prevent the onset of T2D and its associated complications through multiple mechanisms.

More than 85% of individuals with diabetes present with an elevated BMI (BMI>25), and more than half of these victims are obese (CDC, 2017). Excessive adiposity is often associated with decreased insulin sensitivity, especially when located in the abdominal region of the body (Ye, 2013). An overweight or obese individual is 85% more likely to develop T2D in comparison to individuals with healthy body compositions (DiMenna & Arad, 2018). Exercise can be implemented to achieve a healthy body composition, yet this population is struggling greatly to remain physically active. Approximately 40% of individuals with diabetes reported engaging in at least 10 minutes of moderate to vigorous intensity per week (CDC, 2017). Even reductions in physical activity have been shown to affect insulin sensitivity for individuals with prediabetes. McGlory and his colleagues found insulin sensitivity reduced in patients with prediabetes as a result of reducing step counts (McGlory et al., 2018). Furthermore, patients did not obtain the same insulin sensitivity prior to the step reductions until two weeks following the completion of the program. Lifestyle interventions, combining diet and exercise, have proven to be successful at preventing the development of diabetes during a pre-diabetic state. Monumental studies observing diabetes prevention are Da Qing IGT and Diabetes study, Finnish Diabetes Prevention study, and the Diabetes Prevention Program.

Da Qing observed the effects of diet, exercise, and diet and exercise interventions compared to a control group over a six-year intervention, beginning in 1986 (Pan et al., 1997). At the completion of the study, the pure exercise group experienced the highest reduction of developing the disease at 46%, in comparison to pure diet (31%) or the combined diet and exercise group (42%). The pure exercise group experiencing a lower incidence of diabetes in comparison to the combined exercise and diet group demonstrates that the power of exercise may overcome a poor diet. Improvements concerning disease development were also identified in the 20 year follow up. Individuals belonging to the intervention group were more than 40% less likely to develop diabetes in comparison to the control group (Li et al., 2008). The study found greater improvements in diabetes parameters for the intervention group in comparison to the control group, but the two groups did not differ significantly in changes in weight. Thus, demonstrating that metabolic improvements from regular exercise and diet control can be accomplished without changes in body composition.

The Finish Diabetes Prevention study divided participants into a lifestyle intervention of exercise and diet modification and a control group of traditional diabetes counseling for four years (Tuomilehto et al., 2001). The lifestyle intervention group received individualized attention, increased exercise (moderate intensity for 30 minutes a day) and increased their consumption of healthy foods, with the ultimate goal of decreasing body fat by at least 5%. The incidence of diabetes was higher among the subjects of the control group in comparison to the intervention group by more than 10%. Furthermore, the researchers determined a clear relationship with weight changes and the onset of diabetes within their subject. Participants who decreased in weight experienced a lower incidence of developing diabetes and those who increased in weight experienced a higher incidence of developing diabetes.

The Diabetes Prevention Program further demonstrates the importance of exercise over any other form of prevention by comparing the effectiveness of exercise versus pharmaceutical treatments (Knowler et al., 2002). In the Diabetes Prevention Program individuals with pre-diabetes were either randomized into a placebo group, directed to take Metformin or directed to participate in an intensive lifestyle intervention. The goal for the lifestyle intervention group was to reduce body fat by 7% and participate in 150 minutes of moderate-vigorous physical activity for over 16 exercise sessions. A three-year follow up demonstrated individuals on Metformin were 31% less likely to develop diabetes in comparison to individuals not on metformin, and individuals that lost 7% of body fat during the lifestyle intervention were 58% less likely to develop diabetes than the participants that failed to lose 7% of body fat during the study. Thus, proving that the incorporation of exercise as a preventative measure is more effective than medications and can positively impact the outcomes for individuals with type 2 diabetes.

Exercise and Diabetes Management

Once diabetes develops, exercise is a fundamental aspect of disease management. Exercise can be incorporated to either maintain weight or lose weight, both of which are important to the disease prognosis, as excess fat is associated with multiple comorbidities. Furthermore, regular physical activity can promote physiological changes that assist in diabetes management despite a lack of change in body composition (Ross, 2003). For example, exercise is also effective at increasing insulin sensitivity through non-insulin dependent glucose uptake. During exercise, the body's muscles are capable of up taking glucose up to five-fold in comparison to glucose uptake in an inactive state (Colberg et al., 2016).

Studies have shown the benefits of exercise also exist following the exercise session, as insulin mechanisms can be improved for more than 24 hours dependent on the exercise prescriptions volume and intensity (Colberg et al., 2010). The acute periods of increased insulin sensitivity following exercise will eventually lead to long-term improvements in overall health and glucose regulation. Improvements in glucose regulation can decrease the prevalence and severity of symptoms associated with diabetes, such as nerve damage and kidney damage (Balducci et al., 2006; Ghosh et al., 2009).

Aerobic training can assist the exercising diabetic by promoting the use of fats as energy, increasing cardiovascular health, and increasing the amount of GLUT 4 transporters. Increasing the usage of fats will allow for weight management or loss, an important mechanism to improve insulin sensitivity (Goodpaster, Katsiaras, & Kelley, 2003). Increasing cardiovascular integrity will protect the individual from the cardiovascular damage often experienced from high blood glucose levels (Hu et al., 2001). Lastly, increasing the amount of GLUT4 transporters will allow for better glucose metabolism as the GLUT 4 transporters are either insufficient in amount or function for people with diabetes.

The acute effects of a pure aerobic exercise session can benefit the exercising individual with T2D up to 72 hours following the session (Colberg et al., 2010). The long-lasting effects can occur in a relatively short time frame, as Winnick and colleagues found whole-body insulin sensitivity improvements in response to exercise in one week (Winnick et al., 2008). The intensity of aerobic exercise can also determine the impact on diabetic parameters. Though studies have shown greater improvements with greater intensity of exercise, even the incorporation of modest intensity exercising can improve diabetic parameters (Colberg et al., 2010). Thus, considering the majority of individuals with type 2 diabetes are considered sedentary, it may not be necessary to begin participants at a high intensity. Improvements will be experienced either way, and studies have shown that a gradual increase in exercise intensity can reduce the onset of injury and encourage patients to complete the exercise intervention (Colberg et al., 2010).

Improvements in diabetic parameters are made through resistance training as well. When following the ACSM resistance training recommendation of biweekly strength sessions, metabolic health can increase as high as 45% (Ibañez et al., 2005). Resistance training often results in increased muscle mass, which allows for a greater surface to uptake glucose and thus more effectively regulates blood glucose. The incorporation of resistance exercise also serves as a secondary intervention to diabetes by preserving functionality. Dependent on the severity of symptoms associated with diabetes, such as nerve pain or depression, victims may reduce their physical activity levels and consequently their cardiovascular fitness and muscle mass. As most individuals with diabetes are over the age of 45, it is important to consider the muscle wasting that could occur as a consequence of physical inactivity. Increasing or preserving muscle mass through resistance training is essential to preserving the functionality of individuals diagnosed with diabetes.

Cancer

Cancer is the second leading cause of death in the United States. Though it remains responsible for a majority of premature deaths, cancer death rates have declined by 27% due to advanced screening and effective treatment methods (American Cancer Society [ACS], 2019). Though this advancement in managing cancer is encouraging, it is important to recognize the number of individuals who have defeated cancer has increased, creating a disadvantaged community of roughly 15.5 million cancer survivors in the US (ACS, 2019). This community faces a variety of physiological and psychological difficulties and is at risk of developing additional life-threatening chronic diseases. Cancer patients and survivors are at risk of experiencing depression, a lowered QoL, decreases in muscle mass and bone density, and excessive fatigue (ACS, 2016). Furthermore, the ability to prevent the onset of cancer does not reflect the same achievements of preventing mortality rates, as the number of individuals diagnosed with cancer continues to rise throughout the United States each year (ACS, 2019).

Cancer is a genetic disease caused by changes in cell functions that results in abnormal, uncontrollable growth of cells. Such changes arise from a variety of factors; inheritance from parents, errors during cell division, and exposure to cancer-causing environmental factors are the most common causes. Our DNA consists of genes, which mandate the creation of proteins. During this process, gene mutations can convert a normal functioning cell to a cancer cell. As these cells lack specialization, uncontrollable growth can occur and take over the body's organs. The most common cancers in the United States are breast, lung and bronchus cancer, prostate cancer, and colon and rectum cancer (ACS, 2019).

Some communities in the United States are facing a disproportionate burden of cancer. Concerning age, 80% of all cancer cases affect adults of 55 years or older (ACS, 2019). Women and men are affected by cancer differently. More than 35% of women in the United States reside within some area of the cancer continuum each year, and 30% percent of these cases will be from breast cancer. There are 39% of men in the United States that reside within some area of the cancer continuum each year, and 20% percent of these cases will be from prostate cancer (ACS, 2019). Other factors include education, socioeconomic status, and racial and ethnic status. Individuals with a lower education attainment and socioeconomic status are more likely to develop cancer in comparison to individuals who have pursued higher education and live above the poverty line.

Racial and ethnic minorities face a disproportionate amount of cancer occurrence and deaths in comparison to non-minorities (ACS, 2019). It is argued that these communities are most affected by cancer because they pursue more risk factors such as smoking, consuming alcohol, physical inactivity, poor eating habits, and elevated body compositions. More than 40% of all cancer cases could be prevented through lifestyle modifications, including regular physical activity and maintaining a healthy body composition (Islami et al., 2018). Physical activity has been shown to be effective in all areas of the cancer continuum; the primary prevention of cancer, improve the physical and psychological hindrances associated with cancer and it's treatments, and to prevent cancer recurrence. For the purpose of this review, the researchers will concentrate on obesity-related cancers.

Physical Activity Recommendations for Cancer

The American College of Sports Medicine Guidelines for Exercise Testing and Prescription book outlines the specific exercise recommendations for individuals with type 2 diabetes, following the FITT (frequency, intensity, time, type) principle.

