THESIS

CARDIOLOGISTS AND **ONC**OLOGISTS **E**XERCISE **P**ROMO**T**ION **S**TUDY

(CONCEPTS)

Submitted by

Kelli A. LeBreton

Department of Health and Exercise Science

In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Summer 2018

Master's Committee:

Advisor: Heather J. Leach

Barry Braun
Mackenzi Pergolotti
Steven R. Schuster

ABSTRACT

CARDIOLOGISTS AND **ONC**OLOGISTS **E**XERCISE **P**ROMO**T**ION **S**TUDY

(CONCEPTS)

Background: Cardiovascular disease (CVD) and cancer are the two leading causes of death in the U.S. Survivors of CVD and cancer can benefit from exercise following a diagnosis to manage symptoms, improve quality of life, and reduce the risk of mortality. Physicians can play a key role in promoting exercise to their patients, yet the rates of discussion of exercise and referral to exercise programs are lower than expected among oncologists and cardiologists, given the evidence of benefit for their patients. Purpose: This aim of this study was to 1) compare cardiologist's and oncologist's the beliefs about exercise for their patients, 2) compare oncologist's and cardiologist's exercise promotion practices, 3) examine the relationship between physician's own exercise habits and their beliefs about exercise for their patients, and 4) examine the relationship between physician's beliefs about exercise for their patients, and their exercise promotion practices. Method: An online survey was distributed to practicing cardiologists, and medical and radiation oncologists in northern Colorado. The survey consisted of 22 questions in four categories; demographics, self-reported exercise behavior, exercise promotion practices, and beliefs about exercise for patients. activPAL accelerometers were used to objectively measure exercise levels. Results: Out of 154 surveys sent, 37.0% (*N*=57) were returned (*N*=25 cardiologists, *N*=32 oncologists), and *N*=12 cardiologists and *N*=6 oncologists wore the accelerometers. The survey found that 70% of oncologists and 79% of cardiologists agreed or strongly agreed that exercise reduces disease recurrence or increases the likelihood of

survival to a similar extent, but more cardiologists disagreed, and more oncologists reported a neutral belief (FE(2)=9.681, p=.005, *V*=.429). A greater proportion of cardiologists (65%) reported discussing exercise at most or all visits compared to oncologists (35%) ($\chi^2(2)=7.385$, p=.029, *V*=.360). Oncologists were 8 times more likely to look for physical therapists when referring to exercise-based programs ($\chi^2(1)=11.017$, p=.001) whereas more cardiologists were 6 times more likely to look for certified exercise physiologists ($\chi^2(1)=7.267$, p=.009). Among both oncologists and cardiologists, step count and MVPA minutes were inversely related to the belief that exercise improves patients' well-being (r_s=-.515, 95% CI [-.767, -.155] p=.034; r_s=-.609, 95% CI [-.829, -.259], p=.009). Among cardiologists, there was an inverse relationship between MVPA minutes and the belief that exercise improves well-being in patients (r_s=-.671, 95% CI [-.881, -.503], p=.024). Among oncologists, there was a positive association between break rate and believing their patients are capable of exercise (r_s=.828, 95% CI [.664, .980], p=.042). However, there was no relationship between self-report exercise levels and beliefs about exercise for patients. Cardiologists who "agreed or strongly agreed" that exercise reduced recurrence or increased the likelihood of survival were 6.8 times more times likely to discuss exercise at most or all visits compared to those who were "neutral" or "disagreed" (FE(4)=9.351, p=.027, *V*=.514). Conclusions: Although cardiologists and oncologists generally shared positive beliefs about exercise for their patients, more oncologists were neutral in the belief that exercise can reduce recurrence or increase the likelihood of survival and more cardiologists disagreed. Further, the relationship between physicians' own exercise levels and their beliefs about exercise for the patients should be interpreted with caution due to small sample size with activPAL accelerometers. Cardiologists' beliefs about exercise reducing disease recurrence in patients influences their exercise promotion practices, but there were no other relationships. This may be

due, in part, to systemic barriers, such as the need to address more pressing medical issues in a limited amount of time. Future studies need to identify why there is a gap between physicians holding positive beliefs about exercise for patients, yet not discussing or recommending exercise to the same extent in addition to interventions that target closing this gap.

ACKNOWLEDGEMENTS

I want to thank all of my family and friends for encouraging and helping me in various ways throughout this process. I would especially like to thank Kevin, who has been a big supporter throughout the past year. I extend my appreciation towards my colleagues and professors in the Health and Exercise Science Department at Colorado State University. It is with their guidance, education, and mentorship that I was able to pursue this research and produce a successful product. I would like to dedicate this project to my dad, who passed away from cancer in 2003.

TABLE OF CONTENTS

I. INTRODUCTION

Benefits of Exercise for Individuals with Chronic Disease

Chronic disease, including cardiovascular disease (CVD) and cancer is the leading cause of death among adults in the United States. In 2017, about 28.4 million individuals were diagnosed with CVD, and over 600,000 deaths per year are linked to CVD (Centers for Disease Control and Prevention, 2017). Cancer also claims the lives of approximately 600,000 people each year in the United States, and there are 1.6 million new cases projected in 2017 (American Cancer Society, 2017). There are many treatment options for CVD patients, including anticoagulation medications, statins, angiotensin converting enzyme inhibitors, and beta-blockers. These medications have numerous side effects such as dizziness, muscle aches, nausea, fatigue, etc. Similarly, cancer patients receiving chemotherapy, radiation, and/or surgery face side effects including cancer-related fatigue, nausea, hair loss, edema, etc., some of which can last years after treatment. Alternatively, lifestyle changes, such as engaging in exercise has been shown to improve physical health and quality of life, as well as reduce mortality in individuals with CVD or some types of cancer (i.e. breast, colorectal, prostate), without many of the deleterious side effects of pharmacologic treatment.

Benefits of Exercise for Individuals with Cardiovascular Disease

Exercise is beneficial for patients who have suffered CV events, including myocardial infarction, chronic heart disease, revascularization procedures, etc. (Lavie, Thomas, Squires, Allison, & Milani, 2009). Exercise-based rehabilitation after a cardiac event leads to 20-32% reduction in all-cause mortality (Bobbio, 1989; Jolliffe et al., 2001; O'Connor et al., 1989; Taylor et al., 2004) and 20-38% reduction in cardiac mortality (Bobbio, 1989; O'Connor et al., 1989; Taylor et al., 2004). Additionally, both aerobic exercise and resistance training have been shown

to have positive effects on several of the risk factors that contribute to CVD, including reduction in total cholesterol and triglycerides, as well as systolic blood pressure (Adams et al., 2006; Taylor et al., 2004; Williams et al., 2007), further reducing risk for subsequent CV events. Quality of life is also improved from both forms of exercise. The American Heart Association (AHA) issued a statement recommending resistance training for individuals with CVD, stating the improvement in quality of life, independence, functional capacity, and a reduction in disability (Williams et al., 2007). Similarly, a systematic review including 12 studies of individuals who exercised 1-3 times a week for 2 to 12 months post cardiac event, also showed improved quality of life with aerobic training (Taylor et al., 2004).

Considering these benefits, the AHA and American College of Sports Medicine (ACSM) have developed exercise guidelines for individuals with CVD. The current recommendation is 150 minutes of moderate intensity or 75 minutes of vigorous intensity aerobic activity in addition to resistance training two or more days a week (American Heart Association, 2014). Despite these recommendations, only 21.7% of adults meet both the aerobic and resistance training guidelines (Clarke, Noris, & Schiller, 2017). Further, although the prevalence of CVD increases by about 30% when individuals reach the age of 60 (Mozaffarian et al., 2015), the number of individuals meeting guidelines decreases by about 9% (Clarke et al., 2017). Individuals with CVD may need recommendations or referrals from their physicians in order to maintain activity levels once diagnosed.

Benefits of Exercise for Individuals with Cancer

With improvements in early detection rates and advances is treatment, the number of cancer survivors residing in the US has risen to over 15.5 million (Simon, 2016). A large area of research is now focused on survivorship, including ways to improve quality of life and disease-

free survival. For several cancer types, such as breast and colon cancer, exercise may reduce cancer-specific mortality by 18-30% (Li et al., 2016). A recent meta-analysis of more than 3.9 million cancer survivors, including various types of cancer, found that following a cancer diagnosis, for every 1MET-h/week increase of physical activity (up to 7.5MET-h/week) there was reduced risk of cancer-related mortality by about 2% (Li et al., 2016). Exercise interventions for cancer survivors have also demonstrated improvements in overall quality of life by 29%, upper and lower body strength by 99% and 90%, respectively, and aerobic fitness by 32% (Speck, Courneya, Mâsse, Duval, & Schmitz, 2010). Exercise has also been shown to be effective for decreasing fatigue by 54% (Speck et al., 2010), a distressing side effect of cancer treatment reported by more than 75% of survivors (Bower, 2008; Rock et al., 2012; Speck et al., 2010).

This evidence has led organizations such as the National Comprehensive Cancer Network (NCCN), American Cancer Society (ACS), and the American College of Sports Medicine (ACSM) to develop exercise recommendations for cancer survivors. These organizations suggest that cancer survivors should engage in a minimum of 150 minutes per week of moderate intensity aerobic exercise, and two days per week of resistance training, the same recommendation as for CVD (Riebe, Ehrman, Liguori, Magal, & Medicine, 2018; Society, 2017). However, less than half (28-47%) of cancer survivors report meeting the recommended exercise guidelines (Blanchard, Courneya, Stein, & SCS-II, 2008; Karvinen, DuBose, Carney, & Allison, 2010), and objective measures of activity suggest that as low as 4.5% of survivors are meeting these guidelines (W. A. Smith, Nolan, Robison, Hudson, & Ness, 2011).

Levels of exercise are low in individuals with CVD and cancer, and given the benefits of exercise for both populations, efforts must be made to promote exercise among these

patient/survivor populations. Medical providers may play a critical role in exercise promotion, as they are seen as knowledgeable individuals and have patients' trust to make a variety of healthcare decisions and recommendations. Empirical evidence supports this notion, showing that physicians have can influence the number of their patients engaging in exercise (Balady et al., 2011; Calfas et al., 1996; Jones, Courneya, Fairey, & Mackey, 2004).

Physician's Role in Exercise Promotion

Several theories including the Health Belief Model and Precaution Adoption Model suggest that when an individual encounters a life-threatening event, such as a diagnosis of cancer or a CV event, he or she may have increased perceptions of personal vulnerability (McBride, Clipp, Peterson, Lipkus, & Demark-Wahnefried, 2000). This increased perception of susceptibility can increase motivation to reduce risky behavior or increase healthy behavior. This time-period is often referred to as a "teachable moment" (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005; McBride et al., 2000), and presents an opportunity for oncologists and cardiologists to capitalize on exercise behavior change in their patients.

In addition to the physician presence during teachable moments for their patients, physicians may also serve as important individuals whose stance or beliefs on exercise may impact their patient's behavior. The Theory of Planned Behavior (TPB), posits that subjective norms surrounding a behavior is predictive of intention to change behavior, and subsequent behavior change (Ajzen, 1991). Subjective norm includes two components, one of which is the descriptive norm, or the perception that important others themselves (i.e. physician) perform a given behavior. Descriptive norm will be discussed in more detail in a later section. The other component, the injunctive norm, is the perception of the beliefs that others who are important to you hold about whether or not you should perform a certain behavior. This theory can be applied

to patients' perceptions of their physicians' beliefs about exercise, in that if patients perceive that their physicians value exercise and think it is important for patients to exercise, then patients will, indeed, be more likely to exercise. Previous research with cancer survivors supports the importance of subjective norm, finding subjective norm had the strongest correlation to intention to exercise compared to other TPB constructs (i.e. attitude and perceived behavioral control) (Courneya & Friedenreich, 1999). Additional studies with cancer survivors have corroborated that patients perceive physicians as important when considering exercise during cancer treatment (Courneya, Blanchard, & Laing, 2001; Courneya & Friedenreich, 1999; Jones, Courneya, Fairey, & Mackey, 2005). In fact, the strength of the relationship between physicians and subjective norm as a global indicator is similar to spouses and friends, reiterating the importance of physicians' opinions and recommendations (Courneya et al., 2001; Courneya & Friedenreich, 1999).

Studies in primary care settings have shown that when physicians demonstrate their positive beliefs/perceptions about exercise for their patients through verbal or written exercise recommendations, patient's exercise levels increase (Calfas et al., 1996; Swinburn, Walter, Arroll, Tilyard, & Russell, 1998). One predictor for patient participation in cardiac rehabilitation is physician endorsement of the program; patients who have stronger perceptions of physician endorsement are more likely to enroll, participate in, and complete more sessions of cardiac rehabilitation (Arena et al., 2012; Balady et al., 2011; Tsui, Shanmugasegaram, Jamnik, Wu, & Grace, 2012).

