

AN EDUCATIONAL INTERVENTION FOR PHYSICAL THERAPISTS TO
PROMOTE DIETARY COUNSELING IN PATIENTS WITH OSTEOARTHRITIS

by

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As members of the DNP Project Committee, we certify that we have read the DNP project prepared by Lisa Shuk Lam, titled An Educational Intervention for Physical Therapists to Promote Dietary Counseling in Patients with Osteoarthritis and recommend that it be accepted as fulfilling the DNP project requirement for the Degree of Doctor of Nursing Practice.

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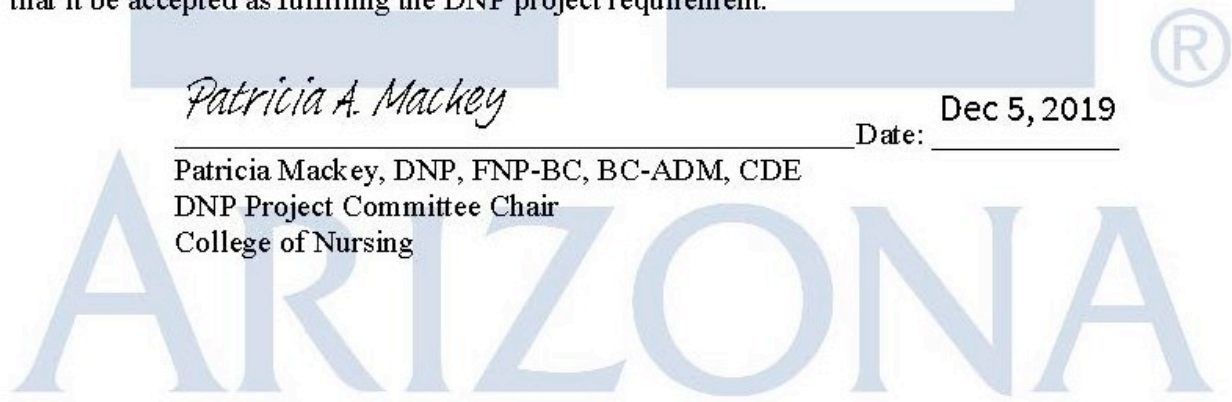
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DEDICATION

To my Maltese mix Koda, for patiently missing many walks, games of fetch and tug of war; and to my Siamese Lynx Zelda, for countless hours spent waiting to snuggle on the couch.

TABLE OF CONTENTS

LIST OF FIGURES	7
LIST OF TABLES	8
ABSTRACT	9
INTRODUCTION	11
Background Knowledge	12
Clinical Guidelines	14
Local Problem	15
Significance to Clinical Practice	17
Purpose and Aims	18
Study Question	19
Theoretical Framework	20
Health Belief Model	20
Concepts and Definitions	21
Synthesis of Evidence	23
Interaction between Osteoarthritis and Obesity	24
Relationship between Obesity and Inflammation	24
Impact of Inflammation on Osteoarthritis	25
Influence of Dietary Behaviors	26
Strengths of Existing Literature	26
Weaknesses and Limitations	27
METHODOLOGY	28
Design	28
Participants	29
Setting	30
Intervention	30
MOVE Approach	31
Tools and Process for Data Collection	32
Statistical Analysis	33

TABLE OF CONTENTS – *Continued*

Outcome Measures	33
Ethical Considerations	34
Respect for Persons	34
Beneficence	35
Justice	35
RESULTS	36
Description of Sample Participants	36
Sample Demographics	37
Perceptions, Current Practices and Knowledge	37
Comparison of Pre-test and Post-test Scores	41
Evaluation of Intervention	42
Participant Feedback	44
DISCUSSION	45
Strengths	49
Limitations	50
Clinical Implications	51
Conclusion	53
APPENDIX A: EVIDENCE APPRAISAL TABLE.....	55
APPENDIX B: THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD APPROVAL LETTER.....	65
APPENDIX C: CORE PHYSICAL THERAPY INSTITUTIONAL REVIEW BOARD APPROVAL LETTER.....	67
APPENDIX D: OSTEOARTHRITIS PRE-TEST.....	69
APPENDIX E: OSTEOARTHRITIS POST-TEST	74
APPENDIX F: “IT’S YOUR MOVE” EDUCATIONAL BROCHURE	78
APPENDIX G: DISCLOSURE FORM	81
REFERENCES	83

LIST OF FIGURES

<i>FIGURE 1.</i>	Utilizing the health belief model to understand likelihood of physical therapists to integrate nutrition counseling in the management of patients with osteoarthritis.	21
<i>FIGURE 2.</i>	Participants' perception of nutrition on osteoarthritis	38
<i>FIGURE 3.</i>	Reported frequency of practices by physical therapists.....	39
<i>FIGURE 4.</i>	Factors affecting participants' current practice with OA patients	40
<i>FIGURE 5.</i>	Level of comfort in delivering nutrition counseling.....	40
<i>FIGURE 6.</i>	Level of interest in providing nutrition counseling for OA patients.....	41
<i>FIGURE 7.</i>	Level of effectiveness in intervention.....	43
<i>FIGURE 8.</i>	Likelihood to incorporate into current practice	43
<i>FIGURE 9.</i>	Perceptions on the use of nutrition counseling as an approach to improve OA management	44

LIST OF TABLES

TABLE 1.	<i>Demographic characteristics of participants (N=6)</i>	37
TABLE 2.	<i>Comparison of pre-test and post-test results</i>	42

ABSTRACT

Objective: To assess the feasibility of an educational intervention on influencing physical therapist (PT) practice behaviors to include nutrition counseling or dietician referrals for the management of patients with osteoarthritis (OA).

Background: Over 30 million Americans suffer from OA, which is an insidious disease, representing one of the leading causes of physical disability. Symptoms are due to the deterioration of articular cartilage and alterations of extracellular matrix. Obesity and poor nutrition are the greatest modifiable risk factors. Obesity induces the production of pro-inflammatory cytokines, which are associated with pathological processes of OA. Special attention has been given to the Mediterranean Diet (MD) for its anti-inflammatory properties. Nutritional counseling and dietary modification can supplement PT treatments in the management of OA. PTs are in an ideal position to encourage health promoting behaviors and self-management by addressing nutritional concerns in OA patients.

Methods: A one-group pre-test post-test quantitative design was employed to evaluate improvements in PTs' knowledge and attitudes. Provider education involved a brief educational intervention utilizing "It's Your MOVE" brochure. A convenience sample of six participants were recruited at CORE Physical Therapy in Orange County, CA.

Results: Six participants completed the pre-test and post-test questionnaires. Descriptive statistics demonstrated a significant improvement in post-intervention knowledge. A 76.7% change was observed. Effectiveness of the intervention on provider knowledge was likely due to the educational seminar. Limitations in PT practice was the main barrier for lack of nutrition

counseling. Likelihood for practice change demonstrated variable results ranging from unlikely to absolutely.