1. Aerobic training: To be performed 3-5 days a week at moderate to vigorous intensity. If vigorous intensity, for 75 minutes. If moderate intensity, for 150 minutes. The type of aerobic training should be prolonged, rhythmic activities using large muscle groups.
2. Resistance training: To be performed 2-3 days per week, starting with low resistance and progressing in small increments for at least 1 set of 8-12 repetitions. The type of resistance exercises can be performed using free weights, resistance machines or weight-bearing functional tasks targeting all major muscle groups.
3. Flexibility training: To be performed for at least 2 days per week, but preferably daily for increased effectiveness. Stretching intensity allows for movement through range of motion as tolerated. When static stretching, 10-30 second holds. The type of stretches or range of motion exercises should focus on all major muscle groups. Address specific areas of joint or muscle restriction that may have resulted from the treatment with steroids, radiation, or surgery.

Furthermore, specific prescriptions for certain cancer types (breast, prostate, colon, adult hematologic, adult HSCT, and gynecologic) are outlined in ACSM's Guidelines for Exercise Testing. When considering the diversity of cancer types, it is important to tailor the exercise prescription based on the characteristics of the individual in order to ensure safe and optimal results.

Exercise and Cancer Prevention

In the United States, approximately 85,000 new cancer cases per year are related to obesity (Jia & Lubetkin, 2010). Obesity is associated with multiple different forms of cancer, including breast, liver, pancreatic, colon, endometrial and ovarian cancers (Brown, Winter-Stone, Lee, & Schmitz, 2012b). Exercise can be utilized to combat the development of obesity, and thus an effective means to prevent the onset of obesity-related cancers. Physical activity, sedentary behavior, diet and healthy weight management are key, modifiable factors that influence insulin resistance, inflammation, and other cancer-related biomarkers (Calle & Kaaks, 2004). Numerous biological mechanisms have been identified linking the onset of cancer to obesity and lifestyle factors.

As addressed earlier in this literature review, excessive adiposity is associated with increased severity of insulin resistance. Insulin resistance has been identified as a risk factor for developing certain cancers such as breast, colon, endometrium, and pancreas (Boyd, 2003). Furthermore, individuals expressing higher levels of insulin resistance encounter more cases of cancer and poorer cancer-related outcomes in comparison to victims who do not experience insulin resistance. When the body presents with insulin resistance, insulin levels are increased in the bloodstream. Though insulin is most recognized for its influence on glucose levels, insulin also plays a major role in cell proliferation (Kaaks & Lukanova, 2001). As more cells are growing, the likelihood of a genetic mishap occurring are increased, thus enhancing the risk of creating cancer cells and developing cancer. Exercise can play a preventative role in insulin-related causes of cancers by decreasing body fat, improving long-term insulin sensitivity through noninsulin dependent glucose uptake, and therefore decreasing overall insulin levels in the bloodstream.

Obesity-related biomarkers associated with cancer are leptin, adiponectin, C-reactive protein (CRP), tumor necrosis factor α (TNF- α), and interleukins 6 (IL-6). Leptin is a hormone secreted by fat cells (Fain, Madan, Hiler, Cheema, & Bahouth 2004). Though well recognized for its role in hunger control and body weight regulation, leptin also assists in cell growth (Dutta, Ghosh, Pandit, Mukhopadhyay, & Chowdhury, 2012). As mentioned in the previous paragraph, an increase in cell proliferation increases the likelihood of creating cancer-related tumors (Chen, Chang, Lan, & Breslin, 2013). Relationships with leptin and certain cancers, such as breast, colorectal, and thyroid cancer are well defined. Adiponectin is an anti-inflammatory biomarker recognized to inhibit cancer growth but exists in decreased levels in the presence of excessive adiposity (Dalamaga, Diakopoulos, & Mantzoros, 2012). Decreased adiponectin levels are associated with an increased risk of developing certain cancers and greater severity of the disease (Katira & Tan, 2016).

Opposite to adiponectin, CRP, TNF- α, IL-6 , and sex hormone levels are increased in the presence of excessive adiposity, and increase the risk of developing cancer. CRP, TNF- α, and IL-6 are most associated with chronic inflammation associated with obesity and the development of obesity-related cancers (Calle & Kaaks, 2004; Cottam et al., 2010). Increased sex hormones are also associated with increased amounts of adiposity, and increased the development of sex-related cancer such as breast and prostate cancer. In women, decreasing body fat will result in a decrease in estrogen, and a lower likelihood of developing breast cancer, as increased levels of estrogen and the development of breast cancer are tightly related. The same concept applies to men with androgens and pancreatic cancer. An aerobic focused exercise intervention held in Canada focused on the prevention of breast cancer for at risk post-menopausal women, and identified decreases in estradiol and CRP as a result of the exercise intervention (Friedenreich et al., 2010; Friedenreich et al. 2012). Though physical inactivity, obesity, and obesity-related biomarkers are tightly linked to the development of cancer, exercise can also serve as an effective secondary intervention of the symptoms associated with cancer.

Exercise and Cancer Management

Cancer patients and survivors experience an elevated risk of premature death. More than 600,000 cancer survivors are expected to die in 2019 (ACS, 2019). Cancer mortality is higher in all cancer types for individuals expressing an elevated BMI. For female cancer survivors residing in the United States, one in five of these deaths can be attributed to an elevated body composition. For male cancer survivors, one in seven deaths can be attributed to an unhealthy body composition (Calle & Kaaks, 2004). Lifestyle factors can help moderate these outcomes, as studies have found cancer survivors who participate in physical activity are at least 30% less likely to experience an all-cause mortality (Desnoyers, Riesco, Fülöp, & Pavic 2016).

As deterioration in functionality often accompanies the hardships of cancer and it's treatments, sedentary behaviors and increases in body weight are commonly experienced. Exercise has been proven to improve or preserve functionality in particular cancer populations, however cancer survivors struggle with remaining active (Morey et al., 2009). Long term, these cancer survivors can experience recurrence, secondary cancers, multiple comorbidities, increased cardiovascular risk, and the development of additional life-threatening conditions as a consequence of developing a poor body composition or pursuing chronic physical inactivity. Exercise can help diminish obesity-related mortalities by either aiding in weight reduction or maintenance of a healthy body composition throughout the cancer continuum.

Though increases in body fat throughout the disease continuum affects multiple cancer communities, studies observing prostate, colorectal, and breast cancer survivors have found this to be particularly true within these subpopulations (Parekh, Chandran, & Bandera, 2012; Nichols et al., 2009). Furthermore, in breast cancer survivors, multiple studies have found a weight increase greater than 5kg following the cancer diagnosis is associated with poorer cancer-related outcomes (Nichols et al., 2009). Exercise interventions that achieve decrease in body fat may be effective by influencing changes in physiology. Sex hormones, insulin levels, and inflammation biomarkers are all associated with obesity and physical inactivity, and are recognized as carcinogens for multiple forms of cancer (Ballard-Barbash et al., 2012). Thus, such exercise interventions can prevent recurrence of the current cancer or the development of a secondary obesity-related cancer.

The impact of regular physical activity goes beyond its role in the physical and physiological improvements for the exercising cancer survivor. It serves as an effective method to overcome several of the social and psychological difficulties that cancer survivors often experience. Such difficulties compromise QoL, and are associated with poor sleeping habits, and increased feelings of depression and cancer-related fatigue (CRF). Insomnia, depression, and fatigue often occur in combination (Donovan & Jacobsen, 2007).

QoL can provide indications of disease treatments, prognosis, and post-treatment life expectancy for cancer survivors (Montazeri, 2009). Thus, it is in the best interest of practitioners and health professionals to help preserve the QoL of their patients to the best of their ability. Exercise has been proven to accomplish this through multiple mechanisms. Exercise interventions focused on weight loss can improve confidence and body image, and thus such patients also experience improvements in QoL (Reeves, Terranova, Eakin, & Demark-Wahnefried, 2014). Cancer patients often undergo muscle wasting through sedentary behaviors and the toxicities in treatments. Exercise has been proven to effectively preserve muscularity (Galvao, Taaffe, Spry, Joseph, & Newton, 2010). Exercise interventions that manage to preserve or increase pre-cancer functionality and physiology can also improve or preserve QoL scores. A decreased ability to perform tasks independently poorly impacts individuals QoL in the cancer community. Participating in regular physical activity often preserves or improves musculature, bone health, flexibility, and cardiovascular health- all which contribute to one's ability to function independently (Almstedt et al., 2016; Mustian, Sprod, Janelsins, Peppone, & Mohile, 2012).

Insomnia can poorly impact an individual's QoL (Roth, 2007). Cancer survivors presenting with insomnia are of concern, as they suffer from insomnia three times the rate of individuals not affected by cancer (Palesh et al., 2010). Furthermore, individuals suffering from insomnia are less likely to be physically active despite the positive impact exercise exhibits on sleeping habits (Palesh et al., 2010). Multiple studies have been conducted observing the impact of physical activity on sleeping habits for cancer survivors. Throughout the majority of studies, there is a consensus that exercise improves sleeping habits for this particular population (Mercier, Savard, & Bernard, 2017).

Depression is associated with poorer disease outcomes in cancer survivors (Pinquart & Dubersein, 2010). Exercise can alleviate depressive symptoms in both healthy and unhealthy populations (Craft, VanIterson, Helenowski, Rademaker, & Courtneya, 2012). A recent meta-analysis attempted to determine the most effective exercise prescription for cancer survivors experiencing depression. The researchers results encourage the implementation of interventions that are supervised, away from their homes and longer than 30 minutes in duration to best manage depression (Craft et al., 2012). However, regardless of the exercise type or frequency, most research supports the implementation of exercise to elicit slight antidepressant improvements for all cancer survivors and at all stages of the cancer continuum (Brown et al., 2012a).