Despite the important influence of the physician on patient participation in exercise, there is still work to be done to fully integrate exercise promotion into healthcare. In 2007, ACSM developed the Exercise is Medicine (EIM) initiative, with the purpose of encouraging physicians

to discuss exercise with patients at every visit. The discussion would begin with recording exercise levels as a vital sign, and end with a prescription or referral to a qualified exercise professional. Further, the Office of Disease Prevention and Health Promotion established Healthy People 2020, which created specific objectives to increase physical activity in adults, including "increasing the proportion of physician office visits that include counseling or education related to physical activity" (Promotion, n.d.). These initiatives demonstrate the importance for connecting the healthcare system to exercise professionals, however the primary focus of EIM has been with general practitioners, and exercise for chronic disease *prevention*. Translating exercise promotion initiatives to practitioners who treat individuals with chronic disease, and the use of exercise as part of *treatment or rehabilitation* presents unique opportunities and challenges.

Exercise Promotion Practices of Cardiology Providers

Cardiac rehabilitation programs emerged after considerable evidence had compiled to demonstrate the benefits of exercise for those with cardiac conditions. Cardiologists and cardiovascular surgeons report cardiac rehabilitation as the standard of practice for individuals with various forms of CVD (Ghisi, Polyzotis, Oh, Pakosh, & Grace, 2013). The American Heart Association and American College of Cardiology have classified cardiac rehabilitation as a Class 1 Recommendation, meaning there is overall agreement that cardiac rehabilitation is effective secondary treatment for cardiac events, with the benefits greatly outweighing the risks, and clinicians should be referring patients to such programs (S. C. Smith et al., 2011). Additionally, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) states that most insurance companies cover cardiac rehabilitation (American Association of

Cardiovascular and Pulmonary Rehabilitation, n.d.), allowing cardiologists to be reimbursed from discussing exercise and to support patients in going to cardiac rehabilitation programs.

Despite this evidence, cardiac rehabilitation participation rates are lower than expected. One of the most common reasons for patients not participating in cardiac rehabilitation is a lack of referral by their physician (Balady et al., 2011; Gravely-Witte et al., 2010). Studies show that ranges of 5-56% of eligible patients are referred to cardiac rehab (Arena et al., 2012; Brown et al., 2009; Dahhan, Maddox, & Sharma, 2015; Gravely-Witte et al., 2010) with an average referral rate of 20-30% of eligible patients (Gravely-Witte et al., 2010; Mampuya, 2012).

There are several factors that have been shown to have an impact on referral rates. Women, older individuals, those with a lower socioeconomic status, and some minority groups receive referrals less often than their counterparts (Arena et al., 2012; Boyden, Rubenfire, & Franklin, 2010; Brown et al., 2009; Centers for Disease Control and Prevention, 2008; Cortés & Arthur, 2006), and those who are married and have education above high school level are more likely to be referred (Boyden et al., 2010; Centers for Disease Control and Prevention, 2008; Cortés & Arthur, 2006). Patient's medical condition is also associated with referral. For example, individuals with a Q wave myocardial infarction (MI), or bypass surgery are more likely to be referred than those with a "complicated MI" or an angioplasty procedure (Cortés & Arthur, 2006; Ghisi et al., 2013). The prevalence of cardiac risk factors, specifically smoking, hypertension, and hyperlipidemia, increases the rate of referral to cardiac rehabilitation programs (Cortés & Arthur, 2006). Additionally, the presence of comorbidities promotes increased referrals (Jackson, Leclerc, Erskine, & Linden, 2005). Systemic, or practical factors can also influence referral rates. Insurance coverage is a major determinant, with those not insured not receiving a referral to participate (Arena et al., 2012; Balady et al., 2011; Boyden et al., 2010;

Ghisi et al., 2013). Accessibility of programs geographically is another determinant (Arena et al., 2012; Balady et al., 2011; Ghisi et al., 2013). Individuals living in urban areas are more likely to receive referrals to programs than those in rural areas (Cortés & Arthur, 2006). Higher referral rates are also seen with cardiac rehabilitation programs that are affiliated with hospitals (Boyden et al., 2010; Cortés & Arthur, 2006).

Physician-related factors that influence referral to cardiac rehab has only been recently explored. A systematic review of 17 studies identified four physician-related factors that influence referral rates: physician's perception of the benefits of cardiac rehabilitation, perception of the patient's motivation to make lifestyle changes, knowledge of cardiac rehabilitation sites, and the referral norms of the institution. There are lower enrollment rates in patients whose cardiologists have negative perceptions of cardiac rehabilitation, whether being uncertain about benefits or having a prior negative experience. Conversely, physician endorsement of, and positive attitude towards cardiac rehabilitation is a significant predictor for patient participation (Arena et al., 2012; Balady et al., 2011; Grace, Grewal, & Stewart, 2008; Jackson et al., 2005). Physicians are also less likely to refer patients to cardiac rehabilitation if they do not perceive their patients are motivated to attend they are not aware of local programs, or it is not the practice's norm to refer (Ghisi et al., 2013).

While there is a growing understanding about patient and physician factors that influence referral rates to cardiac rehabilitation, limited research has been conducted to examine how frequently cardiologists are discussing exercise with their patients. A simple verbal recommendation to exercise can have an impact on patient exercise behavior (Calfas et al., 1996; Jones et al., 2004). Further, as suggested by TPB, if patients have the perception that their cardiologist views exercising as positive behavior (i.e., injunctive norm), then the intention to

exercise, and thus actual behavior of exercising will be increased. Cardiologists' endorsement of exercise behavior has been shown to have an influence on cardiac rehabilitation enrollment and participation (Tsui et al., 2012), but cardiologists' beliefs about the benefits, importance, and safety of exercise for their patients, and prevalence of exercise discussion at patient visits is unknown.

Exercise Promotion Practices of Oncology Providers

Oncologists also have the potential be an important influence on exercise behavior change in their patients. A randomized controlled trial examining the efficacy of a verbal recommendation to exercise from an oncologist to their patient showed an average 3.4MET-h/week greater increase in patient exercise levels compared to usual care (Jones et al., 2004). This study suggested that a simple exercise recommendation from an oncologist can promote increases in physical activity in their patients, however despite such evidence, oncologist's discussion of exercise with their patients, or referral to exercise programs is not standard practice.

Oncologists discuss exercise with their patients at 18-59% of their visits (Barnes & Schoenborn, 2012; Jones, Courneya, Peddle, & Mackey, 2005; Kenzik, Pisu, Fouad, & Martin, 2016; Nadler et al., 2017; Nyrop et al., 2016), and this frequency of discussion varies by several factors. Medical oncologists are more likely than radiation oncologists to discuss exercise on most or every visit (Karvinen et al., 2010). Medical oncologists report discussing exercise 55-75% of the time, versus 13-55% among radiation oncologists (Nyrop et al., 2016), even with radiation oncologists, on average, spending more total time with their patients per visit (Dimoska, Girgis, Hansen, Butow, & Tattersall, 2008). Exercise discussion between the oncologist and patient has also been shown to vary by how long the physician has been in

practice (Karvinen et al., 2010), patient age (Nyrop et al., 2016), and treatment type (Nyrop et al., 2016). Oncologist's in practice 10 years or more reported discussing exercise on most or all visits 25% more often than those in practice less than 10 years (Karvinen et al., 2010). Frequency of exercise discussion has also been shown to increase with patient age. One recent study found that oncologists reported discussing exercise with their patients under the age of 50 only 23% of the time, compared to 45-50% in patients 70 and older (Nyrop et al., 2016). Finally, the type of treatment visit has also been found to be related to oncologist exercise promotion. Oncologists discuss exercise with patients being seen for endocrine therapy at 58% of these visits, followed by surveillance visits (46%) and chemotherapy treatment (37%) (Nyrop et al., 2016). Visits for surgery and radiation treatments had the lowest rate of exercise discussion (19% and 6%, respectively) (Nyrop et al., 2016).

Oncologist's referral practices to exercise programs are unclear. It is unknown how often oncologists are referring their patients to structured exercise programs, and if/when they do refer, what type of exercise programs or exercise professionals are sought out. Although discussing exercise directly with patients is promising, referring patients to exercise-based programs may help address concerns about safety for both the practitioner and patient. Further, supervised exercise can help build the self-efficacy of individuals who may not have the knowledge on how to exercise on their own.

Varying exercise promotion practices in oncologists may be related to the beliefs about exercise they hold for their patients. A Canadian study showed that 62%, 56%, and 63% of oncologists agreed that exercise is beneficial, important, and safe, respectively (Jones, Courneya, Peddle, et al., 2005). In South Korea, 73% and 70% of oncologists agreed exercise was beneficial and important, but only 39% agreed it was safe (Park et al., 2015). It may be assumed

that holding positive beliefs about exercise for patients would lead to greater exercise promotion among, but previous research has not examined the direct relationship between oncologist's beliefs about exercise and rates of exercise discussion and referral.

A large body of evidence shows cancer patients can both participate in, and benefit from exercise during and post treatment (Li et al., 2016; Speck et al., 2010), and report wanting to receive these recommendations from their physician (Demark-Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000). In addition, 80% of oncology providers agreed that exercise counseling should happen (Nadler et al., 2017). Although exercise discussion practices are promising in some provider subgroups (i.e. medical oncologists, and those practicing more than 10 years) and patient populations (i.e. older individuals and those undergoing endocrine treatment), referral rates to exercise professionals or cancer exercise programs, and how oncologists' beliefs about the safety and benefits of exercise for their patients influence their exercise promotion practices is unknown. In cardiology, some information is known about referral rates to cardiac rehabilitation programs, but the frequency of discussion about exercise is unknown. Similar to oncologists, cardiologists' beliefs about exercise for their patients and how those beliefs may affect frequency of discussion and referral to exercise programs has not been researched.

Physicians' Exercise Behavior and Patient Exercise Promotion

Physicians' exercise behavior may be related to their beliefs about the benefits of exercise for their patient, and the subsequent likelihood of promoting exercise. The Theory of Planned Behavior (Ajzen, 1991) construct of attitude which posits that those with more positive attitudes about a behavior (i.e., engaging in the behavior is beneficial, the behavior is enjoyable), and is directly related to intention to perform a behavior, and intention to the succeeding behavior. Based on this theory, physicians who regularly participate in exercise would likely

have positive attitudes about exercise. However, it is unknown if this positive attitude about exercise for themselves is translated into positive beliefs about exercise for their patients.

As discussed previously, based on the TPB construct of injunctive norm, physicians holding positive attitudes and beliefs about exercise for their patients, and discussing exercise or referring patients to exercise-based programs can influence patient behavior, since patients view physicians' opinions with high regard when making the decision to exercise (Courneya et al., 2001; Tsui et al., 2012). The Theory of Planned Behavior (TPB) has also posits another facet of subjective norm, the construct of descriptive norm (Ajzen, 1991). Descriptive norm is the perception of others who are important to them (i.e. physician) performing the given behavior (Ajzen, 1991). For example, if patients perceive that their physician exercises regularly, they may be more likely to exercise. Combined, injunctive and descriptive norms can influence patient exercise behavior by patients identifying physicians as important people, perceiving physicians hold positive beliefs about exercise, and perceiving physicians regularly exercise.

Previous studies that have examined the relationships between physician exercise behaviors and exercise promotion practices are limited. Studies have shown that general practitioners (GPs) who regularly exercise are more likely to discuss exercise with their patients (Abramson, Stein, Schaufele, Frates, & Rogan, 2000; Frank, Bhat Schelbert, & Elon, 2003; Morishita et al., 2014). Further, GPs identifying exercise as a "high priority" in their own lives have a higher rate of counseling patients on exercise (Frank et al., 2003). GPs who are active are also more likely to express confidence in their knowledge and ability to advise patients about exercise (Abramson et al., 2000; Frank et al., 2003). Despite this evidence of a correlation in GPs, data is mixed in the specialty practices of oncology and cardiology. Oncologists meeting physical activity guidelines discussed exercise 15% more often than their inactive counterparts

(Karvinen et al., 2010), and were significantly more likely to report knowing the guidelines, how to counsel patients on exercise, when and who to refer to, and how to encourage exercise to patients (Nadler et al., 2017). One study did not find a relationship among cardiologists' exercise habits and their exercise promotion practices (Fowler, White, Dejong, & Franklin, 2007). However, this research is limited and needs to be explored, and the hypothesized mechanism to explain the relationship by which a physician's own exercise influences exercise promotion practices (via more positive beliefs about exercise) has not been explored.

In addition, none of the studies described above which explored associations between physician exercise behavior and exercise promotion practices have utilized objective measures to quantify physician's activity. A systematic review comparing self-report physical activity to accelerometer measurement in 58 studies showed percent difference range from -78-500%, indicating low validity in self-report measures (Prince et al., 2008). Utilizing objective measures to determine physical activity levels and examine these relationships will give new insight into factors that contribute to exercise promotion practices among oncologists and cardiologists. For example, some accelerometers detect changes in posture, which can quantify continuous time in activity, bouts of physical activity, bouts of sedentary behavior, and number of posture changes (i.e. seated to standing). Physicians have an active job, by constantly changing postures and moving around the clinic. Utilizing these measures provides the opportunity to explore various movement patterns and their potential relationship to physicians' exercise promotion practices. Differentiating between intentional bouts of exercise and unintentional exercise through moving around at the clinic may help give a clearer picture of beliefs about exercise for patients. For example, individuals who accumulate a similar number of steps can have their activity levels distinguished by looking at bouts of MVPA greater than 10 minutes compared to small "spurts"

of activity sporadically throughout the day. The hypothesis is that physicians who engage in intentional bouts of exercise may be more closely associated with holding positive beliefs about exercise for their patients, compared to physicians who unintentionally engage in exercise, by moving throughout the clinic. If physicians believe it is important to plan regular exercise for themselves, then those positive beliefs may translate into positive beliefs about exercise for their patients.