Conclusion: There is a need to improve PT involvement in health promotion efforts for OA patients. Reducing barriers in PT practice will allow providers to integrate nutrition counseling and improve interprofessional collaborations with dietitians in OA care plans. Despite the effectiveness of the education intervention, reservations regarding state practice laws heavily influenced PTs' practice behaviors.

INTRODUCTION

Musculoskeletal disorders are the second leading cause of disability in healthy adults globally and cause significant disease burden in individuals affected (World Health Organization [WHO], 2018). The impact of musculoskeletal disorders is prevalent in all regions of the world, affecting people across all racial groups (Brennan-Olsen et al., 2017). Disorders of the musculoskeletal system are characterized by limitations in mobility and pain that affect muscles, joints, bones, ligaments, and tendons (WHO, 2018).

Among the numerous musculoskeletal conditions, osteoarthritis (OA) is the most common joint disorder (WHO, 2018). The Centers for Disease Control and Prevention (CDC) estimates that over 30 million Americans are living with OA (CDC, 2019). Approximately over 10% of adults in the United States will be affected by 60 years of age (Zhang & Jordan, 2010). The prevalence of individuals with the disease will continue to grow as the population over age 65 is anticipated to increase due to increasing life expectancy (Zhang & Jordan, 2010). Patients who suffer from OA have a higher mortality compared to the general population because of comorbidities from limitations in mobility (Nelson, Allen, Golightly, Goode, & Jordan, 2014). Pain and other symptoms contributed by OA accounts for personal, social, and economic burden (Salmon et al., 2016). In 2011, the WHO reported OA contributed to the greatest proportion of workplace productivity loss with an estimated annual cost of \$213 billion (WHO, 2018). Costs of OA were presented as direct and indirect costs, with orthopedic surgeries for joint replacement making up most of the total amount (Salmon et al., 2016).

Considering the substantial disease burden of OA, seeking treatment for the condition will likely increase in the primary care setting. Pathogenesis of OA was once regarded as an

effect of aging, has now been widely accepted to be multifactorial comprising of both non-modifiable and modifiable factors (Bortoluzzi, Furini, & Scire, 2018). Risk factors that are modifiable includes obesity and dietary patterns (Bortoluzzi et al., 2018). Physical therapy is often the most recommended nonpharmacological intervention of OA management (Brakke, Singh, & Sullivan, 2012). Therefore, physical therapy clinicians are presented with a valuable opportunity to intervene and improve health outcomes for this patient population. Physical therapists (PTs) can revise their care plans during rehabilitation treatment for OA patients to encourage healthy dietary habits and potentially increase referrals to a dietician. In addition to exercise modalities, current guidelines endorsed by the American Physical Therapy Association (APTA) recommend PTs to consult and work intercollaboratively with dieticians for nutrition-based interventions in supporting patients with weight loss and OA symptom management (Cibulka et al., 2017).

Background Knowledge

Risk factors for musculoskeletal conditions are found to be influenced by various factors such as age, genetics, and dietary intake (Zhang & Jordan, 2010). The reported symptoms of these conditions not only cause impaired mobility, but also play a significant burden on the individual's life (CDC, 2019). OA is a degenerative bone disease and the most common form of rheumatoid disorders (CDC, 2019). The progression of OA is slow and occurs over many years. OA is a "wear and tear" condition attributed to activities of daily living and overuse of joints, thus frequently affecting the hands, wrists, knees, and hips (Litwic, Edwards, Dennison, & Cooper, 2013). Symptoms of OA include swelling, joint stiffness, and pain (CDC, 2019).

Symptomatic individuals may eventually suffer from functional disability due to limitations in performing routine daily activities, which leads to decreased quality of life (Litwic et al., 2013).

Numerous studies have consistently demonstrated a strong association between obesity and OA symptoms (Bliddal, Leeds, & Christensen, 2014). The relationship between obesity and OA is found to be multi-factorial. Obesity has traditionally been suggested to contribute to OA primarily due to the impact of excessive body weight at joints (King, March, & Anandacoomarasamy, 2013). Consequences of increased body mass result in increased loading of the weight bearing joints, structural joint damage, altered gait and mobility, and decreased muscle strength (King et al., 2013).

More recently, the inflammatory state, which is a characteristic feature of obesity, is now strongly suggested to contribute to OA initiation and progression (King et al., 2013). Poor nutrition and dietary habits has been found to coexist with the inflammatory component that underlie obesity and OA (Dean & Hansen, 2012). Special attention has been given to the Mediterranean diet (MD), which is a dietary eating pattern that promotes consumption of anti-inflammatory foods. On the other hand, a typical western diet, characterized by consumption of energy dense foods poor in nutritional quality, has been well known to be a major contributor to the obesity epidemic (Botchlett & Wu, 2019). Poor dietary behaviors place an individual at increased risk for various comorbidities including malnutrition, obesity, metabolic syndromes, chronic pain, and poor health outcomes (Zhang & Jordan, 2010). Furthermore, poor nutrition quality can exacerbate the decline in bone health in addition to normal age-related changes on the musculoskeletal system (Christensen et al., 2012). Despite aging and genetics being non-modifiable risk factors contributing to bone health, lifestyle behaviors such as poor nutrition and

obesity can be modified to prevent the deterioration of joints and reduce the risk of further progression of OA (Thomas, Browne, Mobasheri, & Rayman, 2018).

There is currently no cure for the disease (Brennan-Olsen et al., 2017). Considering the growing burden of OA and obesity rates reaching an all-time high, the need for nutritional interventions and development of management strategies for OA is paramount. Addressing inflammation through dietary modification supporting optimal nutrition holds a promising approach for the prevention and management of chronic OA (Dean & Hansen, 2012). Literature supports that counseling on proper nutrition would not only provide an anti-inflammatory benefit on OA, but also minimize risk for other lifestyle related conditions including obesity (Dean & Hansen, 2012).

Clinical Guidelines

The goals of OA management focus heavily on reducing pain, improving functional ability, and slowing disease progression (Nelson et al., 2014). Various practice guidelines for OA management support a multi-factorial approach with nonpharmacological and pharmacological treatment modalities (Hochberg et al., 2012; American Academy of Orthopaedic Surgeons [AAOS], 2013).

Non-steroidal anti-inflammatory drugs (NSAIDs) are often the first line pharmacological treatment in patients presenting with OA (Stanos, 2013). While NSAIDs can provide initial short-term pain relief, long-term use does not prevent disease progression and is generally discouraged due to frequency of NSAID use and its association with numerous complications (Stanos, 2013). Clinical guidelines are often reluctant with recommending opioid prescriptions for pain management (Thorlund, Turkiewicz, Prieto-Alhambra, & Englund, 2019). Opioids are

not only cost ineffective, but also play a negative impact on pain relief, and contribute to comorbidities and dependence (Rosen, Sancheti, Fierlinger, Niazi, Johal, & Bedi, 2016; Thorlund et al., 2019).