Cancer related fatigue (CRF) is one of the most commonly experienced side effects associated with cancer, affecting as many as 99% of individuals in particular cancer communities (Bower, 2014; Hofman, Ryan, Figueroa-Moseley, Jean-Pierre, & Morrow, 2007). CRF is often experienced throughout the entire cancer continuum and heightened during the treatment stages, lasting several months to as many as ten years for some individuals (Bower, 2014). Studies have found cancer patients and survivors suffering from elevated levels of CRF experience lower chances of survival in comparison to those with lower levels of CRF (Lawrence, Kupelnick, Miller, Devine, & Lau, 2004; Quinten et al., 2011). Several exercise trials have determined physical activity is highly associated with lower levels of fatigue within cancer populations (Hilfiker et al., 2018). Thus, providing more evidence that exercise is essential to all aspects of cancer management regarding the psychological, social, and physical challenges experienced and improvements in disease outcomes.

Real-world Practices

There exists a large gap in the literature concerning community-based exercise interventions and the ability to translate science from clinical trials into real-world, community-like settings. For example, all of the exercise trials addressed in this literature review represented well-funded clinical trials with few limitations, increased amounts of participants enrolled in a short time frame, and high retention rates. Furthermore, in the discussion section of many of these studies, the researchers have addressed a recurring theme regarding an inability to replicate such exercise trials into real-world practices.

This lack of information influences our ability to identify the underlying contributors to a disease epidemic, predict future disease burden, optimize resource allocation, and implement tailored and targeted interventions to address risk factors. The purpose of this study is seeking to bridge this large gap in the literature and will provide insight into the way science is translated into realistic, community settings.

Chapter 3: Methodology

Summary

Local cancer and diabetes patients enrolled in a 10-week exercise program on a volunteer basis. After attending the initial evaluation and consenting to participate, patients began exercising biweekly under the supervision of a certified exercise physiologist and student assistants. During the initial evaluation, patients were evaluated on health history, anthropometric measurements, cardiometabolic risk factors, physical functioning, psychological well-being, QOL, and much more domains that encompass psychological and physical health and wellness. Each exercise session lasted roughly one hour and incorporated aerobic and strength training, and was concluded with a cool-down portion of flexibility and breathing exercises. Patients heart rate (HR) and rating of perceived exertion (RPE) were collected throughout the session prior to the cool-down portion. After completing the 10-week intervention patients were re-evaluated in the same variables measured during the initial evaluation. An EXCEL software database was created on the variables collected and transformed into SPSS software. Statistical analyses were conducted using SPSS software.

IRB protocol. This study was approved by the University of the Pacific Institutional Review Board as a collaborating university with St. Joseph's Medical Center Rehabilitation Department. The study was originally approved by St. Joseph's Medical Center Institutional Review Board in Stockton, California in January of 2013 exclusively for the St. Joseph's Medical Center Rehabilitation Department. The initial purpose of exercise physiologists and physical therapists who created the exercise program was to form cancer and diabetes support communities, and increase levels of activity within local cancer patients and survivors and individuals with type 2 diabetes.

Subject recruitment. The exercise program was promoted by physicians, physical therapists and staff members belonging to the cancer and diabetes support groups of the hospital at which the exercise program is conducted. All subjects entered the study through recommendations by friends and family or St. Joseph's staff members, on a volunteer basis. 67 individuals with diabetes and 157 cancer subjects were eligible and enrolled in the program. Subjects included in the analyses conducted for this Thesis are those enrolled from the beginning of the program in January of 2013, until data analysis in October of 2017. The study is ongoing.

Initial Evaluation

Before participating in any tests or surveys, subjects first read through an IRB packet listing the requirements of the study, expectations in terms of physical exertion and exercises entailed their rights as subjects of the study, and their protection in terms of data collection. Subjects were advised to ask any questions they had before providing consent. Upon written consent of the subject, the initial evaluation was continued by the head clinician.

Inclusionary criteria. All patients had to verbally state they were not pursuing a regularly active lifestyle prior to the initial evaluation. If a patient did express he or she was regularly exercising, the initial evaluation was continued but the patient was not included in the study. The patient was informed that he or she's health measurements would not be used for the purpose of the study, but would be allowed to exercise during the exercise sessions.

Cancer group inclusionary and exclusionary criteria. Individuals who have or had cancer at the time of the study, and were willing to participate in a ten-week exercise program met inclusionary criteria. A physician clearance was required for patients undergoing treatment (chemotherapy and/or radiation) at the time or recently underwent cancer-related surgery. Individuals who recently discontinued treatment methods or underwent recent surgery, and were still experiencing excessive negative side effects (extreme tiredness, sensitivity to touch, vertigo, nausea, etc.) met exclusionary criteria. For cautious measures, such patients were encouraged to join the program at a later date-either when side effects diminished or upon approval by their physician.

Diabetes group inclusionary and exclusionary criteria. Individuals who had non-insulin dependent type 2 diabetes, and were willing to participate in a ten-week exercise program met inclusionary criteria. The patient had to verbally agree that their blood sugar was mimicking regular patterns prior to the initial evaluation. Individuals who reported recent irregular blood sugar regulation met exclusionary criteria. For cautious measures, such patients were encouraged to join the program at a later date when regular sugar levels were achieved.

Group assignments for diabetes group. At the initial evaluation, diabetes patients were randomly assigned to two groups. Group 1 was assigned to attend exercise class twice a week and walk for an hour three times a week. Group 2 was assigned to attend an exercise class twice a week with no assigned walking. Random assignment was done by patients reaching into a bag filled with tokens and selecting one; 50% of the tokens were blue (Group 1) 50% were black

(Group 2). Depending on the token drawn, patients who drew a blue token were notified of the additional walking assignment and given walking logs to report walking activity throughout the week.

The demographic and health history survey. The survey was a thorough questionnaire encompassing the contact information, demographics, and health history of the subject. The demographics portion determined the gender, age, race, and ethnicity of the individual. The health history identified if the subject experienced any previous heart attacks, diagnosed hypertension, strokes, diagnosed pulmonary diseases, diagnosed hyperlipidemia, and/or previous and current smoking practices.

Additional cancer group variables. Cancer patients were required to complete an additional cancer history survey. The cancer history portion established the type of cancer(s) developed, previous and/or current treatment methods, and previous surgeries experienced. Additionally, the cancer group completed multiple assessments of psychological well-being. The Fatigue Symptom Index (FSI), Athens Insomnia Instrument and Zung-Self Rating Depression measured fatigue, insomnia, and depression respectively.

Fatigue Symptom Index: The FSI is a 14 item questionnaire that assesses the severity and frequency of fatigue, as well as its perceived interference with quality of life. Each question may be answered on a 0-10 scale, 0 representing no fatigue and 10 representing excessive fatigue. A score between 0-35 identifies no fatigue, 36-64 mild fatigue, 65-84 moderate fatigue, 85-110 severe fatigue, and a score of 110 and onwards is categorized as excessive fatigue.

Athens Insomnia Instrument: Athens Insomnia Scale is an eight item questionnaire that determines the amount of insomnia experienced by the subject. Each question may be answered on a scale of 0-3, 0 being 'no problem' with falling asleep and 3 'very delayed or did not sleep at all'. A total score of zero denotes an absence of any sleep related issues and a score of 24 represents the most severe degree of insomnia.

Zung-Self Rating Depression: The Zung-Self Rating Depression is a survey to quantify the depressed status of a patient. There are twenty questions, and each question is rated on a scale of 1-4. The score 1 indicates a 'little of the time' of depression is experienced, and 4 indicating 'most of the time' depression is experienced. A score between 25-49 indicates a normal range, 50-59 mildly depressed, 60-69 moderately depressed, and a score of 70 and above is categorized as severely depressed.

Additional diabetes group variables. At the initial evaluation, the diabetes group completed a QoL survey and attended an appointment following the completion of the initial evaluation to measure HbA1c levels at the hospital laboratory.

QoL survey: Subjects completed the SF-36 (36-item short form), a self-report QoL questionnaire. The QoL questionnaire encompassed patients perception of physical functioning, limitations due to physical health, limitations due to emotional problems, energy levels, emotional well-being, social functioning, bodily pain, general health, and QoL. The scores could range from 0 to 100, 0 representing a low QoL and 100 representing a high QoL.

HbA1c Testing: The HbA1c test was to determine the severity of the diabetes. HbA1c score reflects the average blood sugar of the individual for the past two to three months. A result of 5.7-6.4% is classified as prediabetes, and a result of 6.5% or above is classified as diabetes. The higher the HbA1c percentage is, the more severe diabetes and the related consequences of diabetes.

Anthropometric measurements. Weight was determined by a balanced scale. Participants weight were rounded to the nearest 0.1 lb. while wearing the exact clothing upon arrival of the initial evaluation. Height was measured to the nearest 0.1 cm with a door height marker, following the standardized procedures. BMI was calculated as weight (kg)/ height $(m)^2$. A BMI of 25-29.9 was considered overweight. A BMI of 30 and above was considered obese. All BMI's under 25 were considered normal weight. Body fat percentage was calculated with bioelectrical impedance analysis, patients were advised to follow standardized procedures.

Cardiometabolic risk factors. Blood pressure was measured by the clinician using a stethoscope and blood pressure cuff. Heart rate and oxygen saturation was retrieved using a finger pulse oximeter.

Physical tests. The second portion of the initial evaluation involved physical tests to determine physical functioning and endurance, strength, flexibility, etc.

Six Minute walk: The six-minute test was an assessment of how much distance the subject could walk in six minutes. The heart rate of the individual was taken by a finger pulse oximeter before and after the completion of six minutes.

Timed up and Go: The timed up and go test is an assessment of how quickly the subject could stand up from the chair, walk ten feet, and return to the chair without any running or jogging movements. The time began as soon as the subject's bottom parted from the chair and ended when the subject's bottom reconnected with the chair.

Chair Stand: The chair stand test, also known as sit to stand, is an assessment of how many times the subject can stand out of the chair and sit back down in thirty seconds. The subject is not allowed to use the arms of the chair to assist in movements, and the subject is scored based on how many times a full stand is achieved.