Summary

Exercise provides many benefits for CVD and cancer patients, including reduced mortality and improved quality of life (Li et al., 2016; Speck et al., 2010). However, the majority of cancer survivors and cardiac patients are not achieving recommended levels of exercise to derive these benefits. Physicians can play a substantial role in promoting exercise to their patients, but exercise promotion practices (i.e., discussion and referral) vary between and among physician specialty groups, with limited knowledge on referral practices of oncologists and the frequency of exercise discussion among cardiologists. Both discussion and referral rates, in addition to which type of exercise programs and professionals sought out, will be explored among both specialties. Further, although cardiac rehabilitation is a part of standard care, cardiologists' beliefs about the safety and benefits of exercise for their patients have not been well studied. Cardiologists' and oncologists' own exercise habits may influence their beliefs about the safety and benefits of exercise for their patients, which may impact their exercise promotion practices, but these relationships have not been well studied.

II. STUDY PURPOSE

The purpose of this study is to describe and compare oncologists' and cardiologists' exercise promotion practices (i.e., discussion and referral), beliefs about exercise for their patients, their own exercise habits, and examine relationships among these factors. The connection between these hypothesized relationships are illustrated in Figure 1.

Research Questions and Hypotheses

RQ1: Do oncologists and cardiologists have similar beliefs about the safety and benefits of exercise for their patients?

Hypothesis: Cardiologists are more likely to agree or strongly agree that exercise is safe for their patients, their patients are capable of exercising, and exercise is effective for improving well-being and survival.

RQ2: Do oncologists and cardiologists discuss exercise and refer their patients to structured exercise programs with the same frequency, and to similar types of exercise programs and professionals?

Hypothesis: A greater percentage of oncologists will discuss exercise at most or all patient visits and recommend exercise to most or all of their patients, and cardiologists will refer their patients to structured exercise programs more frequently than oncologists. Cardiologists will report referring to hospital-based rehabilitation programs and certified exercise physiologists more frequently than oncologists.

RQ3: Are cardiologist's and oncologist's exercise levels associated with their beliefs about the safety and benefits of exercise for their patients?

Hypothesis: There will be a positive association between physicians' moderate-vigorous exercise behavior and their beliefs about exercise for their patients.

RQ4: Are cardiologist's and oncologist's beliefs about the safety and benefits of exercise for their patients associated with their exercise promotion practices?

Hypothesis: Physicians who have positive beliefs about the safety and benefits of exercise for their patients will be more likely to discuss exercise with their patients and refer patients to exercise programs.

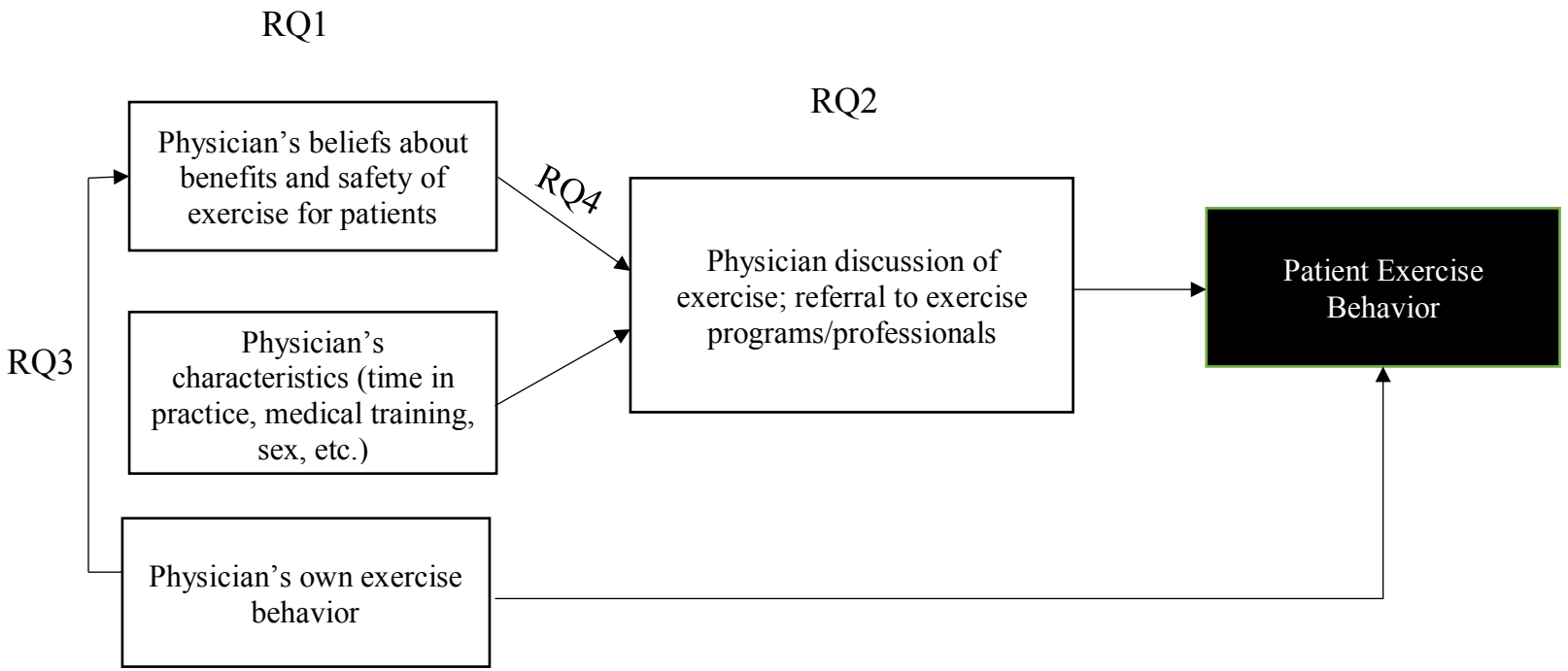


Figure 1. Theoretical Model of study

III. METHODS

Participants and Procedure

This study was conducted at Colorado State University and approved by the Institutional review board for the protection of human subjects (IRB #17-7524H). The study included two major components; an online survey via Qualtrics, and objective physical activity measurement. Participants were practicing medical or radiation oncologists, or interventional or surgical cardiologists.

An employee from oncology and cardiology at practices in Northern Colorado were identified as participating in research at his/her facility. This contact person was emailed a description of the study, and a request to recruit eligible physicians at their location. These employees were provided a copy of the IRB approval, an email containing a link to the survey, and the option to include personalized text. This contact person distributed the email containing the survey link to all eligible physicians and notified study personnel of the number of recipients (i.e., denominator to calculate response rate). Potential participants received the survey link via email, and once they followed the link, informed consent was included as the first question of the survey. If the participant consented, the survey was presented. If the participant did not consent, the survey ended, and data was not collected from that participant. Reminder emails containing the survey link were sent one week, and two weeks after the initial email.

After completion of the survey, an additional email was sent to the original contact person for each location to request participation in the objective physical activity monitoring component of the study. Study personnel attended physician meetings to consent participants to physical activity monitoring and describe procedures. For those who had not yet completed the survey, an iPad was present at the meeting for participants to complete the survey. Bags

containing the programmed accelerometer, logs, copy of the consent, and instruction sheet were provided to the participants with a labeled identification number. Participants signed their name next to the corresponding identification number on a separate form, which was kept in a locked file cabinet. After one week of monitoring, participants dropped off their accelerometer, logs, and consent into a labeled bin, which was then collected by study personnel.

Survey

The survey (see Appendix A) was developed by reviewing similar previous studies which examined physician beliefs about exercise (Jones, Courneya, Peddle, et al., 2005; Park et al., 2015). Several questions were adapted from a survey of oncologists, including questions regarding the capability, safety and benefits of exercise for patients (Jones, Courneya, Peddle, et al., 2005). Additional questions from the study by Jones et al., included oncologists' perception that patients would follow their advice regarding exercise, the percent of patients they have recommended to exercise, and years in practice. Questions from a study by Park et al. (2015) related to perceived barriers to discussing/recommending exercise were adapted to include additional answer options. An additional question adapted from Park et al. (2015) was added to specifically address the belief of exercise reducing disease recurrence in patients. Finally, questions regarding method of referral and exercise professionals referred to were adapted from a survey of general practitioners (Abramson et al., 2000). Other questions regarding referrals, including rate of referral, types of programs referred to, and physicians' beliefs about exercising improving patient well-being were created for the purposes of this study.

The initial version of the survey was reviewed by one cardiologist, and one oncologist who provided feedback on survey content. Based on this feedback, the survey was revised, and pilot tested in the online form with an additional cardiologist and oncologist, who provided

additional feedback on content, and survey length. After considering these comments and suggestions, the final iteration of the survey consisted of 22 questions including demographics, self-reported physical activity, exercise promotion practices (i.e., discussion, referral), and beliefs about exercise for patients (see Appendix A).

Demographics

Demographic information included sex, age, specialty, and total time in practice. Participants were asked if they received formal training in medical school about delivering exercise information to patients and if so, how many hours of training they received.

Exercise Promotion Practices

Exercise discussion was assessed by two questions, "How often do you discuss exercise with your patients?" and "What percent of patients have you recommended should exercise in the past month?" Both questions were scored on a 5-point Likert scale (ranging from 1 [never/none] to 5 [all visits/patients]). If the response 'all' was not selected, barriers to discussion were assessed. If 'few' or higher was selected for discussing exercise with patients, the next question asked were asked what method(s) they use to convey information.

Exercise recommendation was further explored by two additional questions. An open-ended question asked, "If you recommend exercise to your patients, what is the frequency, intensity, time, and type that you recommend?" Participants were also asked to respond to the statement, "If I provide an exercise recommendation, most of my patients will follow my advice," which was scored a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Referral practices were assessed by asking "When you provide a referral to a structured exercise program, which of the following do you use?" (assessing program types) and "When

you refer patients to structured exercise programs, what type of professionals do you look for?" For each question, several options were given, participants were instructed to select all that apply, and had the option to write-in an additional response.

Physician Beliefs about Exercise for their Patients

Beliefs about the safety and benefits of exercise for patients was assessed by 5-point Likert responses (1=strongly disagree, 5=strongly agree) to four questions; "I believe exercise is safe for most of my patients," "I believe that most of my patients are capable of exercise," "I believe exercise is effective for improving my patients' well-being," and "I believe exercise can reduce the likelihood of disease recurrence or increase chances of survival in my patients."

Physician's Exercise Behavior

Physician's exercise behavior was measured using a validated two-question assessment (B. J. Smith, Marshall, & Huang, 2005) in the online survey, and objectively using activPAL accelerometers (PAL Technologies, Glasgow, Scotland).

Self-reported physical activity levels were measured with a validated two-question assessment (B. J. Smith et al., 2005). These questions asked the number of days per week the participant exercised at 1) vigorous intensity for at least 20 minutes; "how many times a week do you usually do 20 minutes or more of vigorous-intensity physical activity that makes you sweat or puff and pant?", and 2) at a moderate intensity for at least 30 minutes; "how many times a week do you usually do 30 minutes or more of moderate-intensity physical activity or walking that increases your heart rate or makes you breathe harder than normal?".

Responses for vigorous-intensity included none, 1-2 times a week, or 3+ times a week. Responses for moderate-intensity or walking included none, 1-2 times a week, 3-4 times a week or 5+ times a week. To calculate total activity, the average number of sessions were taken for

each question (i.e. 1-2 times per week would be counted as 1.5 times per week). Then, the number of sessions for walking or moderate exercise was added to twice the number of sessions for vigorous exercise:

Total activity (sessions/wk) = moderate/walking (sessions/wk) + [2 x vigorous (sessions/wk)]

The activPAL accelerometer was worn for 24 hours per day for seven days. Participants were instructed to only remove the device for bathing, swimming or changing the adhesive. activPALs were wrapped in a nitrile covering, attached with a tegaderm, a hypoallergenic adhesive. Participants were instructed to wear the activPAL on the anterior midline of their thigh, on either leg. This device has been shown to be valid and reliable for quantifying sedentary and upright behaviors in healthy populations (Grant, Ryan, Tigbe, & Granat, 2006). It was also shown to be valid and reliable in categorizing light activity versus moderate-vigorous activity in health adults (Lyden, Keadle, Staudenmayer, & Freedson, 2017). Additionally, the activPAL was shown to be reliable in measuring breaks from sedentary behavior (Lyden, Kozey Keadle, Staudenmayer, & Freedson, 2012). Participants were also given paper logs to report time in and out of bed, and any time they removed the accelerometer and put it back on. For participants who did not complete a log, activPAL data files were visually examined for each day. Time out of bed was written as the time, rounded to the nearest 5 minutes, prior to the first mark of activity, identified by at least one green or red vertical line, indicating moving to an upright position. Similarly, time into bed was written as the time, rounded to the nearest 5 minutes, after the last mark of activity. Valid days were identified as ≥10 hours of wear during waking hours. Participants had to have 4 valid days (including 1 weekend day) for data to be included.