Rehabilitation centered approaches through the care of PTs continue to be the foundation of OA symptom management (Bhatia, Bejarano, & Novo, 2013). Treatment therapies used by PTs typically involve strength training (Brakke et al., 2012). Additional PT treatment modalities may include electrical stimulation, manual therapy, hydrotherapy aquatic therapy, and tai chi (Bhatia et al., 2013). Current clinical practice guidelines by the American College of Rheumatology strongly recommends weight loss counseling and health promotion for all symptomatic OA individuals who are overweight (Hochberg et al., 2012). A greater emphasis was placed on supporting self-management of health promoting behaviors including weight control and regular physical activity (Dean & Hansen, 2012).

Nevertheless, not all recommendations from current practice guidelines are within PT practice. There are barriers and practice gaps that exist, which hinder PTs from addressing the component of nutrition for health promotion (Bezner, 2015). Barriers to incorporate health and wellness counseling in PT patient care plans may include limitations in time, patient noncompliance, limited knowledge, lack of nutritional resources, lack of insurance reimbursement, or restricted scope of practice (Bezner, 2015). The first step in improving implementation of current OA guidelines is by recognizing the need to close the practice gap.

Local Problem

According to the American Physical Therapy Association (APTA), nutrition is outlined in the professional scope of practice for PTs (APTA, 2018). The APTA's position on PTs' scope

of practice is that diet and nutrition should be included as vital components for the management of locomotor conditions (APTA, 2018). Despite the APTA's position on nutrition care, PTs often fail to recognize the influence of nutrition on health promotion and disease outcome likely due to lack of knowledge, lack of time, or lack of training. As a result, PTs often overlook the component of nutrition altogether.

State laws despite APTA's advocacy on nutrition and recommendations on practice guidelines (APTA, 2018) regulate physical therapists' scope of practice. Each state has imposed different restrictions concerning PTs' capacity to provide nutritional information. It is important to recognize that two categories of nutrition laws exist in California. State law does not prohibit any individual from providing general nutrition advice relating to health and wellness. Rather, individuals are prohibited from providing nutrition advice for the prevention and treatment of a specific disease (Physical Therapy Board of California, 2017). Consequently, PTs in California are presented with an invaluable opportunity in their practice to improve clinical outcomes in OA patients. Promotion of health and wellness are outlined in the physical therapy practice act, which allows PTs to supplement current physical therapy interventions by including general nutrition counseling consistent with supporting physical fitness and obesity prevention to maintain health (Bezner, 2015). Components of health and wellness promotion also includes making appropriate dietician referrals for consultation of individualized nutrition therapy (Bezner, 2015).

The CDC currently estimates that arthritis affects one in four U.S. adults nationally (CDC, 2018). The percentage of individuals affected varies state by state ranging from 17.2% to 33.6% (CDC, 2018). In California, the prevalence of adults clinically diagnosed with arthritis is

18.3% (CDC, 2018). Furthermore, percentage of health care providers in California who provided counseling on weight loss for arthritis management was approximately 40.1% (Barbour et al., 2018). With less than half of health care providers in California who provide weight loss counseling in OA patients, interventions to improve in practice are warranted given the growing rates of arthritis nationwide.

Comprehensive Outpatient Rehabilitation Experts (CORE) Physical Therapy, the organization selected for this quality improvement (QI) project, has various outpatient clinics located throughout suburban regions in southern California. This organization provides rehabilitation care to a diverse age group of individuals ranging from college-aged students with sports injuries to older adults with chronic conditions. OA patients accounts for approximately 60-70% of CORE Physical Therapy's patient population (J. Myers, personal communication, November 6, 2019). Staff at this organization consists of rehabilitation providers including PTs, PT aides, occupational therapists, massage therapists, and sports medicine providers. Due to the frequency of OA patient visits at this site, stakeholders at CORE Physical Therapy recognized the need for effective management strategies to improve outcomes for this patient population.

Significance to Clinical Practice

Obesity and poor nutrition are the most important modifiable risk factors to OA (Bliddal et al., 2014). Given the significant impact of obesity and inflammation on OA, strategies for the effective management of OA should be targeted on nutrition and weight loss. There is growing evidence that a healthy diet has a therapeutic effect on chronic pain, reduction of inflammation, and positive health outcomes (Tick, 2015). Nutritional counseling incorporated into practice as

an adjunct to current PT treatment modalities may not only help reduce OA symptoms, but also offer safe lifestyle-related changes in promoting health and weight loss.

PTs are the first in line of defense for the management of OA patients. They are key providers of conservative treatments approaches to address OA symptoms (Teo, Hinman, Egerton, Dziedzic, & Bennell, 2019). Current management of OA involves a combination of nonpharmacological and health promotion interventions such as strength training exercises, self-management education, and weight loss to reduce pain and preserve function (AAOS, 2013). Despite various clinical practice guidelines that outline health promotion approaches in OA management, PTs are often reluctant to take a more active role in educating patients on prevention and wellness (Abaraogu, Ogaga, Odidika, & Frantz, 2016). Efforts to involve PTs in health promotion strategies involve building on their nutrition knowledge and skills so they can be better prepared to address nutrition concerns and counsel lifestyle changes with their patients.

Purpose and Aims

The purpose of this Doctor of Nursing Practice (DNP) QI project is to implement an educational intervention for PTs with the goal of increasing nutrition awareness in OA, and as a result, influence PTs to integrate nutrition guidance and dietician collaborations in rehabilitation care plans to improve treatment outcomes for their OA patients. The aim of the intervention is to improve the physical therapy providers' understanding on the influence of dietary factors and broaden clinical perspectives in the inflammatory mechanisms of OA. PTs may be hesitant to provide patients with nutritional counseling due to insufficient knowledge on the topic, limited training, or lack of concern on diet and nutritional issues, thus neglecting to recommend dietary changes as strategies for OA management (Phadke, 2017). Through an educational intervention,

an evidence-based informational brochure on the role of nutrition in OA management will be disseminated to PTs to increase their awareness of the subject.

The primary avenue for addressing the gap in practice is to encourage PTs to utilize nutrition as an intervention when permitted to do so by scope of practice laws and state of California PT practice act. Incorporating nutritional information into PT treatment regimens broadens PTs' role in primary prevention. Addressing the knowledge gap will prepare PTs to be in a better position to promote health and to maximize treatment potentials (Phadke, 2017). In turn, providers will have nutritional competencies to role model lifestyle changes consistent with optimal nutrition and screen for inflammatory characteristics of their OA patients' diet. Changes in PT practice is anticipated to result in increased interdisciplinary collaborations, increased referrals to dietitians, and improved recognition of dietary concerns and risk for obesity. A DNP project focused on influencing PT practice behaviors may potentially close practice gaps and address barriers that hinder PTs from providing optimal care for their OA patients.