Arm Curl: The arm curl test is an assessment of how many arm curls the subject can perform in thirty seconds with a weighted dumbbell, often ranging from five to ten pounds. The weight used for the assessment was chosen based on a consensus between the head clinician and the subject and noted on the initial evaluation sheet. The weight chosen was not to be overly difficult or easy for the subject.

Hand Grip: The hand grip is an assessment of how much force the individual can exert from his or her handgrip, recorded by a hand dynamometer. The individual was positioned in proper form and instructed to squeeze with as much force as possible. Following each squeeze, the subject was then advised to switch over to the opposite hand for three rounds. The scores were noted on the initial evaluation sheet.

UTM Push/Pull and Epic Lift: The UTM Push, UTM Pull, and Epic Left were performed on the same machine; the Universal Testing Machine (UTM). The head clinician demonstrated proper form of each movement and instructed the patient to push, pull, and lift a box, respectively, with the most strength they could generate.

Functional Reach: The functional reach test was administered while the patient was standing. The subject was positioned parallel to the wall and to perform shoulder flexion in the limb closest to the arm. The subject was then advised to reach as far as possible without taking a step forward. The head clinician advised the subject to perform the reach three times and the average of the three scores were recorded on the initial evaluation sheet.

Sit and Reach: The sit and reach test was administered while the patient was sitting on the floor. The head clinician informed the patient of the protocol and had the subject reach as far forward possible. The average of three scores was recorded on the initial evaluation sheet.

Back Scratch: The back scratch the patient was administered while the patient was standing. The head clinician informed the patient of the protocol and advised the subject to try to touch both arms behind the back. If the subject experienced serious pain when doing this, the test was discontinued and the reasoning was noted on the initial evaluation sheet. Otherwise, the head clinician measured the distance between the two hands and recorded the average of three scores.

Exercise Program

Upon clearance, following the initial evaluation, patients were allowed to begin the exercising portion of the program. Over the next 10 weeks, exercise classes were conducted twice per week by the head clinician who conducted the baseline testing, assisted by student interns from the University of the Pacific with expertise in group exercise classes. With intentions to avoid overcrowding, two classes were held. Individuals with diabetes and cancer patients were advised to attend the class time according to their disease. These classes were called DEP (diabetes exercise program) and CEP (cancer exercise program). Each exercise session consisted of three portions; check in, exercising, and cool down.

Check in. All participants arrived participated in a check in protocol before being cleared to exercise that day. Participants received their exercise card, heart rate, and blood pressure.

Exercise Cards: Upon arrival all patients signed in and retrieved a pencil to record his or her blood pressure and heart rate throughout the program, a clipboard with a chart of the Borg Rating of Perceived Exertion attached to the back for reference throughout the program, and their personal exercise card. Each card displayed the exercise program, the goal heart rate to be achieved during exercise, and contained a section that allowed for the subject to write down his or her blood pressure and heart rate during check in.

Heart Rate and Blood Pressure Protocol: Prior to initiating exercise, the student intern retrieved the patient's heart rate through a pulse oximeter and measured the systolic and diastolic blood pressure after the patient had been at rest sitting for roughly five to ten minutes via auscultation using a mercury sphygmomanometer. If the heart rate or blood pressure did not reflect normal values the student intern directed the patient to the head clinician to re-confirm the values and ensure the patient was able to safely participate in the exercise session.

The goal heart rate was determined during the initial evaluation by subtracting the age of the patient by 220 and multiplying by 70 percent. The goal heart rate was located at the top right corner of the exercise cards, with intentions to visually remind participants to exert themselves to their individualized number. Depending on the heart rate reading following the exercise, student interns would either encourage patients to exert themselves further or caution the patient to not exert themselves too far.

Once the heart rate and blood pressure were recorded and all patients were signed in, the check in portion was concluded and the group collectively entered the exercising room and began the exercise session. The exercise segment is performed individually in a group setting.

Aerobic exercises. Each aerobic exercise was performed for 6 minutes. There were four aerobic exercises, thus patients exercised on aerobic machines for a total of 24 minutes. The aerobic exercises included: Upper Body Extremity (UBE) bike, treadmill, recumbent bike, and the Nu-Step.

Treadmill Protocol: The initial speed of the treadmill was determined by a consensus between the clinician and the patient. The speed set facilitated a ‘power walking’ pattern, very few patients exerted themselves in a jogging or running pattern. The majority of patients walked to their physical capacity, whether that be slow walking or power walking. More physically advanced patients increased the incline on the treadmill, which was noted on the exercise card.

UBE, recumbent bike, and Nu-Step Protocol: The UBE, recumbent bike, and Nu-Step pace was generated by the power produced by the subject. Thus, patients were able to determine the intensity of the exercise. The head clinician and student interns assisted in proper form, encouragement, and recording the HR or RPE following the exercise.

Recording Heart Rate and RPE: If the patient was not on heart medications at the time, the heart rate was reported by a fingertip oximeter following the completion of each aerobic exercise. Patients were encouraged to exert themselves between 60-75% of maximum heart rate. The goal heart rate was posted at the top of the individuals exercise card so he or she remained encouraged to reach that number throughout the exercises. If the patient was on heart medications, the patient reported his or her level of exertion dependent on the Borg Rating of Perceived Exertion, which was both attached to the back of his or her clipboard and an enlarged poster to every wall in front of the aerobic exercise machines. Such patients were encouraged to exert themselves at a score between 12-14.

Patients were encouraged by the clinician and student interns to exert themselves to the goal heart rate or Borg's score, but never was any patient enforced to reach this exact heart rate or score. Following the completion of the six minutes, the score was written down under the appropriate exercise on the exercise card.

Resistance exercises. Resistance exercises encompassed chest press, latissimus dorsi pulldowns, triceps extensions, standing rows, bicep curls, wall squats, and step ups. Patients performed all exercises at their own will and capabilities. If for any reason a patient was in excessive pain he or she was allowed to immediately discontinue the exercise. The clinician and student interns paid close attention to the form of patients during exercise. If the patient was not performing the correct form, the patient was immediately stopped. The clinician and student intern would then perform the exercise as an example, and advise the participant to retry to exercise with proper form. If the patient was still unable to perform the exercise with correct form, the patient was advised to either discontinue the exercise for the remaining of the program or the head clinician would prescribe an alternative exercise for the patient. This change was made on an individual basis and did not occur regularly.

Repetitions and Sets: On the first day of the program, each patient was required to do one set of ten repetitions per exercise. The second day consisted of two sets of ten repetitions per exercise. The third day of the exercise program consisted of three sets of ten repetitions per exercise. Patients continued performing three sets of ten repetitions per exercise for the remaining of the program.

Resistance: The resistance applied on the first day for the chest press, latissimus dorsi pulldowns, triceps extensions, and bicep curls were determined through a consensus between the patient and the clinician. After completion of the exercise session, the clinician and patient decided collectively whether or not to increase resistance for the following exercise session. Increases in resistance throughout the program were always discussed beforehand with the clinician, and were recorded on the exercise cards under the appropriate exercises.

Standing Rows: The standing rows were performed with latex theraband resistance bands, including the colors yellow, red, green, blue, and black. Each band increased in resistance respectively.

Wall Squats: Wall squats were performed with an exercise ball resting against the subjects back. If the subject had knee pain or any functional issues that would interfere with performing a proper squat, the subject was instructed to bend at the knees before the point of pain or discomfort. Otherwise, subjects were advised to perform a ninety-degree bend at the knee joint with legs separated shoulder-width apart.

Step Ups: Step ups could be performed at a four-inch or six-inch height, depending on the patient's capability to perform the step up pain-free and safely. Patients were advised to switch legs for every step up. Advanced patients were allowed to hold dumbbells in their arms while stepping up. Such patients had the weight noted on their exercise card. Twenty step ups total, or ten step ups per leg, completed one set.

Cool down. All patients without personal time constrictions participated in the cool down following the completion of the session. The cool down began when all patients completed the program and was led by either the head clinician or the student interns.

Stretch: The cooldown began with stretching major muscles such as the quadriceps, hamstrings, calves, deltoids, neck muscles, and trapezius. Each muscle group was stretched for roughly 45 seconds each. Yoga poses, the warrior pose and the tree pose, were also incorporated during the cool down.

Breathing: The session was concluded with three deep breathing sessions. Patients were advised to close their eyes and use their arms to facilitate breathing. Following the breathing exercises, the session was concluded and patients were advised to leave at their earliest convenience.

Post-Evaluation

After the completion of the 10 weeks, all subjects attended a post-evaluation with the same head clinician from the initial evaluation. During the post-evaluation, patients were reevaluated in the exact domains assessed in the initial evaluation to determine any changes in the following physical domains; anthropometric assessment (BMI and body fat percent), and cardiometabolic risk factors (blood pressure, heart rate). All physical tests (six minute walking test, timed up and go, chair stand test, arm curls, UTM push, UTM pull, Epic Lift, etc.) were repeated with the same protocol and equipment from the initial evaluation.

Cancer Group Post-Evaluation: Cancer subjects completed post-surveys reassessing psychological well-being including; Fatigue Symptom Index, Athens Insomnia Instrument, and Zung-Self Rating Depression Scale. All psychological surveys were exact to the survey completed in the initial evaluation.

Diabetes Group Post-Evaluation: Diabetes subjects completed post-surveys reassessing their QoL. Additionally, diabetes subjects were scheduled to get blood drawn once more to evaluate the changes in HbA1c.

Diabetes Statistical Analyses

Baseline Characteristics: Descriptive statistics of the entire sample (means, and standard deviations) were conducted to determine the patient characteristics at baseline of the total diabetes population enrolled.

HbA1c and Exercise: Mean differences between both groups (walking and non-walking) was determined with independent-samples t tests when observing baseline data and rates of improvement between the walking and non-walking groups. Multiple linear regression tested predictors of improvement in HbA1c.

QoL and Exercise: Multiple linear regression determined the effect of exercise, physical functioning, and anthropometric indices on QOL outcomes.

QoL Perception of Physical Functioning and Exercise: Linear regressions tested the effect of functional performance on the perception of physical functioning at baseline capacity and after the ten-week intervention.