Statistical Analysis

Descriptive statistics were collected for all demographic variables including sex, age, time in practice, and hours of exercise education in medical school. All demographic variables were reported as frequencies per category and percentage of each specialty. activPAL data were checked for normality and outliers were removed from analysis, utilizing the Winsorizing method, identifying an outlier as greater than three standard deviations from the mean. For all analyses, $p \leq 0.05$ was considered statistically significant. All analyses were conducted using IBM SPSS (Version 25). A power analysis was completed using *G*Power version 3.1*. Alpha was set at α=0.05, beta was set at β=0.8 and effect sizes were estimated between d=0.5 and 0.7. To detect differences in the proportion of cardiologists and oncologists having different beliefs about exercise or discussing/recommending exercise to patients via a chi-square analyses (RQ 1 and 2), a total sample size of approximately *N*=44 (i.e. 22 per group) would be required for two-tailed test of significance. To detect a statistically significant correlation between continuous activPAL variables (i.e. step count, MVPA minutes) and beliefs about exercise (RQ4), a total sample size of approximately *N*=46 would be required.

Research Question 1

To assess physician's beliefs about the safety and benefits of exercise for patients, responses to questions 21-24 (see Appendix A) were collapsed into three categories: disagree (strongly disagree and disagree), neutral, and agree (agree and strongly agree). The number and percent in each category were calculated, and chi-square tests compared frequency in each category between cardiologists and oncologists. For any categories with less than 5 in the expected count, Fisher's Exact Test was utilized. To determine differences between groups, a function in SPSS to run z-tests to "compare column proportions" with adjusted p-values utilizing

the Bonferroni method was completed. To enhance interpretation of results, odds ratio was calculated for 2x2 tables, while Cramer's V was reported for larger contingency tables.

Research Question 2

To assess frequency of exercise discussion, responses to questions 11 and 13 (see Appendix A) were collapsed into three categories: ≤ 25% (none or few), ~50% (some), and ≥ 75% (most or all). The number and percent in each category were calculated, and chi-square tests compared frequency in each category between cardiologists and oncologists. Fisher's Exact Test was used when any category had less than 5 in the expected count. To determine differences between groups, the SPSS function to run z-tests to "compare column proportions" with adjusted p-values utilizing the Bonferroni method was completed.

To assess referral practices, percent 'yes' for the options provided in questions 17 and 19 ((type of structured exercise program), 18 and 20 (type of exercise professional) were calculated. Chi-square tests examined differences between cardiologists and oncologists with the use of z-tests with corrected p values. Fisher's Exact Test was utilized when the expected count for any category was below 5. For all tests, odds ratio was calculated for 2x2 tables, while Cramer's V was reported for larger contingency tables to enhance interpretation of results.

Research Question 3

Physician's exercise behavior was assessed with two-questions on the survey and measured objectively using the activPAL accelerometer.

Self-reported exercise was reported as sessions per week (see scoring protocol in section 'Physicians' Exercise Behavior' above) and separated into four categories: minimal (0-2 sessions/wk), low (3-4 sessions/wk), adequate (5-7 sessions/wk), and high (≥ 8 sessions/wk). Calculations that resulted with a total in-between these categories were rounded down to the

nearest whole number (i.e. 4.5 rounded to 4) based on the scoring criteria (Smith et al., 2005). These four categories were then collapsed into two categories; "meets guidelines" (adequate and high) and "does not meet guidelines" (minimal and low).

activPAL data results in two forms of "meeting guidelines" including minute guidelines (i.e. a minimum of 150 minutes/week total) and bout guidelines (i.e. 150 minutes/week accumulated through bouts of MVPA lasting a minimum of 10 minutes). Continuous activPAL variables included were minutes in light activity and moderate-to-vigorous physical activity (MVPA), number of guideline bouts (i.e. at least 10 minutes in MVPA), average step count, and break rate (transitions from sitting to standing) per sedentary hour. Minutes in each category are represented as average total minutes per day.

All three of the "meets guidelines" variables (i.e. self-report, activPAL minutes, and activPAL bouts) were tested for association with each of the four questions regarding beliefs about exercise (Q21-24 in Appendix A) utilizing chi-square tests. When there were less than 5 in the expected count of any category, Fisher's Exact Test was reported. To determine differences between groups, the SPSS function to run z-tests and compare column proportions with adjusted p-values (Bonferroni method) was utilized. To enhance interpretation of results, odds ratio was calculated for 2x2 tables, while Cramer's V was reported for larger contingency tables.

Spearman's correlation analyzed the relationship between the above continuous exercise variables and beliefs about exercise (Q21-24 in Appendix A). Confidence intervals were assessed utilizing the bootstrap method at 95%. For the correlation, responses to each question regarding beliefs was maintained in the original 5-point Likert scale.

Research Question 4

The four questions regarding beliefs about exercise (Q21-24 in Appendix A) were collapsed into three categories as described above. Each question was tested for association with frequency of exercise discussion (Q11) and recommendation (Q13), and with questions regarding referral (Q17-20), including what types of programs and exercise professionals are sought out. Chi-square tests were utilized with each comparison, with the addition of the z-test function with corrected p-values. When the expected count was less than 5 for any category, Fisher's Exact Test was reported. To enhance interpretation of results, odds ratio was calculated for 2x2 tables, while Cramer's V was reported for larger contingency tables.

IV. RESULTS

A total of 154 surveys were distributed, and 57 (*N*=25 cardiologists and *N*=32 oncologists) were returned (37% response rate). activPAL data was collected from *N*=12 cardiologists and *N*=9 oncologists. Three participants' activPAL data were not valid (two were worn less than 4 days, one did not complete the survey) and were removed from analysis, yielding a final *N*=6 for oncologists. Age ranged from 32-83 (45.4 ± 11.2). Description of other demographic characteristics including sex, time in practice, and medical school education are displayed in Table 1. Descriptive statistics for self-report and activPAL exercise levels are presented in Table 2.

Table 1. Demographics

		Cardiologists	**Oncologists**	**Total**
		N (%)		**N (%)**
Sex	Male	20 (80.0)	16 (50.0)	36 (63.2)
	Female	5 (20.0)	16 (50.0)	21 (36.8)
Time in Practice	<5 years	10 (40.0)	9 (28.1)	19 (33.3)
	5-10 years	6 (24.0)	7 (21.9)	13 (22.8)
	10-15 years	3 (12.0)	6 (18.8)	9 (15.8)
	15+ years	6 (24.0)	9 (28.1)	15 (26.3)
Medical School	None	12 (48.0)	24 (80.0)	38 (66.7)
Education on Exercise	Yes, 1-2 hrs	9 (36.0)	4 (13.3)	13 (22.8)
	Yes, 3-5 hrs	1 (4.0)	2 (6.7)	3 (5.3)
	Yes, 6+ hrs	3 (12.0)	0 (0.0)	3 (5.3)
Age	<40 years	10 (40.0)	14 (43.8)	24 (42.1)
	40-49 years	8 (32.0)	8 (25.0)	16 (28.1)
	50+ years	7 (28.0)	10 (31.3)	17 (29.8)

Table 2. Exercise levels among physicians

	Cardiologists	Oncologists	Total
	N (%)		N (%)
Self-Reported Physical Activity			
Minimal	0 (0.0)	3 (9.4)	3 (5.3)
Low	6 (24.0)	12 (37.5)	18 (31.6)
Adequate	3 (12.0)	6 (18.8)	9 (15.8)
High	16 (64.0)	11 (34.4)	27 (47.4)
Meets Guidelines (Self-Report)*			
No	6 (24.0)	15 (46.9)	21 (36.8)
Yes	19 (76.0)	17 (53.1)	36 (63.2)
Meets Guidelines (Mins - activPAL)†			
No	0 (0.0)	1 (16.7)	1 (5.6)
Yes	12 (100)	5 (83.3)	17 (94.4)
Meets Guidelines (Bouts - activPAL)‡			
No	10 (83.3)	6 (100)	16 (88.9)
Yes	2 (16.7)	0 (0.0)	2 (11.1)
	Mean ± SD		Mean ± SD
Step Count	9435 ± 1934	6365 ± 4092	8411 ± 3092
Num. Guideline Bouts	0.512 ± 0.386	0.308 ± 0.348	.444 ± 0.377
MVPA Minutes	71.35 ± 14.43	47.36 ± 31.12	63.36 ± 23.56
Light Minutes	340 ± 97.7	188 ± 108	289 ± 123
Break Rate	7.29 ± 1.55	4.31 ± 2.33	6.29 ± 2.29

*Defined as minimum 150 mins/wk moderate activity OR 75 mins/wk vigorous activity
†Defined as minimum 150 mins/wk of MVPA
‡Defined as minimum 150 mins/wk of MVPA, accumulated in at least 10-min bouts

Research Question 1

A similar percentage of oncologists (70.0%) and cardiologists (79.2%) "agreed or strongly agreed" that exercise can reduce the likelihood of disease recurrence or increase the chances of survival, and more cardiologists (16.7%) "disagreed or strongly disagreed" compared

to oncologists (0%) (Fisher's Exact (FE)(2)= 9.681, p=.005, *V*=.429). There were no differences between cardiologist's and oncologist's beliefs about the safety of exercise, patient's capability to exercise, or the effectiveness of exercise for improving patient's well-being (Table 3).

Table 3. Beliefs about exercise for patients

	Agree		**Neutral**		**Disagree**	
	CARD	*ONC*	*CARD*	*ONC*	*CARD*	*ONC*
I believe exercise is safe for most of my patients.	21 (87.5)	31 (100)	0 (0.0)	0 (0.0)	3 (12.5)	0 (0.0)
I believe that most of my patients are capable of exercise.	20 (83.3)	26 (86.7)	2 (8.3)	3 (10.0)	2 (8.3)	0 (0.0)
I believe exercise is effective for improving my patient's well-being	22 (91.7)	31 (100)	0 (0.0)	0 (0.0)	2 (8.3)	0 (0.0)
I believe exercise can reduce likelihood of disease recurrence or increase chances of survival in my patients.	19 (79.2)	21 (70.0)	1 (4.2)*	9 (30.0)	4 (16.7)*	0 (0.0)

CARD = cardiologists; ONC = oncologists
*p<.05 difference between cardiologists and oncologists

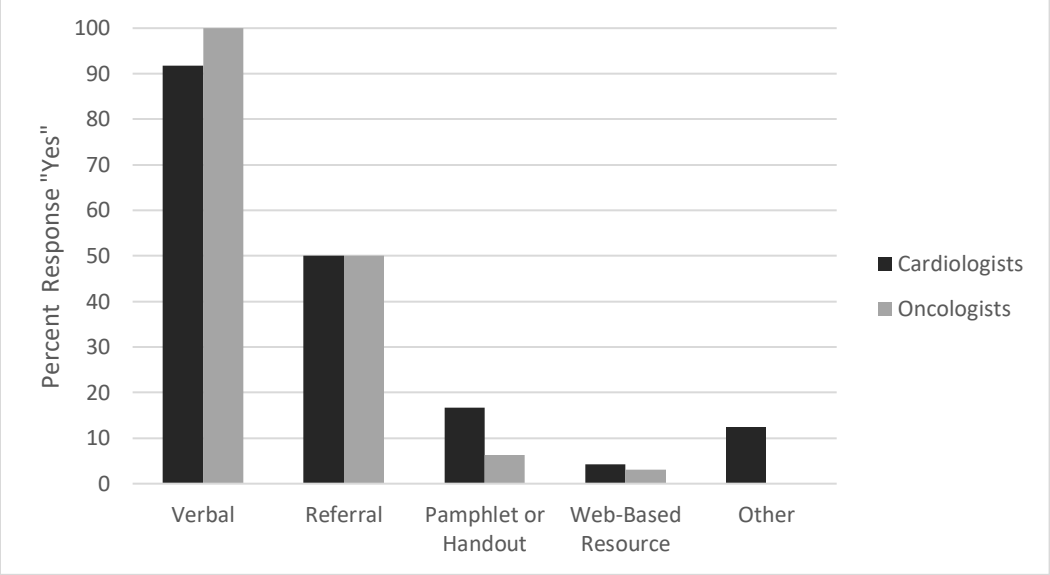
Research Question 2

A greater percentage of cardiologists (52.0%) reported discussing exercise on most or all patient visits compared to oncologists (21.9%) (X^2(2)=7.385, p=.029, *V*=.360). There were no differences between cardiologists and oncologists in the percent of patients they recommend should exercise (p>.05) (Table 4). There were no differences between oncologists and cardiologists in the methods of providing information about exercise to their patients, or the type of exercise programs they refer patients to. The most common method of providing information on exercise was verbally, followed by referral (Figure 2). The most common type of exercise program patients were referred to was hospital-based programs, followed by community programs (Figure 3).

Table 4. Discussion or recommendation to exercise from cardiologists and oncologists.