Study Question

A clinical question to be addressed in this scholarly project to improve clinical practice among PTs in a primary care setting is: "Does a nurse practitioner provided educational intervention on nutrition and the dietary implications associated with reducing osteoarthritis symptoms influence physical therapists to integrate nutrition education or offer dietician referrals for their patients with osteoarthritis when compared to their current practices?"

Theoretical Framework

Health Belief Model

The framework that will be used to guide this quality improvement project is the use of the Health Belief Model (HBM) developed by the United States Public Health Service in the 1950s (U.S. Department of Health and Human Services [HHS], National Institutes of Health [NIH], National Cancer Institute [NCI], 2005). The HBM was originally developed to investigate the behaviors of people on their failure to participate in disease prevention programs implemented by the public health department (HHS, NIH, & NCI, 2005). The HBM speculates that people's willingness to partake in health promotion and disease prevention are influenced by their awareness of their susceptibility to a health condition and the recognition of benefits by taking action to reduce susceptibility (Jones, Jensen, Scherr, Brown, Christy, & Weaver, 2015). The six main constructs in the HBM that describe influences on people's health-related action are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy (Glanz, Rimer, & Viswanath, 2008). Concepts in the theoretical framework predict preventative health behavior and the likelihood of taking action to reduce the threat (Glanz et al., 2008).

Application of the HBM (Figure 1) can be applied to understand the perceptions of PTs in regards to their health-related behaviors. Encouraging PTs to integrate nutrition education in their current practices will come with challenges that go along with adoption of new behaviors. Reasons for PTs to resist change may include inadequate knowledge of nutrition, lack of confidence to promote dietary counselling, increased workload, and shortage of time. Successful implementation of an educational intervention requires understanding of PTs' perceptions and

awareness in nutrition-related benefits impacting OA. Utilizing the HBM will help guide the understanding of provider behaviors, and whether PTs will take action to participate in the adoption of dietary counseling in practice. Addressing the modifying components in the HBM can potentially influence provider behaviors and thus, increase likelihood of adopting recommended practice change.

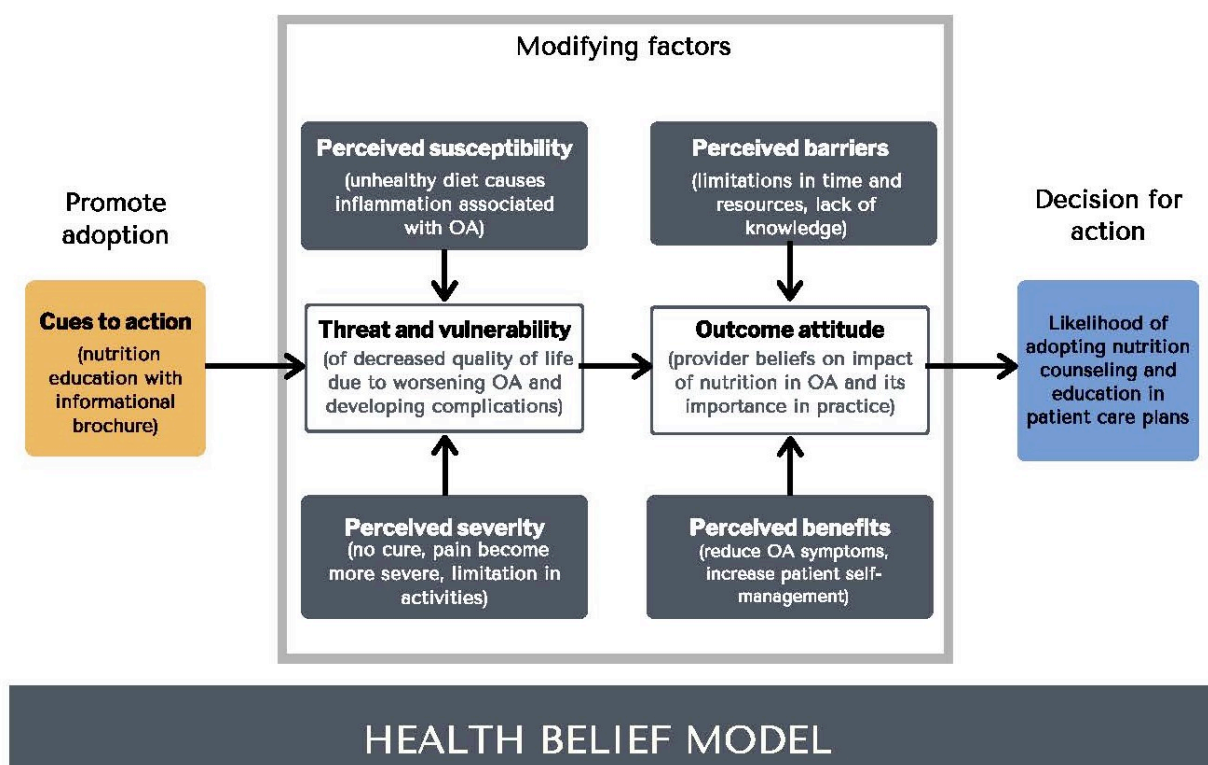


FIGURE 1. Utilizing the health belief model to understand likelihood of physical therapists to integrate nutrition counseling in the management of patients with osteoarthritis.

Concepts and Definitions

The major concepts of the HBM are perceived susceptibility, severity, barriers, benefits, cues to action, and self-efficacy. The concept of perceived susceptibility refers to a person's belief of vulnerability to a health condition or illness (Jones et al., 2015). Perceived susceptibility involves PTs recognition of the interplay between poor nutrition and inflammation. The issue

with consumption of the typical Western diet is due to pro-inflammatory effects of high fat consumption (Dean & Hansen, 2012). Educating PTs on evidence-based research supporting the role of anti-inflammatory eating habits should influence the provider's perceived susceptibility of the disease.