Sex-specific HbA1c responses to exercise: Subjects were assigned to “completers” (N=39) or “non-completers” (N=28) based on adherence to the exercise program. Mean differences between subsamples (completers compared to non-completers, males compared to females) were measured with independent-samples t-tests; differences in categorical data were detected using chi-squared tests. A repeated measures ANOVA with Greenhouse-Geisser correction compared HbA1c levels at baseline and follow-up between sexes who completed the exercise program. Bonferroni post-hoc analyses measured specific group differences.

Cancer Statistical Analyses

Baseline Characteristics: Descriptive statistics of the entire sample (means, and standard deviations) were conducted to determine the patient characteristics at baseline of the total cancer population enrolled.

Radiation Therapy and Exercise: We analyzed differences among the three radiation exposure groups (NR, PR, and CR) using a one-way analysis of variance (ANOVA) in baseline characteristics and exercise adherence ($p<0.05$). Post-hoc analyses tested specific group differences. Multivariate tests analyzed improvements for pre and post exercise programs in several parameters of health and function

Chemotherapy and Exercise: We compared baseline data and exercise adherence between the three exposure groups: no chemotherapy (NC), history of chemotherapy (HC), and currently undergoing chemotherapy (CC) using a one way ANOVA ($p=0.05$). Post-hoc analyses measured specific differences between each group. Pre-to-post differences were analyzed using multivariate tests.

Adiposity, Exercise, and Cancer: Independent-samples t-tests compared baseline characteristics between obese and non-obese patients. A mixed analysis of variance (mixed ANOVA) with repeated measures evaluated changes in outcome measurements of obese and non-obese patients who completed the exercise program.

Fatigue, Insomnia, and Depression and Exercise: Group means were compared with paired-sample t tests. Differences in the association between insomnia, depression, and fatigue were measured with Pearson's correlation coefficient. Logistic regression evaluated the effects of fatigue, insomnia, and depression on odds of completion. Linear regression analyses tested the prediction of fatigue, insomnia, and depression.

Physical Functioning and Exercise: Descriptive statistics calculated sample characteristics of completers at baseline. Baseline data were compared to follow-up data using paired-samples t-tests on all individuals who completed the study.

Program Retention: Differences between patients who were retained and patients who were lost during the exercise intervention were calculated and compared using independent-samples t tests and chi-squared tests as appropriate. Our prediction models, estimating the odds of completing the exercise program, were determined with logistic regressions.

Chapter 4: Results

Diabetes Baseline Characteristics

Demographics: The subjects (n=67) ages ranged from 39 to 87 years (mean: 68.3 ± 10.7), the majority of patients (61.2%) were female (n=41). 51 subjects had ethnicity coded; 10 were Hispanic; 41 were not Hispanic. 54 subjects with race coded; 36 (66.7%) were white, 8 (14.8%) were black, 6 (11.1%) were Asian, and 4 (7.4%) were considered "other."

Health History: 66.7% of subjects were hypertensive, 53.8% had a diagnosed case of hyperlipidemia, and 18.2% previously experienced a heart attack.

Anthropometric measurements: 59.7 of the participants were obese. Body mass index ranged from 19.2 to 54.5 (mean: 32.4 ± 6.8) and body fat percentages ranged from 19.3% to 54.4% (mean: 39.3 ± 6.9).

Cardiometabolic parameters at baseline: Participants had a systolic blood pressure of 128.3 ± 11.9 mmHg, diastolic blood pressure of 75.0 ± 8.4 mmHg, heart rate of 78.1 ± 14.3 bpm and HbA1c of 7.0 ± 1.1.

Physical functioning at baseline: Patients were evaluated on eight assessments of physical functioning. Six minute walk test (mean: 394.8 ± 112.6 feet), timed-up-and-go (mean: 8.0 ±2.7 seconds), chair stand test (mean: 10.4 ±3.3), grip strength (mean:59.5± 21.3 kg), amount of arm curls (mean: 14.3 ± 4.5), functional reach (mean: 10.7 ± 30 cm), sit-and-reach, (mean: -4.9 ± 2.9 cm), and back scratch (mean: -11.9 ± 6.3 cm).

HbA1c and Exercise

Baseline data of walking vs. non-walking groups: Group differences at baseline were minimal. Patients in Group 2 were 4.7 years older (p=0.063), body mass index was 3.3 points lower (p=0.058), and they walked an additional 72.7 meters in the 6-minute walk (p=0.009). There were no differences in body fat percent (p=0.507), HbA1c (p=0.512), other cardiometabolic parameters, or the other eight assessments of physical functioning.

Rates of improvement of walking vs non-walking groups: The patients who completed the exercise intervention (n=39) improved in 13 of 16 assessments (p<0.05), including HbA1c (p=0.045). There were no differences in improvement between exercise groups.

Predictors of improvement in HbA1c: Across the total sample, linear regression analysis found elevated baseline body fat percent (p=0.001) and improvements in strength, assessed by arm curls (p=0.009) and grip strength (p=0.042) corresponded with poorer outcomes in HbA1c; the overall model was significant (R2 =0.733; p<0.001).

QoL and Exercise

QoL at Baseline: At baseline, patients expressed a composite QOL score of 58.9 ± 18.1. Older age (p<0.001), six minute walk test (p<0.001), functional reach (0.048), and chair stand (p=0.005) all associated with higher baseline QoL. Obesity associated with a trend for higher QoL (p=0.054).

Changes in QoL: From baseline to post test, QOL improved 17.7% (p<0.001). Whether the subject was in the walking or non-walking group, the group assignment was not a significant predictor of this change (p=0.998). Women improved more than men (p=0.031), and improvement in six minute walk (p=0.021) and sit and reach (p=0.009) associated with greater improvements in QOL.

QoL at Follow Up: Age (p=0.022), six minute walk (p<0.001), and functional reach (p=0.007) corresponded to elevated QOL. Group assignment was not a significant predictor (β=9.3; p=0.098).

QoL and Six Minute Walk: At baseline (p<0.001), change scores (p=0.021), and at follow-up (p<0.001), the six-minute walk was the most pronounced variable of physical functioning to correspond to QOL.

Perception of Physical Functioning QoL and Exercise

Subject Characteristics at Baseline: Among the total study sample, 38 participated in the QoL survey at the initial evaluation, and are included in this particular analysis. Patients were 67.9±9.1 years of age, 57.9% were female, 66.7% were white, 21.1% had experienced a previous heart attack, 10.5% had experienced a previous stroke, mean hbA1c was 6.9 ±9.1, BMI was

31.5±6.1, body fat percent was 38.1±7.5%, blood pressure was 129.5±12.9 / 74.3±9.5 mmHg. Self-reported physical functioning ranged from 5.0 to 100.0; mean score was 54.7±26.8.

Variables not Related to Perception of Physical Functioning at Baseline: Perception of physical functioning was not related to sex (r=0.054; p=0.751), age (r=-0.141; p=0.405), race (r=-0.043; p=0.831), ethnicity (r=0.273; p=0.160), body mass index (r=0.087; p=0.610), body fat percent (r=0.030; p=0.864), history of myocardial infarction (r=-0.255; p=0.128) or stroke (r=-0.259; p=0.121), or arm curls(r=0.270; p=0.106).

Variables Related to Perception of Physical Functioning at Baseline: Perception of physical functioning was related to systolic blood pressure (r=-0.294; p=0.077), six-minute walk (r=0.655; p<0.001), functional reach (r=0.335; p=0.046), timed up-and-go (r=-0.292; p=0.080), chair stand (r=0.447; p=0.006), and sit-and-reach (r=0.372; p=0.024).

Variables not Related to Perception of Physical Functioning at Follow-up: Perception of physical functioning was not related to the following anthropometric or functional tests: BMI (r=-0.130; p=0.457), body fat percent (r=0.112; p=0.526), systolic blood pressure (r=0.000; p=0.999), six-minute walk (r=0.273; p=0.131), functional reach (r=0.186; p=0.293), timed up-and-go (r=0.210; p=0.226), arm curl (r=-0.007; p=0.966), chair stand (r=-0.095; p=0.592), and sit-and-reach (r=0.007; p=0.970).

Variables Related to Perception of Physical Functioning at Follow-up: Age and stroke history variables emerged as predictors of QoL; older patients (r=-0.366; p=0.024), and subjects who had experienced a previous stroke (r=-0.435; p=0.006) perceived themselves as having a poorer physical function. Furthermore, perception of physical functioning was inversely related to the baseline value (r= -0.519; p=0.001); patients with a lower self-perception of physical functioning at baseline experienced more improvement at follow-up. Across the study sample, subjects increased by 13.8±24.5 points (25.7%) from baseline to follow-up (p=0.002).

Sex-specific HbA1c Responses to Exercise

Completers vs. Non-completers Baseline Characteristics: 39 participants completed the entire trial. 34 (13 males and 21 females) had a complete HbA1c record prior to data manipulation. At baseline, completers and non-completers did not differ in demographic and anthropometric data, cardiometabolic parameters or medical history (p>0.05). Furthermore, HbA1c levels did not differ between completers and non-completers (p=0.234).

Males vs. Females: 61.5% males and 56.1% females completed the intervention. Sex was not related to the completion of the trial (p=0.660) or baseline HbA1c (p=0.117). Females expressed higher body fat percentages, better back-scratch scores, and lower grip strength force in comparison to males. Males experienced more heart attacks and were older in age than the female participants. HbA1c did not differ between males and females at baseline (p=0.117). All other variables concerning anthropometric measurements, cardiometabolic parameters, medical history, and physical functioning did not differ between males and females (p>0.005).

HbA1c Changes Among Completers: The repeated measures ANOVA found HbA1c to improve with exercise (F=7.878; p=0.008) and an interaction effect with sex (F=6.734; p=0.014). Male completers HbA1c values decreased more than women (0.61 compared to 0.02). Bonferroni correction revealed a mean difference of 0.316 between pre- and post-HbA1c values among completers (p=0.008).