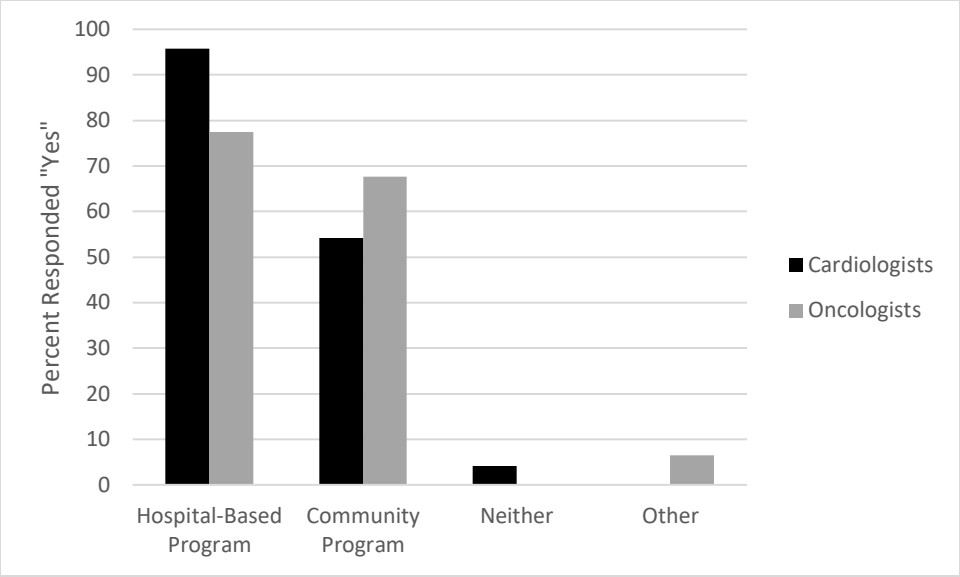
	CARD	ONC	CARD	ONC	CARD	ONC
	Most or All of their Visits *N (%)*		Some of their visits *N (%)*		Few or none of their visits *N (%)*	
How often do you discuss exercise with your patients?	13 (52.0)*	7 (21.9)	10 (40.0)	14 (46.9)	2 (8.0)*	10 (31.3)
	Most or All (>75%) *N (%)*		Some (50%) *N (%)*		Few or none (<50%) *N (%)*	
What percent of patients have you recommended should exercise in the past month?	15 (62.5)	13 (40.6)	8 (33.3)	11 (34.4)	1 (4.2)	8 (25.0)

CARD = cardiologists; ONC = oncologists
*p<.05 difference between cardiologists and oncologists



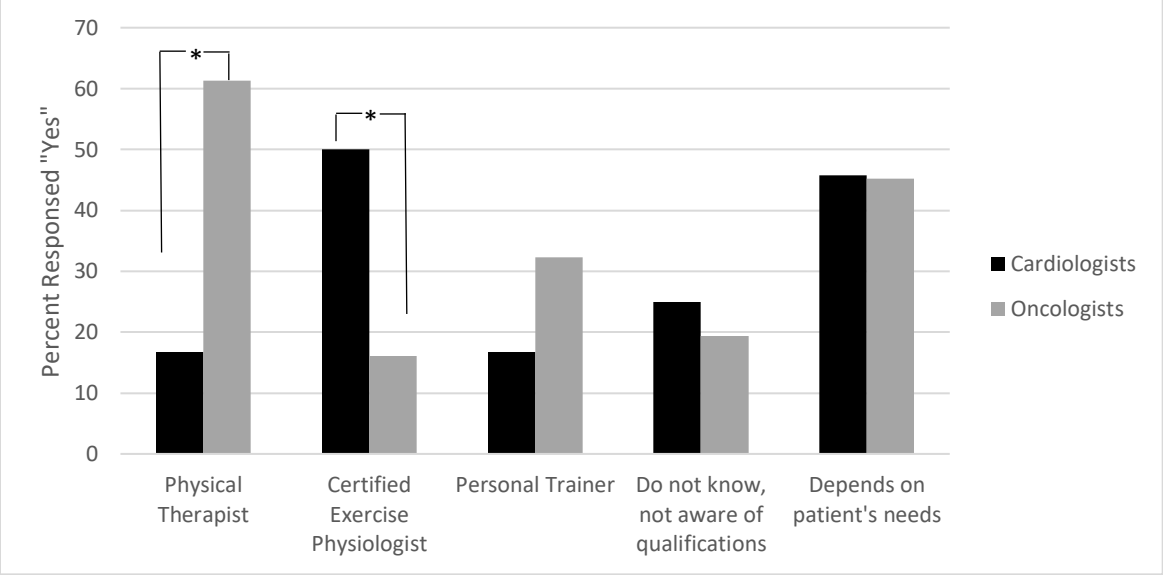
Note: Participants selected "all that apply" so responses do not add up to 100%.
Figure 2. If you provide information about exercise to your patient, which of the following methods do you use to convey information?

There was a significant association between specialty (cardiology vs. oncology) and looking for physical therapists when referring to structured exercise programs ($X^2(1)=11.017$, p=.001) and certified exercise physiologists ($X^2(1)=7.267$, p=.009). Oncologists were 8 times more likely than cardiologists to look for physical therapists when referring to structured exercise programs. Cardiologists were 5 times more likely than oncologists to look for certified exercise physiologists when referring to structured exercise programs (Figure 4).



Note: Participants selected "all that apply" so responses do not add up to 100%.

Figure 3. When/if you (were to) provide a referral to a structured exercise program, which of the following would you use?



*p<0.05

Note: Participants selected "all that apply" so responses do not add up to 100%.

Figure 4. When/if you refer patients to structured exercise programs, what type of professionals do you look for?

Research Question 3

There were no significant associations between meeting physical activity guidelines and beliefs about exercise for patients among cardiologists or oncologists, for self-report or activPAL measured exercise (p>.05). When cardiologists and oncologists were combined, step count (measured from activPAL) was inversely associated with the belief that exercise improves well-being (r_s=-.515, 95% CI [-.767, -.155], p=.034) (Table 5).

Table 5. Spearman correlations between exercise levels and beliefs about exercise among all physicians.

	Step Count	**Light Mins**	**MVPA Mins**	**Guideline Bouts**	**Break Rate†**
I believe exercise is safe for most of my patients	.093	.098	-.033	.095	.159
I believe that most of my patients are capable of exercise.	.256	.271	.206	.442	.361
I believe exercise is effective for improving my patients' well-being.	-.515*	-.100	-.609*	-.424	-.105
I believe exercise can reduce likelihood of disease recurrence or increase chances of survival in my patients.	-.046	.264	-.156	.012	.230

Note: All variables are average per day, from the activPAL accelerometers.
*p<0.05
†Defined as number of transitions from sit to stand in one sedentary hour.

In addition, for both specialties combined, MVPA minutes (activPAL) were also inversely associated with the belief that exercise improves well-being (r_s=-.609, 95% CI [-.829, -.259], p=.009) (Table 5). Among cardiologists, MVPA minutes (activPAL) were inversely associated with the belief that exercise improves patients' well-being (r_s=-.671, 95% CI [-.881, -.503], p=.024) (Table 6). Among oncologists, break rate (activPAL) was positively associated with the belief that patients are capable of exercising (r_s=.828, 95% CI [.664, .980], p=.042) (Table 7). Those with a higher break rate had a stronger level of "agreement" compared to those with a lower break rate.

Table 6. Spearman correlations between exercise levels and beliefs about exercise among cardiologists.

	Step Count	**Light Mins**	**MVPA Mins**	**Guideline Bouts**	**Break Rate†**
I believe exercise is safe for most of my patients	.412	.441	.265	.444	.397
I believe that most of my patients are capable of exercise.	.200	.110	.160	.563	.236
I believe exercise is effective for improving my patients' well-being.	-.596	.000	-.671*	-.450	.000
I believe exercise can reduce likelihood of disease recurrence or increase chances of survival in my patients.	-.194	.323	-.258	-.097	.323

Note: All variables are average per day, from the activPAL accelerometers.
*p<0.05
†Defined as number of transitions from sit to stand in one sedentary hour.

Table 7. Spearman correlations between exercise levels and beliefs about exercise among oncologists.

	Step Count	**Light Mins**	**MVPA Mins**	**Guideline Bouts**	**Break Rate†**
I believe exercise is safe for most of my patients	-.207	.000	-.207	-.630	.414
I believe that most of my patients are capable of exercise.	.414	.621	.414	.210	.828*
I believe exercise is effective for improving my patients' well-being.	-.655	-.655	-.393	-.399	-.393
I believe exercise can reduce likelihood of disease recurrence or increase chances of survival in my patients.	-.309	-.309	-.062	.016	-.370

Note: All variables are average per day, from the activPAL accelerometers.
*p<0.05
†Defined as number of transitions from sit to stand in one sedentary hour.

Research Question 4

Among all physicians, there were no significant associations between beliefs about exercise and their exercise promotion practices. Among cardiologists, there was a significant association between the belief that exercise can reduce the likelihood of disease recurrence for their patients, and discussion of exercise. Cardiologists who reported that they agreed or strongly agreed that exercise can reduce the likelihood of disease recurrence or increase the chances of

survival were 6.8 times more likely to discuss exercise at all or most patients visits (FE(4)= 9.351, p=.027, *V*=.514). Among oncologists, there were no significant associations between beliefs about exercise for patients and exercise discussion or referral.

V. DISCUSSION

This study described and compared cardiologists' and oncologists' exercise promotion practices and their beliefs about exercise for their patients. This study also examined the relationship between cardiologists' and oncologists' own exercise habits and their beliefs about exercise for their patients, as well as the relationship between their beliefs and their exercise promotion practices.

Research question one explored whether oncologists and cardiologists had similar beliefs about exercise for their patients. A similar proportion of oncologists and cardiologists "agreed" that exercise can reduce disease recurrence or increase the likelihood of survival in their patients, but more oncologists were "neutral" about this belief, and more cardiologists "disagreed." The current study found that 70% of oncologists agreed with this statement, which is different from a previous study, in which only 4.8% of oncologists reported the perception that exercise reduced recurrence or increased survival (Park et al., 2015). None of the oncologists in the current study disagreed that exercise can reduce disease recurrence or increase the likelihood of survival in their patients, but almost a third (30%) responded with "neutral," despite studies that have shown reduced mortality as a benefit of exercise in cancer survivors (Li et al., 2016). To our knowledge, no previous studies have examined the beliefs about exercise for reducing disease recurrence or increasing survival among cardiologists. The proportion of cardiologists (16.7%) that disagreed with this statement was surprising, given the many studies published demonstrating the associations between exercise and reduced CVD recurrence and CVD-associated mortality (Adams et al., 2006; Bobbio, 1989; Jolliffe et al., 2001; O'Connor et al., 1989; Taylor et al., 2004; Williams et al., 2007). There were no other differences in beliefs about exercise between cardiologists and oncologists.

Research question two compared cardiologists' and oncologists' exercise promotion practices, including frequency of discussing or recommending exercise, methods of delivering exercise information, and if they provide a referral, which types of programs and exercise professionals are sought. A greater proportion of cardiologists (52%) reported discussing exercise at "most or all visits" compared to oncologists (21.9%). Previous research has not reported the frequency of discussion among cardiologists. Among oncologists, previous literature has various reports of the frequency of discussing exercise with most or all patients; ranging from 11% (Jones, Courneya, Peddle, et al., 2005), to 35-42% (Nadler et al., 2017; Nyrop et al., 2016). The lower rates of discussion among oncologists compared to cardiologists in this study may be partially explained by oncologists' perception that "other priorities during appointments" were a barrier to discussion. Oncologists were 7.6 times more likely to report having "other priorities" as a barrier compared to cardiologists ($\chi^2(1)=6.362$, p=.021). No previous studies surveying oncologists about exercise promotion practices have included 'other priorities' as a response option, which may provide new insight to limitations that oncologists may have in regularly discussing exercise with their patients. This indicates a hierarchy of priorities that occurs during appointments, with exercise perhaps being towards the bottom for oncologists. Further, this study was conducted in Colorado, which has some of the highest rates of PA, and it could be surmised that oncologists may assume many of their patients are already active, and therefore do not feel discussing exercise is a pertinent use of their time. Future studies should consider asking oncologists' perceptions of their patients' exercise levels.

Cardiologists and oncologists both reported delivering information about exercise primarily verbally and sought out the same types of exercise programs (i.e., hospital-based and community-based). Referral was the second most common method of delivering exercise

information, with half of cardiologists and oncologists reporting referring patients to exercise programs. This is consistent with previous literature in cardiology, which has reported that between 5-56% of eligible patients are referred to cardiac rehabilitation (Arena et al., 2012; Brown et al., 2009; Dahhan et al., 2015; Gravely-Witte et al., 2010; Mampuya, 2012). However, there has not been research examining rates of referral to exercise programs among oncologists. This finding is of interest, and contradictory to our hypothesis in which we predicted the rate of referral would be higher among cardiologists. The absence of differences in referral rates were surprising due to the established nature of cardiac rehabilitation and physicians identifying cardiac rehabilitation as the "standard of care" (Ghisi et al., 2013), versus the lack of institutionalization of cancer rehabilitation as part of standard care. A reason for this could be that oncologists who reported 'referring to exercise programs' may have included referrals to physical or occupational therapy, rather than cancer-specific exercise programs. Although approximately 50% of both cardiologists and oncologists report referring patients to exercise programs, based on the wealth of data supporting the benefits of exercise for these patients, there is a need to increase these referral rates.