Perceived severity involves evaluating the seriousness of unhealthy dietary habits, which contributes to the progression of OA (Glanz et al., 2008). Diets poor in nutritional quality contribute to excessive body weight and in turn, fat tissue derived from obesity releases pro-inflammatory cytokines that can accelerate disease progression in OA (Souza et al., 2017). Increasing provider awareness of lifestyle behaviors contributing to OA may persuade PTs on the concept of perceived severity. The intent to act on health promoting activities depends on perceived benefits with the behavior change (Glanz et al., 2008). Perceived benefits are a result of increasing provider knowledge on the effectiveness of the MD as a dietary strategy to reduce inflammation, disability, and pain in OA patients. Another perceived benefit resulting from increased dietician referrals can improve interprofessional collaboration and patient outcomes. Perceived barriers involves recognizing the various obstacles that hinder behavior change (Glanz et al., 2008). Barriers may include the various obstacles involved against PTs' adoption of nutrition promoting strategies. Barriers anticipated are lack of knowledge, lack of time, and lack of funding (Bezner, 2015). Removing barriers can significantly optimize care in OA patients by enhancing PTs' role in OA management. The concepts cue to action and self-efficacy are two crucial components of the HBM that prompts action (Jones et al., 2015). Cue to action refers to a stimulus (educational intervention) that generates readiness to participate in health actions, whereas people with confidence in behavior change have self-efficacy to engage in a desired

behavior to successfully reduce the health threat (Jones et al., 2015). Evaluating the six constructs of the HBM can provide a better understanding of influences on health behaviors and provider perceptions when addressing practice change. Understanding PTs' perceptions provide insight on evaluating the effectiveness of the intervention and the improvements needed in order to persuade practice behavior change.

Synthesis of Evidence

OA is a progressive disease that requires long-term management to minimize pain, improve physical functioning, and slow the process of joint damage. Maintaining quality of life is the goal of OA management. Guidelines for OA management is aimed at a multi-component approach including diet and exercise, reduction in inflammation, and obesity prevention (Hochberg et al., 2012; Thomas et al., 2018; AAOS, 2013). Data from numerous studies have reported a strong association between obesity and OA severity and progression (Mears et al., 2019).

Diet and nutrition are modifiable risk factors of OA; therefore, supporting evidence for the efficacy of a healthy diet on OA symptoms is imperative. A comprehensive search was performed to conduct the literature review of current evidence on evaluating the inflammatory OA disease process and dietary associations. Literature searches were executed using electronic databases including PubMed, Cochrane Database of Systematic Reviews, CINAHL, and EMBASE. Several key search terms were used to find publications within the last 10 years from 2009 to 2019. Key terms consisted of osteoarthritis, obesity, inflammation, Mediterranean diet, nutrition, and physical therapists. The inclusion criteria for the literature review limited articles to English language, human species, and all adults. The Cochrane Database of Systematic

Reviews yielded seven results, PubMed database yielded 79 results, CINAHL yielded 21 results, and Embase yielded 60 results. Of the total search results, only 10 most relevant articles were used to provide evidence-based sources for this DNP project (Appendix A).

Interaction between Osteoarthritis and Obesity

Studies have suggested that the progression of OAs is multifactorial, involving body composition, cholesterol, lipids, and nutrients (Thomas et al., 2018). Obesity and overweight individuals are at a higher risk for worsening OA due to the strain on weight-bearing joints from excessive body weight (Purcell et al., 2016). Elevated lipids in obese individuals are found to have a positive association with cartilage loss, thus causing structural damage to joints (Lu et al., 2017). Diet quality was significantly associated with OA severity in several studies (Dean & Hansen, 2012; Vergis et al., 2018; Veronese et al., 2016). Hypercholesterolemia was found to positively influence progression of OA due to inflammation and cartilage destruction (Thomas et al., 2018). Mineral deficiencies such as inadequate intake of vitamin D is associated with degradative activity of articular cartilage, which also contributes to OA progression (Garfinkel, Dilisio, & Agrawal, 2017). Adipose tissue found primarily in body fat secretes pro-inflammatory hormones such as leptin and adiponectin, which negatively regulates articular cartilage (Wang & He, 2018). A negative correlation was observed between weight loss and production of pro-inflammatory substances (Wang & He, 2018).

Relationship between Obesity and Inflammation

More recently, increasing emphasis on inflammation in obesity have been suggested to contribute to the advancement of OA (Bortoluzzi et al., 2018). The mechanisms involved with inflammation in particular are identified as primary contributors to joint disease and subsequent

OA pain (Harasymowicz, Dicks, Wu, & Guilak, 2019). Patients who are overweight or obese are thought to be in a constant low-grade inflammatory state that affects joint function (Harasymowicz et al., 2019). Historically, the load applied to joints due to excessive body weight was thought to attribute to the increase in wear and tear of OA (Purcell et al., 2016). It is now believed that chronic inflammation and metabolic dysregulation are responsible for degradation of cartilage and joint tissues in OA (Harasymowicz et al., 2019). Individuals with obesity undergo metabolic changes because of dietary imbalances, thus affecting the composition of various cells and tissues that include synovial fluid, cartilage, and joint tissues (Harasymowicz et al., 2019). Weight loss in OA patients was observed to have significant improvements in joint function, pain, and cartilage quality (King et al., 2013). Most notably, weight loss demonstrated reductions in inflammatory markers (King et al., 2013).

Impact of Inflammation on Osteoarthritis

There are interacting mechanisms involved between inflammation, obesity, dietary behavior, and OA. A number of inflammatory mechanisms contributes to the pathophysiology of cartilage degradation resulting in OA (Rayman, 2015). Inflammatory cytokines, which are strongly associated to OA, are produced by the synovium and chondrocyte cells (Goldring & Otero, 2011). Being in a chronic state of low-grade inflammation and oxidative stress can negatively impact OA when inflammatory mediators from joint tissues and synovial fluid activate inflammatory signals (Goldring & Otero, 2011). Mechanical stress from cartilage and joints are also involved in activating downstream signaling pathways when exposed to environmental insults (Goldring & Otero, 2011). As a result, a prolonged state of systemic inflammation drives the progression of joint damage (Sokolove & Lepus, 2013). Reducing the

presence of systemic inflammation can prevent joint destruction and slow disease progression (Sokolove & Lepus, 2013).

Influence of Dietary Behaviors

Special diets such as low carbohydrate diets and Mediterranean diets are found to be significant in reduction of knee OA and pain (Strath et al., 2019; Veronese et al., 2018). A typical western diet is notorious for foods high in fat, which contribute to oxidative stress and stimulates inflammatory processes (Dean & Hansen, 2012). Adherence to the MD, defined as a conventional healthy plant-based dietary pattern of eating, has been shown to exert anti-inflammatory properties and consistently linked to beneficial health effects (Dyer, Davison, Marcora, & Mauger, 2017). Considering there are increasing amounts of evidence to support the influence of inflammation and dietary imbalances associated with OA, it is only imperative for providers to examine an individual's a nutrition status, alert patients on risks of diet quality, and provide nutrition advisement as strategies to reduce risk for worsening OA. Nutrition education can help PTs review individual behaviors of food intake, educate patients on the health consequences associated with their food choices, and promote self-management through diet modification (Strath et al., 2019). A diet involving a reduction in excessive amounts of saturated fatty acids or foods that induce pro-inflammatory properties may be beneficial in disease management (Veronese et al., 2018).