Cancer Baseline Characteristics

Demographics: The average age was 61.1 ± 10.7 years old, 76.6% of the entire population was female, 50.3% of the population had breast cancer, and 29.9% had a diagnosed case of hyperlipidemia, and 33.8% were obese.

Anthropometric Measurements: Weight (179.1 ± 56.0 lbs.), BMI (29.8 ± 8.6 kg/m^2), and body fat percentage (35.9 ± 8.5%) were determined.

Cardiovascular Measurements: Systolic blood (122.9 ± 14.8 mmHg), diastolic blood pressure (77.5 ± 9.7 mmHg), mean arterial pressure (92.4 ± 9.9), pulse pressure (45.7 ± 11.7), heart rate (79.1 ± 15.8), and Vo2 Max (22.8 ± 6.2 L/kg) were measured.

Physical Functioning: Subjects averaged a 379.9 ± 100.8 m six minute walk, 11.1 ± 2.8 cm function reach score, 7.8 ± 2.4 second timed up and go, -3.0 ± 5.6 cm sit and reach score, -4.0 ± 8.0 inch back scratch score, and 51.8 ± 15.1 kg grip average.

Fatigue, Insomnia, and Depression: Patients reported 60.9 ± 26.1 fatigue scores, 8.6 ± 4.6 insomnia scores, and 37.5 ± 6.3 depression scores.

Radiation Therapy and Exercise

Radiation Group Differences at Baseline: The study contained 59 patients who never used radiation (NR), 63 who previously completed radiotherapy (PR), 18 currently undergoing treatment (CR), and 17 individuals with an unknown radiation status. When comparing the PR, NR and CR groups there were no baseline differences in age (p=0.713), body composition (p=0.536), cardiovascular parameters (SBP: p=0.957, DBP: p=0.807, MAP: p=0.998, PP: p=0.863, HR: p=0.984) fatigue (p=0.820), insomnia (p=0.282), or depression (p=0.241). Based on post-hoc analyses, patients in the NR group performed better on the five times sit-to-stand test than PR patients (p=0.013) and better on sit-and-reach (p=0.037) and functional reach (p=0.059) than CR patients.

Exercise Adherence Based on Radiation Status: 40.6% of PR patients, 45.6% of NR patients and 27.8% of CR patients completed the program. There were no differences in program completion based on the use of radiation (p=0.404).

Group changes in subjects who completed the program: Although there were no baseline differences in the six-minute walk (p=0.987), CR patients improved more than PR patients (p=0.038) and NR patients (p=0.051). Additionally, there were no baseline differences in systolic blood pressure (p=0.957) but CR patients experienced greater reductions than patients in the PR group (p=0.011) and NR group (p=0.035).

Chemotherapy and Exercise

Chemotherapy Group Differences at Baseline: The study contained 40 patients that never received chemotherapy (NC), 80 had a history of chemotherapy (HC), 24 were currently undergoing treatment (CC), and 13 individuals had an unknown chemotherapy status. Patients with no history of chemotherapy were older (p=0.013), weighed more (p=0.054), and had a higher body mass index (p=0.067). Obesity affected 56.7% of NC patients, 39.1% of HC patients, and 19.0% of CC patients (p=0.026). The NC group also had a higher incidence of hyperlipidemia (p=0.058) and worse performances in the six-minute walk (p=0.019), timed up-and-go (p=0.002), chair stand (p=0.043), and epic lift (p=0.029).

Program Completion Based on Chemotherapy Status: 31.8% of CC, 33.3% of NC, and 43.8% of HC completed the entire program. There were no group differences in exercise adherence based on the use of chemotherapy (p=0.414).

Improvements between groups: Patients who never used chemotherapy improved the least in arm curls (p=0.022) and improved the most in VO_2 max (p=0.037) and systolic blood pressure (p=0.064).

Adiposity, Exercise, and Cancer

Obese Vs. Non-obese subject characteristics: Obese and non-obese patients exhibit no differences in cardiovascular profile at baseline: Systolic blood pressure (p=0.818), diastolic blood pressure (p=0.416), mean arterial pressure (p=0.109), pulse pressure (p=0.386), heart rate (p=0.889), and VO_2 max (p=0.195). Assessments of wellbeing are not different between obese and non-obese patients at baseline: Fatigue index (p=0.366), insomnia score (p=0.314), and depression score (p=0.615) are all the same. Most tests of physical functioning are not different between obese and non-obese patients: Functional reach (p=0.565), chair stand (p=0.202), timed sit to stand (p=0.877), sit and reach (p=0.537), back scratch (p=0.912), grip strength (p=0.953), arm curls (p=0.494), and epic lift (p=0.909).

Baseline physical functioning variables that are different between obese and non-obese cancer patients: Obese patients are poorer at six minute walk ($p<0.001$) and timed up-and-go (p=0.012). Regarding strength, obese patients are stronger in the UTM push (p=0.017) and UTM pull (p=0.040).

Relationship between obesity status and retention: Whether a participant was obese or not obese did not influence the likelihood of completing the intervention (p=0.853). 38.2% of obese patients participated for the full duration of the intervention; 36.5% of non-obese patients participated for the full duration of the intervention.

Changes in response to exercise intervention: From baseline to follow-up, patients improved in wellbeing and most functional tests, but there were no differences in improvement between obese and non-obese patients in any component of their cardiovascular profile, psychological health, or physical functioning ($p>0.190$).

Fatigue, Insomnia, and Depression

Completers characteristics at baseline: The average Athens Insomnia Score was 8.1. The average depression score was 38.1. The average Fatigue Index Score was 62.5.

Relationship between fatigue, depression, and insomnia and completion of the program: Among patients who completed the intervention (n=58), fatigue decreased (p<0.001); insomnia (p=0.673) and depression (p=0.675) were unchanged.

Odds of completion: Fatigue (p=0.432), insomnia (p=0.759), and depression (p=0.932) did not predict program completion. Score r= -0.677 and category r= -0.685, as an ordinal variable (completion or failed to complete).

Predictors of fatigue, insomnia, and depression: Patients who were more fatigued at baseline experienced greater reductions in fatigue at follow-up, assessed by score (r= -0.677; p<0.001) and category (r=-0.685; p<0.001). Patients with worse insomnia at baseline reported greater improvements at follow-up (r=-0.761; p=0.079); elevated depression did not facilitate greater improvement (p=0.228).

Physical Functioning and Exercise

Characteristics of Completers at Baseline: 51 females and 7 males completed the study. The average physical functioning tests was a 7.7 second Timed Up and Go, 13.1 Arm Curls, 9.7 Chair Stands, -1.0 cm Sit and Reach, -3.3 Back Scratch, 14.4 second Sit-to-Stand, and a 399.9 m 6 minute walk test. Patients cardiometabolic variables averaged as a 74.5 bpm resting heart rate, 171.4 lbs. weight, 38.1% body fat percentage.

Changes in Anthropometric and Cardiovascular Variables: Patients did not experience any significant change in body weight (p=0.585), BMI (p=0.477), BF% (p=0.367), systolic blood pressure (p=0.560), diastolic blood pressure (p=0.292), or heart rate (p=1.000).

Changes in Functional Tests: Improvements in VO_2 max (p=0.005), timed up-and-go (p<0.001), chair stand (p<0.001), arm curl (p<0.001), grip strength (p<0.001), UM push (p<0.001), UM pull (p<0.001), epic lift (p=0.005), functional reach (p=0.001), six-minute walk (p<0.001), and sit-to-stand (p=0.005). Mean values improved in sit-and-reach (p=0.321) and back-scratch (p=0.099), but pre-post comparisons were not significant.

Program Retention

Characteristics of Sample at Baseline: We retained 37.7% of patients through follow-up; 99 patients withdrew and 58 completed the entire 10 weeks. Women (n=120) and breast cancer patients (50.3%) were the most common subjects enrolled. Additional significant differences were weight, sit-and-reach scores, and hyperlipidemia. Non-completers weighed more (p=0.052). Completers had more cases of diagnosed hyperlipidemia (p=0.040) and better sit and reach scores (p=0.016).

Completers vs. Non Completers: Adherence was better among breast cancer patients (p=0.016) but this was attributable to sex; there was no difference among patients with multiple cancers (p=0.583) or patients who had a previous heart attack (p=0.681) or stroke (p=0.528), had diagnosed hypertension (p=0.513) or pulmonary disease (p=0.199), were obese (p=0.893), or smoked (p=0.333). Fatigue (p=0.696) and mode of treatment (surgery, chemotherapy, radiation; p>0.225) did not affect completion.

Predictors of program completion: There was a difference among patients with hyperlipidemia (50.0% retained) compared to patients without hyperlipidemia (32.4%; p=0.040). Patients with poor sit-and-reach scores were also more likely to drop out: 53.3% of patients who could reach their toes completed the program compared to 26.5% who could not reach their toes (p=0.016). Women were more likely to complete the trial (43.2%) than men (19.4%; p=0.010). In a multiple logistic regression when holding sex constant, hyperlipidemia increased the odds of completion by about 2.1-fold. Holding hyperlipidemia constant, to be a woman associated with a 3.1-fold increase in the odds of completion.

Diabetes Conclusions

HbA1c and exercise. Ten weeks of a balanced flexibility, aerobic, and resistance exercise program improved physical functioning and cardiometabolic profiles of diabetes patients, including HbA1c. However an additional volume of aerobic exercise did not enhance outcomes of physical functioning or cardiometabolic factors in comparison to the non-walking group.

Improvements in strength associated with poorer outcomes of HbA1c. As the number of arm curls performed and grip strength conducted increased, the level of HbA1c of the patient also increased at the post evaluation. Our findings demonstrate that although combining aerobic and resistance training is effective in improving physical functioning and cardiometabolic factors, further research may be needed to determine a specific prescription of exercise in order to appropriately assist the exercising diabetes patient in HbA1c control, as proper HbA1c management is imperative to reducing physical and psychological symptoms associated with diabetes.