There was a significant difference in the type of exercise professional sought. Cardiologists were 5 times more likely to refer patients to certified exercise physiologists, and oncologists were 8 times more likely to refer patients to physical therapists. No previous studies have explored the type of exercise professionals cardiologists and oncologists seek out when referring to exercise programs, and these findings may provide insight into the physicians' knowledge and underlying beliefs about the qualifications of various exercise professionals. Certified exercise physiologists are common in cardiac rehabilitation programs, but this profession is relatively new in the oncology field and may not be as well-known to oncologists.

For instance, ACSM developed a Cancer Exercise Trainer certification in 2009, and currently, less than 500 individuals hold the certification in the U.S (American College of Sports Medicine, 2015). Physical therapists can specialize in treatments for lymphedema or other ailments of cancer treatment and are perhaps seen as easier to refer to, or more well known to oncologists, especially considering the use of physical therapists in early models of cancer rehabilitation (DeLisa, 2001). Expanding oncologists' knowledge about cancer specific credentialing of exercise professionals, and where to find them, may help improve referral rates to qualified exercise professionals.

Research question three examined the relationship between physicians' own exercise habits and their beliefs about exercise for their patients. There was no relationship between meeting exercise guidelines and beliefs about exercise. Among all physicians, there were inverse associations between step count and MVPA minutes (measured by accelerometer), and the belief that exercise improves patients' well-being. Among cardiologists, there was an inverse association between MVPA minutes (measured by accelerometer) and the belief that exercise improves patients' well-being. However, when these associations were explored further, it was clear that there were two outlier respondents, who reported "strongly disagree" for the belief about exercise improving patients' well-being, thus driving these correlations. Aside from these two outliers, every other physician agreed or strongly agreed with the belief that exercise improves patients' well-being, regardless of exercise levels. Among oncologists only, there was a positive association between break rate and the belief that patients are capable of exercise. Those who had a higher break rate were more likely to report "strongly agree" compared to those with a lower break rate who reported "agree." However, because all oncologists did agree, it is

clear that physicians' exercise levels were not associated with their beliefs about exercise for their patients in this study.

Previous research in oncology has shown a positive association between oncologist exercise habits and exercise promotion practices; the more active the physician, the more likely they were discuss exercise with their patients (Karvinen et al., 2010; Nadler et al., 2017). Among cardiologists, one study found no relationship between exercise levels and rate of referral to exercise programs (Fowler et al., 2007). To our knowledge, this is the first study to examine relationships between physician's exercise levels and their beliefs about exercise for their patients. Our findings do not support the proposed pathway illustrated in Figure 1, in which physician's own exercise habits influence their beliefs about exercise for their patients. There was no relationship among self-report exercise levels, and this study was the first to measure exercise via accelerometers. However, with the limited accelerometer sample size, we cannot confirm these findings, and encourage further exploration with a larger sample size.

Research question four examined the relationship between physicians' beliefs about exercise for their patients, and their exercise promotion practices. Cardiologists who "agreed" that exercise can reduce disease recurrence or increase the likelihood of survival, were 6.8 times more likely to discuss exercise with most or all patients. However, there were no relationships between beliefs about exercise and exercise promotion practices among oncologists. This finding for cardiologists supported our hypothesis, and the proposed pathway illustrated in Figure 1, that positive beliefs about exercise would increase the likelihood of discussing or recommending exercise to patients. The lack of relationship between other beliefs about exercise and exercise promotion practices may be in part due to selection bias in the survey, where the majority of physicians who responded to the survey reported positive beliefs about exercise. In fact, all

oncologists and over three-quarters of cardiologists who participated in the survey agreed that exercise is safe, their patients are capable of exercise, and exercise improves patients' well-being.

Important to note is that although the majority of cardiologists and oncologists agree in these beliefs about exercise, the rates of discussion among each specialty are not reflective of the prevalence of these positive beliefs. For example, the proportions of physicians who hold positive beliefs about exercise for their patients and who report discussing at most or all visits are not the same, indicating a gap between beliefs and exercise promotion practices. There are two proposed explanations for this gap between positive beliefs about exercise and exercise promotion practices. First, although they believe in the benefits of exercise, physicians may not believe that patients will follow their advice, and thus not take the time to promote exercise. For example, one of the survey questions asked, "If you provide a recommendation, do you believe your patients will follow your advice?" About half (46.7%) of oncologists "agreed" that patients would follow their advice, and those who "agreed" were the only oncologists who reported discussing exercise at most or all visits ($FE(2)=10.789$, $p=.004$, $V=.575$). A previous study found that a simple recommendation from an oncologist increases patients' exercise levels (Jones et al., 2004), which suggest that oncologists who may "disagree" that patients would follow their advice, their recommendations can have significant impact on patients' exercise behavior.

A second explanation for the gap between physicians holding positive beliefs about exercise, yet not discussing/recommending exercise, could be due to perceived barriers. As mentioned previously, our survey found that "other priorities" was the barrier most frequently reported by oncologists (92%), and time was the second most frequently reported barrier for both cardiologists (72%) and oncologists (50%). This is consistent with previous literature which also

reports time is the most common barrier in both oncology (Karvinen et al., 2010; Nadler et al., 2017; Park et al., 2015) and cardiology (Arena et al., 2012; Cortés & Arthur, 2006; Thomas, 2007). Time is a difficult barrier to overcome in the current U.S. medical system, where physicians are pressed to see a certain number of patients per day. However, utilizing other resources, such as automated, or electronic referral to exercise programs or qualified professionals may be a way to increase exercise promotion without adding additional demands on physician's time.

Although knowledge of exercise guidelines is a commonly reported barrier in previous research (Dahhan et al., 2015; Moradi, Maleki, Esmaeilzadeh, & Abkenar, 2011; Nadler et al., 2017), in this study, 'lack of knowledge of exercise guidelines' was only reported as a barrier to exercise promotion by 13.6% of all physicians. This indicates that among cardiologists and oncologists, the attention toon education surrounding exercise recommendations should shift to systems and organizational approaches that can overcome the barriers of other priorities and time. For example, an electronic referral system can remove the need for physicians to give detailed exercise recommendations, and instead, provide patients with outside resources and personnel to fill in those gaps, in a systematic manner. However, for cancer survivors, a limited number of hospital-based, cancer rehabilitation programs exist in the U.S (Alfano, Cheville, & Mustian, 2016; Stubblefield et al., 2013). Cancer-specific exercise programs are often based out of wellness centers or not-for-profit programs in urban areas, but these programs are not standard, and vary widely in design (Stubblefield et al., 2013). The development of cancer rehabilitation began in the 1970s with the National Cancer Act being passed by Congress, allowing funds to be distributed for training, development, and research on cancer rehabilitation (DeLisa, 2001). In 1980, a review of current programs was completed, which illustrated the

comprehensive nature of programs including patient education, family involvement, and various protocols depending on cancer sites (Harvey, Jellinek, & Habeck, 1982). However, DeLisa (2001) points out that research and development of cancer rehabilitation programs did not continue to progress much after the 1980s potentially due to lack of funding, education, and prioritization. Due to the wide variety of insurance options, there are many issues with patient reimbursement, including pre-authorization requirements, in-network vs out-network costs, caps on coverage, etc. (Alfano, Ganz, Rowland, & Hahn, 2012). Further, there are no Current Procedural Terminology (CPT) codes for outpatient cancer rehabilitation programs.

Conversely, exercise was promoted for CVD survivors in the early 1950s (Mampuya, 2012). Around this time, Hellerstein created a comprehensive cardiac rehabilitation model, which is still largely what we see today (Mampuya, 2012). Since then, cardiac rehabilitation has been institutionalized, with most hospitals having a program and two CPT code options for reimbursement. However, referral processes vary widely, leading to estimates that only half of eligible patients are being referred to cardiac rehabilitation. One solution could be to focus on establishing an electronic referral system, which has been shown to improve referral rates by up to 70% (Balady et al., 2011; Boyden et al., 2010; Dahhan et al., 2015). The less than ideal referral rate in an established system such as cardiac rehabilitation suggests that in order to bolster exercise promotion in chronic disease populations, creating and establishing an electronic referral system or utilizing supporting personnel to aid in referrals, needs to happen.

Study Limitations

This study was not without limitations. First, our sample size for objectively measured physical activity (activPAL accelerometer data) was not statistically powered to see significance in Spearman correlations. The study should be done with a larger sample size of accelerometer

data because this data allows us to explore differences between step count, bouts of MVPA, break rate, etc. which separates physicians being busy in the clinic compared to those who engage in intentional bouts of exercise. While there was statistical power for all chi square analyses with survey data (including self-report exercise levels), this study was limited to physicians in Northern Colorado, and could be expanded to a representative population of physicians in the U.S.

Additionally, this study may have elicited selection bias, with physicians who had more favorable views about exercise, more likely to take part. One option to remove this bias would be to include questions from this survey in a different survey asking a variety of types of questions in order to gather a broader range of respondents. Future studies could also elicit a chart review rather than a survey, to gather non-biased information about discussion exercise or referring to programs across physicians at selected locations.

A chart review approach could also improve the limitation of self-report and recall of frequency of discussion and recommendation of exercise to patients. Participants may have recalled an inaccurate frequency, and a chart review would eliminate pressures to respond a certain way to a survey, or error in recall.

Finally, for the purposes of this study, medical and radiation oncologists were combined in the same category, and they were not separated by the type of cancer(s) they treat. The majority of research on exercise in cancer patients has been in breast, colorectal, and prostate, with limited knowledge on safety and efficacy of exercise in other cancer types, or advanced stage patients. Therefore, oncologists' beliefs about exercise, and exercise promotion practices may differ depending on the type of cancer they treat. Future studies with larger sample sizes

should investigate these subgroups to further identify where beliefs, barriers, and exercise promotion practices may vary among oncologists.

VI. SUMMARY, FUTURE RECOMMENDATIONS, AND CONCLUSIONS

Summary

Cardiologists' and oncologists' beliefs about exercise for their patients were generally positive, and similar; except oncologists held more neutral, and cardiologists held more negative beliefs that exercise can reduce recurrence or increase the likelihood of survival. Cardiologists discussed exercise more frequently than oncologists, and both groups reported referral as their primary method of delivery of exercise information. When referring, type of exercise program sought out was similar between specialties (hospital and community-based), but cardiologists were more likely to look for certified exercise physiologists, while oncologists were more likely to look for physical therapists as exercise professionals. There was no relationship between physicians' exercise habits and their beliefs about exercise for their patients. Finally, among cardiologists, those who agreed exercise can reduce recurrence or increase the likelihood of survival in patients were more likely to discuss exercise.

Future Recommendations

Future studies should aim to increase rate of discussion about exercise and rate of referrals among cardiologists by minimizing or removing systemic barriers, particularly time, which may limit patient-physician interaction to only the most immediate, pressing medical issues. Specifically, there should be a focus on establishing electronic referral systems, which have the advantage of little to no additional time during a patient visit, and also increasing accessibility to appropriate exercise professionals. Previous research has shown that the presence of an electronic referral system increases the rate of referral among cardiologists to cardiac rehabilitation programs (Balady et al., 2011; Boyden et al., 2010; Dahhan et al., 2015). In addition, for oncologists, greater dissemination of knowledge about exercise professionals

qualified to work with cancer patients, may enhance referral rates to exercise programs. To do this, it may be helpful to create resources for physicians to seek out qualified exercise professionals to refer to. For example, ACSM has a search engine to find qualified professionals in a particular state. A similar system could be expanded to make it easy for physicians to identify exercise professionals with appropriate certifications for their patient population, and local to their region. Alternatively, supportive care personnel in hospitals and clinics could be utilized as liaisons to connect patients to exercise programs and professionals in the area, thus also relieving the stress of time from the physicians. Any of these options could help address the systemic issues physicians face in promoting exercise to their patients.

While our data concluded that physicians' exercise habits did not translate into positive beliefs about exercise for their patients, physicians' own exercise levels may still have a direct impact on patients' exercise behavior. Based on the Theory of Planned Behavior's construct of descriptive norm, future studies should examine how patient's perceptions of their physician's exercise behavior affects their likelihood of engaging in exercise.

Last, this study was conducted in Colorado, the second most active state in the U.S. (Centers for Disease Control and Prevention). It is worth exploring how cardiologists and oncologists promote exercise to patients in different regions of the U.S. Physicians in less active states may discuss exercise more often due to the higher rates of inactivity and obesity in that region. With the U.S. being so diverse, it is worth exploring how physicians exercise promotion practices differ between regions, and how different barriers or beliefs may play a role into these differences.

Conclusions

The benefits of exercise for both CVD and cancer survivors are well established in the literature. While physicians agree with these benefits, they are not discussing exercise or referring to exercise-based programs as often as they should be, indicating a gap from beliefs to practice. Physicians' recommendations are shown to have a positive impact on patient exercise behavior, so further efforts to increased exercise promotion among physicians should be made. Particularly, increasing referrals to qualified exercise professionals may help relieve the restrictions on time for physicians. Additional studies using objectively methods to measure physicians PA/exercise are needed to determine whether their own exercise habits are associated with positive beliefs about exercise for their patients, and subsequent exercise promotion.

REFERENCES

Abramson, S., Stein, J., Schaufele, M., Frates, E., & Rogan, S. (2000). Personal exercise habits and counseling practices of primary care physicians: a national survey. *Clin J Sport Med, 10*(1), 40-48.