Strengths of Existing Literature

Abundant evidence exists in current literature to support the crucial role of proper nutrition and benefits of healthy eating utilized in self-management of OA (Phadke, 2017). Health outcomes of individuals with a greater adherence to the MD have been linked to having a

protective factor against overall mortality and chronic degenerative diseases (Sofi, Abbate, Gensini, & Casini, 2010). The association between health outcomes and adhering to the MD as compared to a typical western diet was suggested to be a result of its anti-inflammatory properties (Dyer et al., 2017). Studies found the benefits of consuming a MD are due to foods rich in antioxidants, monounsaturated fatty acids, and polyunsaturated fats that are shown to offset inflammatory effects in OA patients (Veronese et al., 2016). Patients adhering to the MD had increased quality of life scores and associated to better patient outcomes when compared to OA patients following a western diet (Dyer et al., 2017). Literature supports the role of plant-based diets for its anti-inflammatory benefit on reducing inflammation and inducing weight loss to prevent obesity (Dean & Hansen, 2012).

Weaknesses and Limitations

Despite increased research exploring the relationship between inflammation and OA, there are some weaknesses against study findings. Many studies that involved cross-sectional epidemiological studies to evaluate associations did not confirm a specific type of diet on OA symptom improvement. The presence of various confounding factors may interfere with the outcome measure. For example, socioeconomic or demographic characteristics such as income, race, or physical activity can contribute to bias of findings. Although there continues to be growing acknowledgement emphasizing the importance of nutrition on OA, there are limited studies in North America that assessed improvement in long-term health and quality of life with the MD (Veronese et al., 2016)

Poor nutrition is often a significant component for adversely influencing many health conditions commonly encountered in physical therapist practice (Phadke, 2017). While proper

diet and nutrition is recommended in the long-term management of OA patients, PTs do not regularly include dietary assessment or health promotion interventions in the plan of care for OA patients (APTA, 2019). Jurisdictional scope of practice does not mandate PTs to screen or provide diet information to patients despite its support on nutrition (APTA, 2019). Additionally, practice laws vary by state regarding nutrition counseling within PT scope of practice (APTA, 2019).

METHODOLOGY

Design

A one-group pre-test/post-test quantitative design was used to examine whether following the educational intervention, there is an increase in PT awareness of benefits associated with the Mediterranean diet-based eating patterns and an inclination to endorse dietary counseling or dietician referrals in practice. The pre-test and post-test research design provides a useful comparison tool to evaluate the effect of a treatment (Polit & Beck, 2012). Participants served as their own comparison group to minimize confounding issues and threats to internal validity (Newhouse, Dearholt, Poe, Pugh, & White, 2007). Pre-intervention and post-intervention surveys were administered to assess the therapists' current practices for OA patients, perceptions and interests in nutrition counseling, and knowledge in nutrition in regards to OA. Both surveys are structured into two sections with 18 multiple-choice questions in the pre-intervention questionnaire and 14 questions in the post-intervention questionnaire. The first section of the pre-intervention survey was comprised of 12 questions to assess the participants' perceptions and interests (Appendix D). Both of the second sections were comprised of six questions to assess physical therapist providers' knowledge about nutrition and inflammation relevant to OA. The

questionnaire for the post-intervention survey contained a different first section (Appendix E). The first section was comprised of eight questions to assess effectiveness of the intervention and likelihood of the intervention on changing the provider's practice behavior to include nutrition counseling or dietician referrals for OA patients.

Participants

Participants recruited in this quantitative QI initiative project are PTs at CORE Physical Therapy (CORE) outpatient clinics. Additional staff members at CORE consists of PT aides, PT doctoral students, massage therapists, occupational therapists, and sports medicine providers (CORE Physical Therapy, 2019). PTs are allied health care professionals who have formal training and education in kinesiology to assess and treat impairments in physical functioning and mobility. These PT practitioners are of special interest in this project given their frequency working with OA patients, direct involvement in chronic symptom management, and use of conservative approaches. There are approximately 10 PTs employed at CORE clinics (CORE Physical Therapy, 2019). Practitioners at this organization specialize in rehabilitation care for sports injuries, orthopedic conditions, musculoskeletal disorders, mobility impairments, fitness and wellness, and degenerative joint diseases (CORE Physical Therapy, 2019). Convenience sampling was utilized to recruit participants. With the help of CORE clinical supervisor, email announcements that provided a brief description of the DNP project were sent to staff and requested for voluntary participation.

Criteria for inclusion in this DNP project included: a) licensed physical therapists in the state of California; b) current employment at CORE; and c) therapists involved in the direct care of OA patients.

Setting

The project was conducted at CORE Physical Therapy in Fullerton and Orange, California. CORE is a private organization that serves the Orange County regions of southern California. CORE specializes in rehabilitation care, pain management, occupational medicine, sports medicine, and wellness (CORE Physical Therapy, 2019). The Fullerton clinic location is the main CORE facility. Approximately 60-70% of ambulatory patients at CORE facilities are managed for OA symptoms (Myers, J., personal communication, November 6, 2019). Site authorization from the organization's clinical supervisor was obtained prior to the implementation of the educational intervention at the facility (Appendix C).

Intervention

Participants was introduced with an educational brochure (Appendix F), "It's Your MOVE" that the principal investigator (PI) developed based on recommendations by the CDC (2019), American Heart Association (AHA) (AHA, 2018), and Arthritis Foundation (AF) (AF, 2015) in addition to other supportive findings from evidence-based studies (Appendix A). The brochure referenced scientific reviews from published studies to support the role of anti-inflammatory properties found in foods consumed in a MD, and the negative impact of pro-inflammatory factors on OA symptoms (Morales-Ivorra, Romera-Baures, Roman-Vinas, & Serra-Majem, 2018). A dietary approach highlighting the MD was proposed for PTs to identify concerning dietary behaviors and nutritional status in OA patients. Information on the brochure supports provider practice and facilitates appropriate nutrition counseling. The handout emphasized MD eating behaviors by encouraging a greater consumption of specified foods found to be rich in monounsaturated fatty acids and polyphenols (Morales-Ivorra et al., 2018). The

educational session was a 15-minute in-person classroom presentation that discussed the brochure and reviewed elements of inflammatory mechanisms contributing to OA. Key points discussed during the presentation included the following:

- 1) What is OA
- 2) OA statistics
- 3) OA non-modifiable risk factors and modifiable risk factors
- 4) Role of obesity and inflammation
- 5) Role of diet and nutrition
- 6) Components of the MD and anti-inflammatory foods
- 7) MOVE approach to change dietary habits

MOVE Approach

The MOVE (Managing Osteoarthritis via Eating) approach was developed for PTs as an informal guide to understanding the influence of nutrition on OA in regards to inflammation and the MD. The brochure is user-friendly highlighting essential information regarding OA and nutrition. The acronym was created with the intention of its use as a memorable phrase to convey the message of need for behavior change and to promote proper nutrition in the management of OA. The educational information on the brochure is comprehensible and easy to understand, thus encouraging PTs to reference the guide when addressing nutrition with OA patients. The goal of utilizing the brochure was to support PTs in practice by providing proper nutritional education based on a Mediterranean-style dietary pattern.