QOL and exercise. Variables collected at the initial evaluation (age, six minute walk, functional reach, and chair stand), post evaluation (age, six minute walk, and functional reach), and changes in pre and post evaluations (six minute walk and sit and reach) impacted QOL scores. These findings suggest functionality (six minute walk, chair stand) and flexibility (functional reach and sit and reach) play important roles in QOL, and thus must be preserved in order to optimize physical and psychological outcomes for individuals with T2D. These findings further provide insight to health clinicians on the characteristics of individuals with low QOL scores, to ensure their participation and enjoyment of the exercise intervention.

Perceived physical functioning QOL and exercise. An improvement of approximately 25% in the perception of physical function, independent of enhancement of any anthropometric or performance domain, was observed over the course of ten weeks. Patients seem to improve their perception of physical function with mere participation, not progress. As preserving QOL is essential to disease prognosis, it may be important to incorporate the behavior of exercise into treatments, even if it fails to elicit physical improvement.

Sex and exercise responses. HbA1c values in patients with non-insulin dependent T2D decreased over the course of ten weeks. Decreases were more pronounced in male participants than females. These findings help illustrate clinical importance for personalizing exercise programs to men and women at risk for, or diagnosed with, T2D.

Cancer Conclusions

Radiation therapy and exercise. A structured, comprehensive exercise program performed at moderate intensity improved blood pressure and six-minute walk more in patients who were currently undergoing radiation treatment in comparison to individual's not undergoing radiation therapy at the time. This further solidifies the incorporation of exercise is essential to the cancer survivor, and may be an effective way to mitigate some of the health consequences associated with radiation therapy.

Chemotherapy and exercise. Our results indicate chemotherapy is not a barrier for exercise participation. As long as exercise is tolerated, exercise should be encouraged throughout the entire cancer survivorship. Furthermore, the use of chemotherapy influenced strength (arm curls) and cardiometabolic risk factors (systolic blood pressure and VO2 max). However, we acknowledge the patients who had used chemotherapy in the past or were currently undergoing treatment were younger than those with no history of use; age may explain the differences noted.

Adiposity, cancer, and exercise. Obese and non-obese cancer survivors in our population expressed similar profiles at baseline. Obese patients were scored higher in strength exercises and poorer in functional tests.   and generally improved equally in response to exercise.

Our results imply that exercise is beneficial for cancer patients; participation seems to be just as beneficial for non-obese patients as it is for obese patients.

Fatigue, insomnia, and depression. Fatigue, insomnia, and depression are often indissoluble from the daily experience of a cancer survivor. Our intervention improved fatigue and insomnia, with greater improvements among the more severely affected. Though we did not identify significant alleviation of depression symptoms, collectively these findings suggest that exercise is a safe, effective strategy that may improve some psychological symptoms associated with cancer.

Physical functioning. 11 of 13 tests of physical functioning showed significant improvement at follow-up. However, the 10 week exercise intervention did not elicit any changes in body composition (weight, BMI, or BF%) or cardiometabolic parameters (HR or blood pressure). In this population, maintenance of functional capacity can help preserve the ability to perform tasks of daily living, and it is associated with prolonged survival. Exercise not only improves the patients' abilities, but also their recovery and may reduce the risk of cancer recurrence. Exercise programs similar to the one conducted for this study can greatly enhance the lives of participants, by means of improving the quality of life and/or rejuvenation of their pre-cancer health.

Program retention. In our sample, fewer than 40% of patients were retained through follow-up. Flexibility tests and hyperlipidemia diagnosis predicted retention, but sex had the strongest association and could have explanatory power over such findings. Further efforts must be made to identify risk factors for attrition in this population. The differences observed in retention by sex suggest other cohorts may need to be stratified by sex to verify our findings.

Chapter 5: Discussion

The main findings of this study demonstrate the outcomes that could be expected in a community-based intervention with limited resources. Furthermore, it demonstrates that the prescription of exercise may be more effective by individualizing exercise programs that are tailored to subpopulations of diseased populations.

Diabetes Group

HbA1c and exercise. Maintaining optimal levels of HbA1c and properly managing glucose is essential to diabetes control. Studies have shown that reductions in HbA1c can be achieved through regular exercise, which can be explained through multiple mechanisms; weight loss, increased insulin sensitivity, lowered blood sugar, etc. (Colberg et al., 2016). However, discrepancies in the optimal dosage and type of exercise prescription to best reduce HbA1c levels exist.

Multiple studies have found significant improvements in HbA1c through pure resistance training, while others found similar results through pure aerobic training. Whether it be resistance, aerobic, or a combination exercise intervention, the incorporation of exercise to improve glycemic control and HbA1c values is supported (Yang, Scott, Mao, Tang, & Farmer, 2014). Our study found improvements with an intervention combining both aerobic and resistance training. However in our population, individuals who increased in strength gains also increased in HbA1c levels after the ten weeks of exercise- a finding that does not agree with our general knowledge on muscle physiology and diabetes. It is assumed that the more strength you can produce, the more muscle fibers you have and thus the more cells you can use for non-insulin dependent glucose uptake during exercise. Our findings suggest that adjusting the exercise prescription for strength training may be necessary to better control HbA1c. A specific, detailed resistance exercise regime is suggested.

The researchers have identified a potential limitation to the finding concerning increased strength gains to poorer diabetic outcomes. Considering HbA1c is a blood glucose test that measures blood sugar bound to hemoglobin over the past 3 months, one could argue the 10-week exercise program is not a sufficient amount of time to see accurate changes in HbA1c (Alqahtani, Khan, Alhumaidi, & Ahmed, 2013). When focused on changes in HbA1c, many exercise programs create exercise interventions lasting 12 weeks, with the purpose of replicating the lifespan of a red blood cell. On the contrary to this argument, the researchers want to point out the effectiveness of exercise on HbA1c can occur in a smaller time frame than expected (10 weeks instead of 12 weeks) (Umpierre et al., 2011).

QoL and exercise. The physical hardships that accompany diabetes can negatively impact the victim's QoL. On average, individuals with diabetes express a lower QoL and higher rates of other psychological distress, including depression, in comparison to healthy individuals without diabetes (Goldney, Phillips, Fisher, & Wilson, 2004). Multiple studies have found exercise to improve the QoL of individuals with diabetes through multiple mechanisms such as changes in body composition and improvements in diabetic parameters (Cai, Li, Zhang, Xu, & Chen, 2017).

Exercise programs that achieve weight loss can increase the patient's body image and positivity. Increases in muscle mass can increase functionality and allow participants to either regain, preserve, or improve their ability to perform everyday tasks. Lastly, as many individuals with type 2 diabetes struggle with managing their disease properly, significant improvements in diabetic parameters may instill a better outlook on the patients disease and stimulate a greater will to exercise. In agreement with many other studies, our results identified exercise can be an effective way to improve QoL conducted (Cai et al., 2017; Myers et al., 2013). Furthermore, our study found that improvements in QoL were made even without significant improvements in anthropometric variables and functionality. Though improvements in functionality and anthropometric measurements are ideal, the act of exercise alone was sufficient enough to improve patients' perceived quality of life.

Our study also analyzed factors that influence QoL in a diabetic population before initiating an exercise intervention. QoL has proven to be an important aspect of the diabetes disease continuum and can be used to predict outcomes of an intervention in healthy and unhealthy populations (Jing et al., 2018). Identifying factors that influence QoL scores in this population can allow researchers to focus on the populations most at risk of suffering from low QoL. More studies are focused on the changes of QoL in response to an exercise program, rather than the influence of QoL has on exercise program completion (Jiang et al., 2018; Myers et al., 2013). However, it is accepted that individuals expressing lowered QoL scores generally face greater psychological difficulties, and may be less likely to complete an exercise intervention. By focusing special attention on these populations, you can expect the patients to increase their QoL throughout the study trial, and could in-turn have a higher likelihood of completing the study, resulting into a better disease prognosis

Exercise and Perception of Physical Functioning QoL: In the case of improvements in exercise perception, our findings suggest just participating in exercise can positively impact exercisers outlook on functional capabilities. When experiencing an improved physical functioning QoL, one could infer the individual would be more willing to exercise often and at higher intensities. Thus, increasing insulin sensitivity, cardiovascular fitness, muscle mass and optimizing physical and diabetic results for individuals with diabetes through exercise.

Additionally, our findings could indicate that improvements in QoL may occur in a shorter time frame in comparison to physical improvements. A study that is longer in duration could support this claim, however, the researchers are optimistic that this increased physical functioning QoL observed will influence greater confidence in participating in exercise and further physical improvements.

HbA1c and sex. The differences in responses to exercise identified for this study (men improving more than women in HbA1c levels) suggests there is a need to further tailor exercise prescription for individuals with noninsulin dependent type 2 diabetes. Few studies exist observing sex-specific differences in response to exercise interventions, making it difficult to compare the legitimacy of our findings to other clinical trials. However, a previous study concluded similar results, identifying greater improvements in weight loss for male diabetes participants in comparison to female diabetes patients in response to the same exercise program (Perreault et al., 2008). Perreault and colleagues also identified the gap in the literature observing the lack of information concerning differences in responses to exercise by sex for individuals with type 2 diabetes.

Several studies are focused on differences between sexes in the development of the disease rather than the treatment. In the United States, males and females are not affected by type 2 diabetes at the same rate- one in every nine adult women and one in every eight adult men in the United States are diagnosed with type 2 diabetes (CDC, 2017). Furthermore, the severity of the disease differs between sexes. Females with diabetes often present with higher rates of depression, cardiovascular morbidity, and mortality, and exhibit poorer exercise capacities (Kautzky-Willer, Harreiter, & Pacini, 2016; Krag et al., 2016; Regensteiner et al., 2015). Exercise can be incorporated to counter all of these setbacks.