Adams, J., Cline, M., Reed, M., Masters, A., Ehlke, K., & Hartman, J. (2006). Importance of resistance training for patients after a cardiac event. *Proc (Bayl Univ Med Cent), 19*(3), 246-248.

Ajzen, I. (1991). *The theory of planned behavior*. (2, 50). Organizational Behavior and Human Decision Processes.

Alfano, C. M., Cheville, A. L., & Mustian, K. (2016). Developing High-Quality Cancer Rehabilitation Programs: A Timely Need. *Am Soc Clin Oncol Educ Book, 35*, 241-249. doi:10.14694/EDBK_156164

Alfano, C. M., Ganz, P. A., Rowland, J. H., & Hahn, E. E. (2012). Cancer survivorship and cancer rehabilitation: revitalizing the link. *J Clin Oncol, 30*(9), 904-906. doi:10.1200/JCO.2011.37.1674

American Association of Cardiovascular and Pulmonary Rehabilitation. (n.d.). Cardiac Rehabilitation. Retrieved from https://www.aacvpr.org/Portals/0/Resources/Marketing%20CR%20Resources/AACVPR_CR_Fact_Sheet.pdf

American Cancer Society. (2017). Cancer Facts & Figures. Retrieved from https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2017.html

American College of Sports Medicine. (2015). ProFinder. Retrieved from https://certification2.acsm.org/profinder?_ga=2.41074850.1203745459.1522009283-904264674.1488054246

American Heart Association. (2014). American Heart Association Recommendations for Physical Activity in Adults. Retrieved from http://www.heart.org/HEARTORG/HealthyLiving/PhysicalActivity/FitnessBasics/American-Heart-Association-Recommendations-for-Physical-Activity-in-Adults_UCM_307976_Article.jsp#.WpLuapPwbLY

Arena, R., Williams, M., Forman, D. E., Cahalin, L. P., Coke, L., Myers, J., . . . American Heart Association Exercise, C. R. a. P. C. o. t. C. o. C. C., Council on Epidemiology and Prevention, and Council on Nutrition, P.ysical Activity and Metabolism. (2012). Increasing referral and participation rates to outpatient cardiac rehabilitation: the valuable role of healthcare professionals in the inpatient and home health settings: a science advisory from the American Heart Association. *Circulation, 125*(10), 1321-1329. doi:10.1161/CIR.0b013e318246b1e5

Balady, G. J., Ades, P. A., Bittner, V. A., Franklin, B. A., Gordon, N. F., Thomas, R. J., . . . Committee, A. H. A. S. A. a. C. (2011). Referral, enrollment, and delivery of cardiac rehabilitation/secondary prevention programs at clinical centers and beyond: a presidential advisory from the American Heart Association. *Circulation, 124*(25), 2951-2960. doi:10.1161/CIR.0b013e31823b21e2

Barnes, P. M., & Schoenborn, C. A. (2012). Trends in adults receiving a recommendation for exercise or other physical activity from a physician or other health professional. *NCHS Data Brief*(86), 1-8.

Blanchard, C. M., Courneya, K. S., Stein, K., & SCS-II, A. C. S. s. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: results from the American Cancer Society's SCS-II. *J Clin Oncol, 26*(13), 2198-2204. doi:10.1200/JCO.2007.14.6217

Bobbio, M. (1989). Does post myocardial infarction rehabilitation prolong survival? A meta-analytic survey. *G Ital Cardiol, 19*(11), 1059-1067.

Bower, J. E. (2008). Behavioral symptoms in patients with breast cancer and survivors. *J Clin Oncol, 26*(5), 768-777. doi:10.1200/JCO.2007.14.3248

Boyden, T., Rubenfire, M., & Franklin, B. (2010). Will increasing referral to cardiac rehabilitation improve participation? *Prev Cardiol, 13*(4), 192-201.

Brown, T. M., Hernandez, A. F., Bittner, V., Cannon, C. P., Ellrodt, G., Liang, L., . . . Investigators, A. H. A. G. W. T. G. (2009). Predictors of cardiac rehabilitation referral in coronary artery disease patients: findings from the American Heart Association's Get With The Guidelines Program. *J Am Coll Cardiol, 54*(6), 515-521. doi:10.1016/j.jacc.2009.02.080

Calfas, K. J., Long, B. J., Sallis, J. F., Wooten, W. J., Pratt, M., & Patrick, K. (1996). A controlled trial of physician counseling to promote the adoption of physical activity. *Prev Med, 25*(3), 225-233. doi:10.1006/pmed.1996.0050

Centers for Disease Control and Prevention. Nutrition, Physical Activity, and Obesity: Data, Trends and Maps. Retrieved from https://nccd.cdc.gov/dnpao_dtm/rdPage.aspx?rdReport=DNPAO_DTM.ExploreByTopic&islClass=PA&islTopic=PA1&go=GO

Centers for Disease Control and Prevention. (2008). Receipt of outpatient cardiac rehabilitation among heart attack survivors--United States, 2005. *MMWR Morb Mortal Wkly Rep, 57*(4), 89-94.

Centers for Disease Control and Prevention. (2017). Heart Disease. Retrieved from https://www.cdc.gov/nchs/fastats/heart-disease.htm

Clarke, C., Noris, T., & Schiller, J. (2017). *Early Release of Selected Estimates Based on Data from the 2016 National Health Interview Survey*. National Center for Health Statistics.

Cortés, O., & Arthur, H. M. (2006). Determinants of referral to cardiac rehabilitation programs in patients with coronary artery disease: a systematic review. *Am Heart J, 151*(2), 249-256. doi:10.1016/j.ahj.2005.03.034

Courneya, K. S., Blanchard, C. M., & Laing, D. M. (2001). Exercise adherence in breast cancer survivors training for a dragon boat race competition: a preliminary investigation. *Psychooncology, 10*(5), 444-452.

Courneya, K. S., & Friedenreich, C. M. (1999). Utility of the theory of planned behavior for understanding exercise during breast cancer treatment. *Psychooncology, 8*(2), 112-122. doi:10.1002/(SICI)1099-1611(199903/04)8:2<112::AID-PON341>3.0.CO;2-L

Dahhan, A., Maddox, W. R., & Sharma, G. K. (2015). The Gaps in Cardiac Rehabilitation Referral: The Elephant in the Room. *J Am Coll Cardiol, 66*(22), 2574. doi:10.1016/j.jacc.2015.06.1359

DeLisa, J. A. (2001). A history of cancer rehabilitation. *Cancer, 92*(4 Suppl), 970-974.

Demark-Wahnefried, W., Aziz, N. M., Rowland, J. H., & Pinto, B. M. (2005). Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *J Clin Oncol, 23*(24), 5814-5830. doi:10.1200/JCO.2005.01.230

Demark-Wahnefried, W., Peterson, B., McBride, C., Lipkus, I., & Clipp, E. (2000). Current health behaviors and readiness to pursue life-style changes among men and women diagnosed with early stage prostate and breast carcinomas. *Cancer, 88*(3), 674-684.

Dimoska, A., Girgis, A., Hansen, V., Butow, P. N., & Tattersall, M. H. (2008). Perceived difficulties in consulting with patients and families: a survey of Australian cancer specialists. *Med J Aust, 189*(11-12), 612-615.

Fowler, A. L., White, B. A., Dejong, A. A., & Franklin, B. A. (2007). Cardiologists' perception of secdonary prevention and cardiac rehabilitation referral patterns: Influence of personal lifestyle practices. In (Vol. 39, pp. S281). Medicine & Science in Sports & Exercise.

Frank, E., Bhat Schelbert, K., & Elon, L. (2003). Exercise counseling and personal exercise habits of US women physicians. *J Am Med Womens Assoc (1972), 58*(3), 178-184.

Ghisi, G. L., Polyzotis, P., Oh, P., Pakosh, M., & Grace, S. L. (2013). Physician factors affecting cardiac rehabilitation referral and patient enrollment: a systematic review. *Clin Cardiol, 36*(6), 323-335. doi:10.1002/clc.22126

Grace, S. L., Grewal, K., & Stewart, D. E. (2008). Factors affecting cardiac rehabilitation referral by physician specialty. *J Cardiopulm Rehabil Prev, 28*(4), 248-252. doi:10.1097/01.HCR.0000327182.13875.07

Grant, P. M., Ryan, C. G., Tigbe, W. W., & Granat, M. H. (2006). The validation of a novel activity monitor in the measurement of posture and motion during everyday activities. *Br J Sports Med, 40*(12), 992-997. doi:10.1136/bjsm.2006.030262

Gravely-Witte, S., Leung, Y. W., Nariani, R., Tamim, H., Oh, P., Chan, V. M., & Grace, S. L. (2010). Effects of cardiac rehabilitation referral strategies on referral and enrollment rates. *Nat Rev Cardiol, 7*(2), 87-96. doi:10.1038/nrcardio.2009.223

Harvey, R. F., Jellinek, H. M., & Habeck, R. V. (1982). Cancer rehabilitation. An analysis of 36 program approaches. *JAMA, 247*(15), 2127-2131.

Jackson, L., Leclerc, J., Erskine, Y., & Linden, W. (2005). Getting the most out of cardiac rehabilitation: a review of referral and adherence predictors. *Heart, 91*(1), 10-14. doi:10.1136/hrt.2004.045559

Jolliffe, J. A., Rees, K., Taylor, R. S., Thompson, D., Oldridge, N., & Ebrahim, S. (2001). Exercise-based rehabilitation for coronary heart disease. *Cochrane Database Syst Rev*(1), CD001800. doi:10.1002/14651858.CD001800

Jones, L. W., Courneya, K. S., Fairey, A. S., & Mackey, J. R. (2004). Effects of an oncologist's recommendation to exercise on self-reported exercise behavior in newly diagnosed breast cancer survivors: a single-blind, randomized controlled trial. *Ann Behav Med, 28*(2), 105-113. doi:10.1207/s15324796abm2802_5

Jones, L. W., Courneya, K. S., Fairey, A. S., & Mackey, J. R. (2005). Does the theory of planned behavior mediate the effects of an oncologist's recommendation to exercise in newly diagnosed breast cancer survivors? Results from a randomized controlled trial. *Health Psychol, 24*(2), 189-197. doi:10.1037/0278-6133.24.2.189

Jones, L. W., Courneya, K. S., Peddle, C., & Mackey, J. R. (2005). Oncologists' opinions towards recommending exercise to patients with cancer: a Canadian national survey. *Support Care Cancer, 13*(11), 929-937. doi:10.1007/s00520-005-0805-8

Karvinen, K. H., DuBose, K. D., Carney, B., & Allison, R. R. (2010). Promotion of physical activity among oncologists in the United States. *J Support Oncol, 8*(1), 35-41.

Kenzik, K., Pisu, M., Fouad, M. N., & Martin, M. Y. (2016). Are long-term cancer survivors and physicians discussing health promotion and healthy behaviors? *J Cancer Surviv, 10*(2), 271-279. doi:10.1007/s11764-015-0473-8

Lavie, C. J., Thomas, R. J., Squires, R. W., Allison, T. G., & Milani, R. V. (2009). *Exercise Training and Cardiac Rehabilitation in Primary and Secondary Prevention of Coronary Heart Disease*. (4, 84). Mayo Clinic Proceedings.

Li, Y., Gu, M., Jing, F., Cai, S., Bao, C., Wang, J., . . . Chen, K. (2016). Association between physical activity and all cancer mortality: Dose-response meta-analysis of cohort studies. *Int J Cancer, 138*(4), 818-832. doi:10.1002/ijc.29828

Lyden, K., Keadle, S. K., Staudenmayer, J., & Freedson, P. S. (2017). The activPALTM Accurately Classifies Activity Intensity Categories in Healthy Adults. *Med Sci Sports Exerc, 49*(5), 1022-1028. doi:10.1249/MSS.0000000000001177

Lyden, K., Kozey Keadle, S. L., Staudenmayer, J. W., & Freedson, P. S. (2012). Validity of two wearable monitors to estimate breaks from sedentary time. *Med Sci Sports Exerc, 44*(11), 2243-2252. doi:10.1249/MSS.0b013e318260c477

Mampuya, W. M. (2012). Cardiac rehabilitation past, present and future: an overview. *Cardiovasc Diagn Ther, 2*(1), 38-49. doi:10.3978/j.issn.2223-3652.2012.01.02

McBride, C. M., Clipp, E., Peterson, B. L., Lipkus, I. M., & Demark-Wahnefried, W. (2000). Psychological impact of diagnosis and risk reduction among cancer survivors. *Psychooncology, 9*(5), 418-427.

Moradi, B., Maleki, M., Esmaeilzadeh, M., & Abkenar, H. B. (2011). Physician-related factors affecting cardiac rehabilitation referral. *J Tehran Heart Cent, 6*(4), 187-192.