Tools and Process for Data Collection

Data collection involved coded paper questionnaires developed by the PI. In addition, the PI developed the “It’s Your MOVE” brochure, which was utilized as an informational tool for the educational presentation. The pre-test questionnaire (Appendix D) and post-test questionnaire (Appendix E) were distributed to participants prior to the intervention. Participants were instructed to first complete the pre-test prior to the educational seminar then complete the post-test immediately following the presentation.

The first section of the pre-test questionnaire contained Likert scale questions to assess the PTs’ current practices, nutritional awareness, and incorporation of dietary counseling when treating OA patients. The first section of the post-test questionnaire also comprised of Likert scale questions with the purpose of evaluating the post-intervention likelihood for dietician referrals, delivery of nutrition counseling, and changing PT practice behaviors. The second sections of both questionnaires were identical, which included multiple-choice questions to evaluate the outcome of interest and efficacy of intervention (Dimitrov & Rumrill, 2003). Likert scale is an approach to obtain a better understanding of participants’ opinion on a subject using scores associated to a range of agreements to disagreements (Polit & Beck, 2012).

Estimated time for completion of each questionnaire was approximately five minutes. Survey responses were completely anonymous and was not associated with any personal identifying information. The questionnaires were coded with letters and numbers in order to pair the respondent’s pre-test with post-test results. Data collection occurred at two locations to increase participation attendance in the educational presentation. After completion of the education intervention, data from the pre-test and post-test surveys were gathered collectively

with the help of a random participant in attendance, and was then given to the PI enclosed in an envelope. Data results were transferred electronically into an Excel spreadsheet to be stored.

Statistical Analysis

A one-group pre-test/post-test design was utilized for this QI initiative. The study question was addressed by analyzing sample characteristics using descriptive statistics. Utilizing descriptive analysis allows data variables to be summarized and presented numerically with graphic presentations, cross tables, and bar graphs (Spriestersbach, Röhrig, du Prel, Gerhold-Ay, & Blettner, 2009). Data was presented as mean score for quantitative measures and presented as frequency and percentages for discrete variables. Differences between pre-test and post-test data were assessed using percentage change to evaluate the effect of the intervention and to observe for any significant changes from the participants' baseline variables. Bar graphs were utilized to illustrate the frequency of distribution and provide a visual interpretation of significant differences between the pre-test and post-test results (Polit & Beck, 2012).

Outcome Measures

Answering the clinical question and addressing the components of the theoretical framework included the following outcome measures:

- 1.) Perceptions on nutrition relating to OA symptoms
- 2.) Evaluation of the educational intervention
- 3.) Evaluation of brochure
- 4.) Perceptions on use of nutrition counseling to improve patient outcomes
- 5.) Improvement in knowledge score
- 6.) Intention to incorporate nutrition counseling and dietician referrals in current practice

Ethical Considerations

Ethical considerations were maintained during the conduct of this quality improvement initiative involving health care provider participation. The three core principles that guided the development and implementation of this DNP project included respect for persons, beneficence, and justice (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Approval from University of Arizona Institutional Review Board (IRB) was obtained prior to initiation of project (Appendix B). University of Arizona IRB determination granted permission to proceed with the project with no oversight requirements due to the absence of human subjects and patient involvement; there were no additional requirements requested.

Respect for Persons

Participation in this DNP quality initiative were on a voluntary basis (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Participants were given the opportunity to contribute to the project on their own terms and refusal to participate did not incur any penalty (Polit & Beck, 2012). No incentives were offered for partaking in the project and participants were permitted to withdraw at any time during the course of the project if they wish to do so (Polit & Beck, 2012). All participants had the right to full disclosure (Appendix G). No identifiable information was collected to protect privacy and confidentiality (Polit & Beck, 2012). Risks were minimized given the anonymous design of the survey. Collecting unidentifiable data from the participants was achieved using unique identification letters and numbers. Identification numbers were assigned to each set of questionnaires for comparing before and after intervention data (Alessandri, Zuffiano, &

Perinelli, 2017). Pairing a participant's pre-test with post-test data provided a methodological approach to analyze intervention effects on outcome measures (Alessandri et al., 2017).

Beneficence

Participants in this quality initiative project involved medical providers rather than patients. Participants were required to answer pre- and post-survey questions. Subjects were not exposed to any type of harm including physical injury or emotional stress (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Project participants were protected from harm involving sensitive questioning and in-depth evaluation of personal topics (Polit & Beck, 2012). Response to questions were only relevant to the study. All efforts were made to ensure the volunteers were not subjected to unnecessary discomfort in their participation (Polit & Beck, 2012). A disclosure form was provided to reassure that information provided by participants would not be used against them. IRB approval from the University of Arizona College of Nursing (Appendix B) and approval from CORE (Appendix C) was obtained before initiation of participant recruitment and collection of data. The DNP project was granted approval to proceed data collection considering the minimal risks of the quality initiative and lack of patient involvement.

Justice

Participants were treated equally and respectfully (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). All data from the paper surveys was transferred electronically into a password-protected computer. Participants were entitled to full disclosure before participating in the quality improvement project. Risks and benefits of providing responses to survey questions was stated in the disclosure form (Appendix

G). Although minimal risks were anticipated for the project, potential risks include self-disclosure of personal practices, loss of status, and loss of time. Potential benefits included increased awareness of improved patient practices, improved patient satisfaction through changes in care, satisfaction to participate on improving a gap in practice.

RESULTS

Description of Sample Participants

The educational seminar was delivered to participants on a scheduled date at two CORE outpatient clinics located in Fullerton, California and Orange, California. The audience consisted of PTs, PT students, PT aides, and a massage therapist. The length of the in-person presentation was approximately 15 minutes. Five minutes were allotted for each pre-test and post-test questionnaire to provide sufficient time for survey responses. Nine participants attended the presentation at the CORE outpatient clinic in Fullerton, CA. Out of the nine participants; only four were licensed physical therapy providers. The remainder of the audience consisted of a massage therapist, two PT students, and two PT aides. Three participants attended at the Orange, CA location. Participants comprised of two PTs and a PT doctoral student. The PT students are enrolled in a doctoral level physical therapy program, and are completing their clinical internship at CORE facilities. The massage therapist and PT aides, who work under the supervision of a PT provider, are CORE staff and have provided direct care to OA patients. A convenience sample of 12 participants were recruited from the two locations; however, only six participants (N=6) met inclusion criteria and were eligible to be included in the data. Of the eligible participants, half were female (n=3) and half were male (n=3).