It is well known that exercise efficacy differs between individuals. Biological and environmental factors such as age, baseline physical fitness, and sex can impact an individual's response to exercise. The same holds true in a diabetic population. Our study identified both male and female participants differed in their responses to exercise, as men experienced greater margins of improvement in their HbA1c scores in comparison to female participants. Furthermore, women participants decreased more in body fat percentage in comparison to men upon completion of the trial. This observation supports the claim that individuals with diabetes can experience improvements in diabetic biomarkers despite experiencing significant changes in body composition, but also disagrees with the known physiology involving decreases fat mass and increases in diabetic parameters.

One possible explanation identified is the differences in exercise intensity and physical exertion during the exercise sessions between male and female participants. It is important to consider on average, men exhibit higher exertion levels in comparison to women. Though all participants were recommended to exert themselves at 75% of their maximum heart rate, tight monitoring concerning the achievement of this number did not occur. Thus, it is possible that men may have experienced more improvements in HbA1c in comparison to women because they were exerting themselves more. The researchers observations, observing men sweating more than the women participants exercising, supports this hypothesis. However, as mentioned in the previous paragraph, the women participants experiencing greater improvements in body fat percentages does support this hypothesis. The researchers are encouraging future research to investigate these discrepancies.

Cancer Group

Radiation therapy. In our population, the radiation status of participants (previously had radiation, never had radiation, currently undergoing radiation) failed to influence the completion of the 10 weeks of exercise. Few clinical studies have observed the direct influence of radiation therapy status on exercise, although it is well known that cancer patients undergoing therapy struggle with remaining active (Jones, Eves, Haykowsky, Freedland, & Mackey 2009). Many studies have focused on the impact of an exercise intervention on cancer patients undergoing radiation therapy (Lipsett, Barrett, Haruna, Mstian, & O'Donovan, 2018).

However, differences in functional and cardiometabolic variables did exist following the completion of the program based on radiation status. Patients that were undergoing radiation therapy during the time of the study did experience greater improvements in six minute walk and systolic blood pressure. An explanation to this could be that this population was undergoing severe physical hardships at the beginning of the exercise intervention, and were able to experience greater improvements through the conditioning from the exercise intervention. Thus, the researcher recommend creating individualized exercise programs dependent on the radiation status in order to elicit similar improvements among all radiation groups.

A potential limitation to this finding is that radiation treatment information and history was not obtained in the post evaluation. It is possible that some participants discontinued the radiation therapy during the exercise intervention, which could explain more profound improvements within the participants that were undoing radiation during the initial evaluation. However the researchers are assuming all participants that the status (never, previously or currently using radiation) remained the same for each participant from the pre and post evaluations.

Chemotherapy. Similar to the radiation therapy outcomes, though retention was not affected by the relationship with chemotherapy, the exercise outcomes were. Patients who never used chemotherapy improved more in blood pressure and VO2 Max in comparison to participants who previously used chemotherapy. Thus, there may exist a need to implement more intense cardiovascular training in order to improve such outcomes for this distinct subpopulation. The limitation addressed in the previous section, concerning the lack of treatment information at post evaluation applies to this finding as well.

Adiposity, cancer, and exercise. With increasing rates of cancer survivorship and obesity prevalence in the United States, the obese population is of clinical importance when considering the management of cancer. Exercise interventions with effective prescriptions are essential to managing this epidemic. Our findings are in support of exercise regardless of participants initial body composition. However it is important to recognize a personal exercise prescription for obese cancer patients may help the individual in various domains of the cancer continuum.

Though improvements in response to exercise are always desired, it is important to consider the consequences of obesity for the cancer patient and the necessary improvements needed for this specific subpopulation. Exercise effectiveness may be more critical to obese cancer survivors, not only because of cardiovascular, psychological, or functional improvements that could arise, but owing to the risk of recurrence associated with excess adiposity (Park, Morley, Kim, Clegg, & Scherer, 2014). Thus our researchers recommend a different exercise prescription for obese cancer survivors from non-obese cancer survivors.

Fatigue, insomnia, and depression. Though improvements in insomnia and fatigue were achieved by our participants, rates of depression did not improve upon completion of the intervention. Concerning improvements in insomnia and fatigue, our findings are in agreement with most exercise interventions on cancer survivors (Lee, Fang, Hung, Chan, & Huang, 2019; Pekmezi & Denmark-Wahnefried, 2011; Craft et al., 2012). Our findings are also in agreement with most depression outcomes on cancer exercise interventions. In general, the direct impact of exercise interventions on depression in cancer survivors is undetermined. However there is an overall agreement that exercise influences slight improvements in depression, however the improvement is not as profound in comparison to other psychological parameters (Craft et al., 2012). Thus, our findings provide further evidence that depression may be a more serious psychological barrier associated with cancer that requires further attention. Exercising twice a week for one hour periods may not be satisfactory. The researchers suggest incorporating exercise programs with psychological therapeutic assistance to better assist patients experiencing depression.

The researchers have identified limitations to this outcome. Specific data concerning the years of survivorship, what stage of the treatment, etc. were not obtained. All of which are important factors to consider, as feelings of depression may be exacerbated during certain areas of the cancer continuum. Furthermore, researchers failed to note or record additional factors related to psychological health outside of the surveys. It is also possible that participants experienced a life-changing event during the time of his or her program length unrelated to their cancer, or the patient may have been experiencing an abnormally great or poor day during the initial or final evaluation. Such factors are important to consider when concerning day to day mood and may cause the patient to incorrectly record his or her psychological well-being during the evaluations. This uncertainty may threaten the accuracy of the results, as it is completely subjective and dependent to the individual. Furthermore, the patients that did not finish the trial do not have a post score for fatigue, insomnia or depression. It is important to consider these psychological hindrances may have been so profound it interfered with the patient's ability to complete the intervention, thus our findings may reflect bias as it represents a particular subpopulation of cancer survivors.

Physical functioning. Physical functioning is often compromised as a result of cancer and its treatments. Many exercise interventions have been created to preserve or increase physical functioning for cancer survivors, and most have concluded similar results in functionality improvements as our study has (Silver & Gilchrist, 2011). Our participants experienced improvements in measurements of physical functioning but failed to improve in anthropometric and cardiometabolic profiles.

Preserving functionality is exceptionally important to the cancer survivor, as decreased physical functioning can influence an increase in sedentary behaviors and the development of obesity. Our findings further exemplify the importance of regular physical activity to the cancer survivor, but also suggests that there may be a need to implement exercise programs specific to cardiometabolic and anthropometric improvements. Incorporating exercise interventions with a supplementary diet may be more effective to achieving improvements in both functional and anthropometric profiles.

Retention. Our findings concerning retention contributes to the evidence that the cancer community fails to regularly exercise, despite its associated benefits. However, the researchers noticed many studies do not continue exercise interventions with excessive attrition rates. Furthermore, many studies that do publish their work often identify retention rates specific to certain cancer types. The researchers were unable to find studies that observed baseline variables collected influencing the retention of the participant. When regarding retention in our study, the researchers found relationships concerning the impact of sex, functionality, diagnosed diseases, and the absence of physical activity in our current society.

Concerning sex, the trial served as both an exercise and support group, as the women, being of higher quantities and similar cancer type (breast), had much in common. Males may have been intimidated by this environment, possibly accounting for the high attrition amongst male participants. Programs separated by sex may serve as an effective way of promoting an inclusionary environment and higher rates of retention among both sexes participating.

Concerning functionality, an increased sit and reach score and a decreased body weight can attest for an increased level of functionality. Since the lighter and more flexible express a more functional profile, incorporating exercise in their life may be less difficult in comparison to the less functional cancer survivors. This could attest to the higher rates of retention within the more functional subpopulation. Thus the researchers encourage exercise interventions to express greater individual attention on those that are less functional, or implementing an exercise program that groups participants based on their physical capabilities may motivate this less functional subpopulation to remain in the program.

Concerning the influence of a diagnosed case of hyperlipidemia increasing retention, the researchers are hypothesizing this finding demonstrates the impact of a clinical finding. These participants could previously be educated by their physicians of the impact of hyperlipidemia, and thus have found more reason to exercise. However, it is important to note that our participants did suffer from other diagnosed diseases, but did not express the same commitment to the exercise intervention. The researchers recommend conducting seminars to inform patients of the other diseases they have, the consequences of those diseases, and their increased susceptibility to develop additional chronic diseases because of their post-cancer health status.

Diabetes and Cancer Groups

Community based intervention. When comparing our retention rates to that of clinical trials, it is clear that the community interventions are not as effective in this area, as many clinical trials express significantly higher retention rates (Gul & Ali, 2010). The relatively high amount of participants who failed to complete the study may create a subject profile bias. Low retention rates can be related to the community-based program arrangement. Though encouraged to keep up to date on participants, the program budget did not allow for designated staff members focused on maintaining participants, nor were patients given significant monetary awards for participants to employ as motivation for completing the program. Additionally, bearing in mind the considerably low retention rates, patients that were retained may express excessive determination and display a different patient profile in comparison to the average diseased individual.

Lastly, adherence to the program was not well recorded by the researchers, and was not considered in the analyses conducted for either cancer or diabetes group. Participants were tested for the post-evaluation after 10 weeks. Whether the participant missed multiple exercise sessions or attended every exercise session throughout the ten weeks is unknown. Patients who did attend all 20 sessions are likely to express more improvements in comparison to patients who did not attend all 20 sessions.

Final conclusions of diabetes and cancer groups. Physical inactivity is an issue prevalent within all communities of the United States, not just the cancer and diabetes communities (Troiano et al., 2008). If we are failing to get the general US population to maintain a physically active lifestyle, the odds of a cancer survivor and diabetes patients, who face a variety of health and psychological difficulties, to adopt one is equally as low, demonstrated by our low retention rates within our study (47% for cancer and 58% for diabetes).

The outcomes from our study give our cancer and diabetes health professionals and communities insight on the reality diseased populations are facing. Furthermore, our study exemplifies the importance in creating realistic exercise programs for diseased populations. The researchers hope that the findings from this intervention can provide insight in areas that need improvement. If we can identify and restore the problems occurring within diseased populations on a community level, we can create sustainable improvements within these epidemics.

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