Morishita, Y., Numata, A., Miki, A., Okada, M., Ishibashi, K., Takemoto, F., . . . Kusano, E. (2014). Primary care physicians' own exercise habits influence exercise counseling for patients with chronic kidney disease: a cross-sectional study. *BMC Nephrol, 15*, 48. doi:10.1186/1471-2369-15-48

Mozaffarian, D., Benjamin, E. J., Go, A. S., Arnett, D. K., Blaha, M. J., Cushman, M., . . . Subcommittee, A. H. A. S. C. a. S. S. (2015). Heart disease and stroke statistics--2015 update: a report from the American Heart Association. *Circulation, 131*(4), e29-322. doi:10.1161/CIR.0000000000000152

Nadler, M., Bainbridge, D., Tomasone, J., Cheifetz, O., Juergens, R. A., & Sussman, J. (2017). Oncology care provider perspectives on exercise promotion in people with cancer: an examination of knowledge, practices, barriers, and facilitators. *Support Care Cancer, 25*(7), 2297-2304. doi:10.1007/s00520-017-3640-9

Nyrop, K. A., Deal, A. M., Williams, G. R., Guerard, E. J., Pergolotti, M., & Muss, H. B. (2016). Physical activity communication between oncology providers and patients with early-stage breast, colon, or prostate cancer. *Cancer, 122*(3), 470-476. doi:10.1002/cncr.29786

O'Connor, G. T., Buring, J. E., Yusuf, S., Goldhaber, S. Z., Olmstead, E. M., Paffenbarger, R. S., & Hennekens, C. H. (1989). An overview of randomized trials of rehabilitation with exercise after myocardial infarction. *Circulation, 80*(2), 234-244.

Park, J. H., Oh, M., Yoon, Y. J., Lee, C. W., Jones, L. W., Kim, S. I., . . . Jeon, J. Y. (2015). Characteristics of attitude and recommendation of oncologists toward exercise in South Korea: a cross sectional survey study. *BMC Cancer, 15*, 249. doi:10.1186/s12885-015-1250-9

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Connor Gorber, S., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *Int J Behav Nutr Phys Act, 5*, 56. doi:10.1186/1479-5868-5-56

Promotion, O. o. D. P. a. H. (n.d.). Physical Activity. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/physical-activity/objectives

Riebe, D., Ehrman, J. K., Liguori, G., Magal, M., & Medicine, A. C. o. S. (2018). ACSM's Guidelines for Exercise Testing and Prescription. In (10th ed., pp. 264-273). Philidelphia: Wolters Kluwer.

Rock, C. L., Doyle, C., Demark-Wahnefried, W., Meyerhardt, J., Courneya, K. S., Schwartz, A. L., . . . Gansler, T. (2012). Nutrition and physical activity guidelines for cancer survivors. *CA Cancer J Clin, 62*(4), 243-274. doi:10.3322/caac.21142

Simon, S. (2016). ACS Report: Number of US Cancer Survivors Expected to Exceed 20 Million by 2026. Retrieved from https://www.cancer.org/latest-news/report-number-of-cancer-survivors-continues-to-grow.html

Smith, B. J., Marshall, A. L., & Huang, N. (2005). Screening for physical activity in family practice: evaluation of two brief assessment tools. *Am J Prev Med, 29*(4), 256-264. doi:10.1016/j.amepre.2005.07.005

Smith, S. C., Benjamin, E. J., Bonow, R. O., Braun, L. T., Creager, M. A., Franklin, B. A., . . . Association, W. H. F. a. t. P. C. N. (2011). AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease: 2011 update: a guideline from the American Heart Association and American

College of Cardiology Foundation. *Circulation, 124*(22), 2458-2473. doi:10.1161/CIR.0b013e318235eb4d

Smith, W. A., Nolan, V. G., Robison, L. L., Hudson, M. M., & Ness, K. K. (2011). Physical activity among cancer survivors and those with no history of cancer- a report from the National Health and Nutrition Examination Survey 2003-2006. *Am J Transl Res, 3*(4), 342-350.

Society, A. C. (2017). ACS Guidelines for Nutrition and Physical Activity. Retrieved from https://www.cancer.org/healthy/eat-healthy-get-active/acs-guidelines-nutrition-physical-activity-cancer-prevention/guidelines.html

Speck, R. M., Courneya, K. S., Mâsse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: a systematic review and meta-analysis. *J Cancer Surviv, 4*(2), 87-100. doi:10.1007/s11764-009-0110-5

Stubblefield, M. D., Hubbard, G., Cheville, A., Koch, U., Schmitz, K. H., & Dalton, S. O. (2013). Current perspectives and emerging issues on cancer rehabilitation. *Cancer, 119 Suppl 11*, 2170-2178. doi:10.1002/cncr.28059

Swinburn, B. A., Walter, L. G., Arroll, B., Tilyard, M. W., & Russell, D. G. (1998). The green prescription study: a randomized controlled trial of written exercise advice provided by general practitioners. *Am J Public Health, 88*(2), 288-291.

Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K., . . . Oldridge, N. (2004). Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *Am J Med, 116*(10), 682-692. doi:10.1016/j.amjmed.2004.01.009

Thomas, R. J. (2007). Cardiac rehabilitation/secondary prevention programs: a raft for the rapids: why have we missed the boat? *Circulation, 116*(15), 1644-1646. doi:10.1161/CIRCULATIONAHA.107.728402

Tsui, C. K., Shanmugasegaram, S., Jamnik, V., Wu, G., & Grace, S. L. (2012). Variation in patient perceptions of healthcare provider endorsement of cardiac rehabilitation. *J Cardiopulm Rehabil Prev, 32*(4), 192-197. doi:10.1097/HCR.0b013e318255a39d

Williams, M. A., Haskell, W. L., Ades, P. A., Amsterdam, E. A., Bittner, V., Franklin, B. A., . . . American Heart Association Council on Nutrition, P. y. A., and Metabolism. (2007). Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. *Circulation, 116*(5), 572-584. doi:10.1161/CIRCULATIONAHA.107.185214

APPENDICES

A. SURVEY

Survey Flow

Block: Demographics (10 Questions)
Standard: Exercise Counseling (10 Questions)
Standard: Beliefs About Exercise (5 Questions)

Page Break

Start of Block: Demographics

Q1 You are invited to take part in a research survey related to physician's beliefs about exercise. Your participation will require approximately 5-10 minutes and is completed online at your computer or on your mobile device. Upon completion of this survey, you will be contacted to wear a physical activity monitor for 7 consecutive days to measure time spent sitting, standing and stepping.

Taking part in this study is completely voluntary. If you choose to participate in this study, you can withdraw at any time without adversely affecting your relationship with anyone at Colorado State University.

All data will be assigned an identification number and only trained researchers will have access to the link between your email address and the survey responses. All confidential information will be stored in a locked cabinet in a secure office within the Colorado State University Human Performance Clinical Laboratory facility. Any report of this research that is made available to the public will not include your name or any other individual information by which you could be identified. While there are no direct benefits to you, we hope to gain more knowledge about physician's beliefs and practices regarding exercise for their patients. There are no known risks or discomforts anticipated with this survey.
Selecting "Yes" below indicates that you are 18 years of age or older, and your consent to participate in this survey.

The principal investigator is Dr. Heather Leach and the Co-Principal Investigator is Kelli Lebreton.
If you have any questions, please contact Heather Leach at 970-491-8951 or Kelli Lebreton at 970-491-4653, kelli.lebreton@colostate.edu. If you have any questions about your right as a research volunteer, contact the CSU IRB at RICRO_IRB@mail.colostate.edu; 970-491-1553.

This study has been approved by the Research Integrity & Compliance Review Office (RICRO) at Colorado State University, IRB # 17-7524H

I have read the above consent and agree to participate in this survey.

- ○ Yes (1)
- ○ No (2)

Skip To: End of Survey If Q1 = 2

Q2 Please provide your email address to be contacted about this study. Your email address will not be shared with anyone outside of study personnel.

_____

Q3 Sex

- ○ Male (0)
- ○ Female (1)

Q4 Age

_____

Q5 Place of Work

- ○ Hospital/Clinic Name _____
- ○ Department _____
- ○ Specialty _____

Q6 How long have you been in practice?

- ○ <5 years (0)
- ○ 5-10 years (1)
- ○ 10-15 years (2)
- ○ >15 years (3)

Q7 How long have you practiced at your current clinic?

_____

Q8 Did you receive formal training about how to deliver physical activity or exercise information to patients in medical school? If so, how many total hours of training did you receive?

- ○ No (0)
- ○ Yes, 1-2 hours (1)
- ○ Yes, 3-5 hours (2)
- ○ Yes, 6+ hours (3)

Q9 How many times a week do you usually do 20 minutes or more of vigorous-intensity physical activity that makes you sweat or puff and pant? (e.g., heavy lifting, digging, jogging, basketball, cross country skiing, aerobics, or fast bicycling?)

- ○ 3+ times a week (2)
- ○ 1-2 times a week (1)
- ○ None (0)

Q10 How many times a week do you usually do 30 minutes or more of moderate-intensity physical activity or walking that increases your heart rate or makes you breathe harder than normal? (e.g., carrying light loads, bicycling at a regular pace, skiing, dancing, or tennis?)

- ○ 5+ times a week (3)
- ○ 3-4 times a week (2)
- ○ 1-2 times a week (1)
- ○ None (0)

End of Block: Demographics

Start of Block: Exercise Counseling

Q11 How often do you discuss exercise with your patients?

- ○ None of their visits (0)
- ○ Few of their visits (<25%) (1)
- ○ Some of their visits (~50%) (2)
- ○ Most of their visits (>75%) (3)
- ○ All of their visits (4)

Skip To: Q13 If Q11 = 4

Q12 If you do **NOT** discuss exercise with a patient at one of their visits, what are some of the barriers? Please select all that apply.

- ☐ Not enough time (0)
- ☐ Not enough knowledge on the subject (1)
- ☐ No reimbursement from insurance (2)
- ☐ I don't think my patient is motivated (3)
- ☐ Patient has too many barriers or contraindications (4)
- ☐ Other priorities during appointments (5)
- ☐ Other (please describe) (6) _____

Q13 What percent of patients have you recommended should exercise in the past month?

- ○ None (0)
- ○ Few (<25%) (1)
- ○ Some (~50%) (2)
- ○ Most (>75%) (3)
- ○ All (4)

Skip To: Q15 If Q13 = 0

Q14 If you recommend exercise to your patients, what is the frequency, intensity, time and type that you recommend?

_____

_____

_____

_____

_____

Q15 If I provide an exercise recommendation, most of my patients will follow my advice.

- ○ Strongly disagree (0)
- ○ Disagree (1)
- ○ Neutral (2)
- ○ Agree (3)
- ○ Strongly agree (4)

Q16 If you provide information about exercise to your patient, which of the following methods do you use to convey this information? Please mark all that apply.

- ☐ Verbally (0)
- ☐ Referral to a structured exercise program (1)
- ☐ Pamphlet or other handouts to patient at time of visit (2)
- ☐ Web-based resources (please list) (3) _____
- ☐ Other (please describe) (4) _____

Skip To: Q19 If Q16 ≠ 1

Q17 When you provide a referral to a structured exercise program, which of the following do you use?

- ☐ Hospital-based rehabilitation program. Enter program name if applicable) (1) _____
- ☐ Community-based exercise program or facility (ex. group fitness, walking group, personal trainers, etc.) Enter program name if applicable. (2) _____
- ☐ None (0)
- ☐ Other (please describe) (4) _____

Q18 When you refer patients to structured exercise programs, what type of professionals do you look for? Please select all that apply.

- ☐ Physical Therapist (1)
- ☐ Certified Exercise Physiologist (2)
- ☐ Personal Trainer (3)
- ☐ Do not know or not aware of appropriate qualifications (0)
- ☐ Depends on the patients' needs (4)

Skip To: End of Block If Selected Choices = 0,1,2,3,4

Q19 If you were to provide a referral to a structured exercise program, which of the following would you use?

- ○ Hospital-based rehabilitation program (1)
- ○ Community-based exercise program or facility (ex. group fitness, walking group, personal trainers, etc.) (2)
- ○ Neither (0)
- ○ Both (3)
- ○ Other (please describe) (4) _____

Q20 If you were to refer patients to structured exercise programs, what type of professionals would you look for?

- ☐ Physical Therapist (1)
- ☐ Certified Exercise Physiologist (2)
- ☐ Personal Trainer (3)
- ☐ Do not know or not aware of appropriate qualifications (0)
- ☐ Depends on the patients' needs (4)

End of Block: Exercise Counseling

Start of Block: Beliefs About Exercise

Q21 I believe exercise is safe for most of my patients.

- Strongly disagree (0)
- Disagree (1)
- Neutral (2)
- Agree (3)
- Strongly agree (4)

Q22 I believe that most of patients are capable of exercise.

- Strongly disagree (0)
- Disagree (1)
- Neutral (2)
- Agree (3)
- Strongly agree (4)

Q23 I believe exercise is effective for improving my patients' well-being.

- ○ Strongly disagree (0)
- ○ Disagree (1)
- ○ Neutral (2)
- ○ Agree (3)
- ○ Strongly agree (4)

Q24 I believe exercise can reduce likelihood of disease recurrence, or increase chances of survival in my patients.

- ○ Strongly disagree (0)
- ○ Disagree (1)
- ○ Neutral (2)
- ○ Agree (3)
- ○ Strongly agree (4)

Q25 In the box below, please add any additional comments related to exercise for your patients:

_____

_____

_____

_____

_____

End of Block: Beliefs About Exercise