Sample Demographics

Demographic data of participants was obtained from the pre-test questionnaire that included gender, age group, education, and years as a practitioner (Table 1). Among the survey respondents, 50% of the PT providers were male (n=3) and 50% were female (n=3). The age group ranging from 20 to 34 years make up 100% of the respondents (n=6). The majority of the participants, comprising 83.3% of the sample, have a doctorate level education (n=5). Only one respondent has a post-graduate degree (n=1). About 33.3% of respondents worked less than one year as a practitioner (n=2) and 66.7% have 1 to 4 years of experience in PT practice (n=4).

TABLE 1. *Demographic characteristics of participants (N=6).*

Characteristics	Sample size (n)	Percent (%)
Gender		
Male	3	50
Female	3	50
Age Group		
20 – 34	6	100
35 – 44	0	0
45 – 54	0	0
55+	0	0
Education Level		
Diploma	0	0
Graduate	0	0
Post-graduate	1	16.7
Doctorate	5	83.3
Years as a Practitioner		
Less than 1 year	2	33.3
1 – 4 years	4	66.7
5 – 10 years	0	0
Greater than 10 years	0	0

Perceptions, Current Practices and Knowledge

Assessment of provider perceptions, knowledge in nutrition-related benefits, and current practices with OA patient management are included to address the HBM constructs of perceived

susceptibility, severity, and benefits. Five out of the six sample participants (83.3%) agreed to the statement concerning nutrition as an important contributing factor to OA, while only one participant was neutral (Figure 2). Gaining the PTs' perspective on dietary implications of OA provides a better understanding of whether they will act to participate in the adoption of nutrition education and counseling in practice. Figure 3 depicts the frequency of current PT practice treating OA patients, offering nutrition advice, and making dietician referrals.

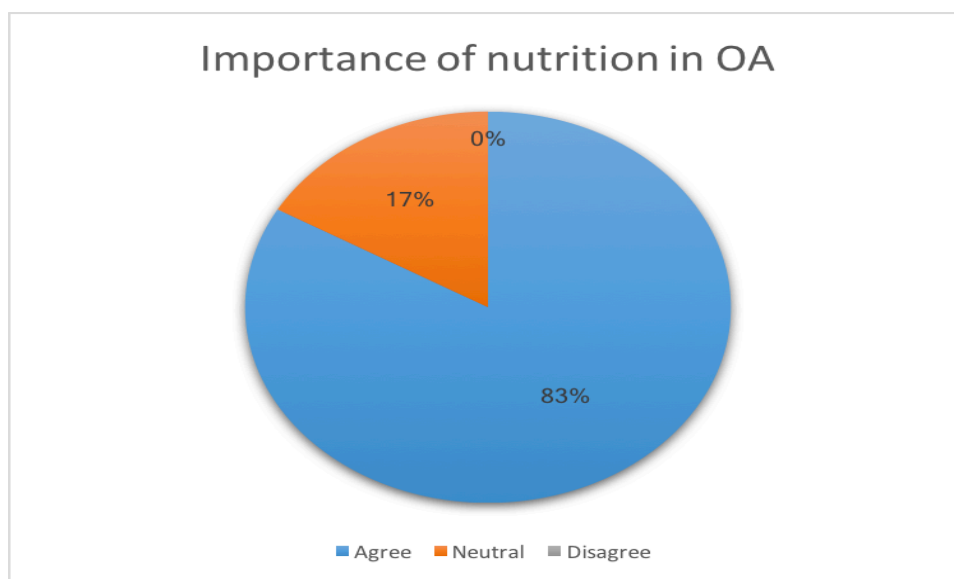


FIGURE 2. Participants' perception of nutrition on osteoarthritis.

Respondents reported a high prevalence of OA patient encounters in their practice with five out of the six subjects stating "always" (83.3%) working with OA patients. One participant reported "often" (17%) encountering OA patients and none of the participants answered less frequent encounters. Frequency of delivering nutrition counseling was reported as "never" (33.3%) and "sometimes" (66.7%). Respondents answered "never" (66.7%) and "sometimes" (33.3%) in regards to offering dietician referrals to patients. Results suggest that nutrition counseling and dietitian referrals were uncommon practices in PT practice. Four participants

(66.7%) expressed unfamiliarity with nutrition-related information, while 33.3% of subjects expressed constraints in time were barriers in current practice on providing nutrition counseling. Half of the participants expressed unfamiliarity with nutrition-related information, and were barriers in offering dietician referrals. Interestingly, two subjects (33.3%) stated no limitations or expressed factors affecting dietician referrals (Figure 4). The level of confidence among participants ranged from no experience to a fair amount. Half (50%) of participants reported some comfort with delivering nutrition counseling (Figure 5). Interest level in providing nutrition counseling was evenly split among the six participants. In addition, half (50% of subjects conveyed some interest and 50% were very interested (Figure 6).

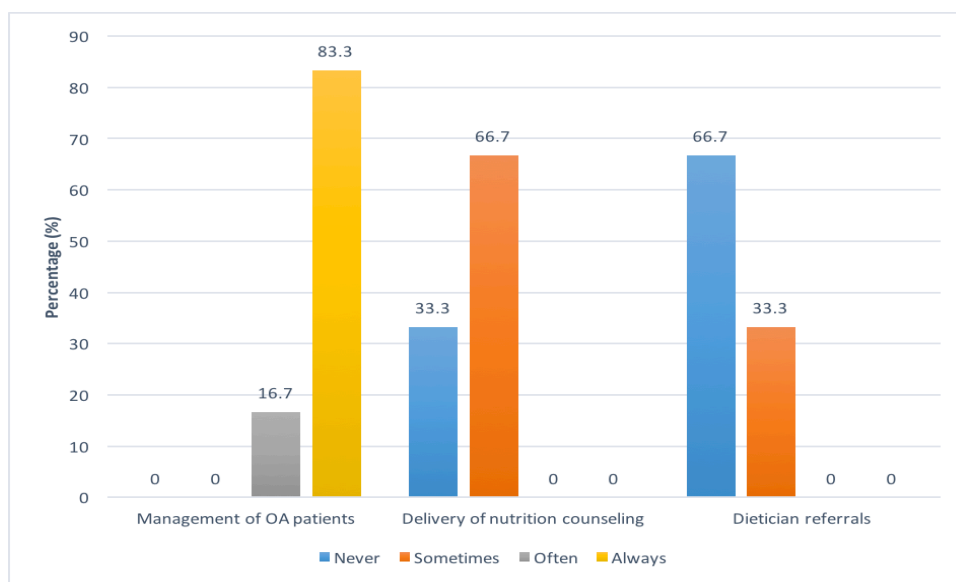


FIGURE 3. Reported frequency of practices by physical therapists.

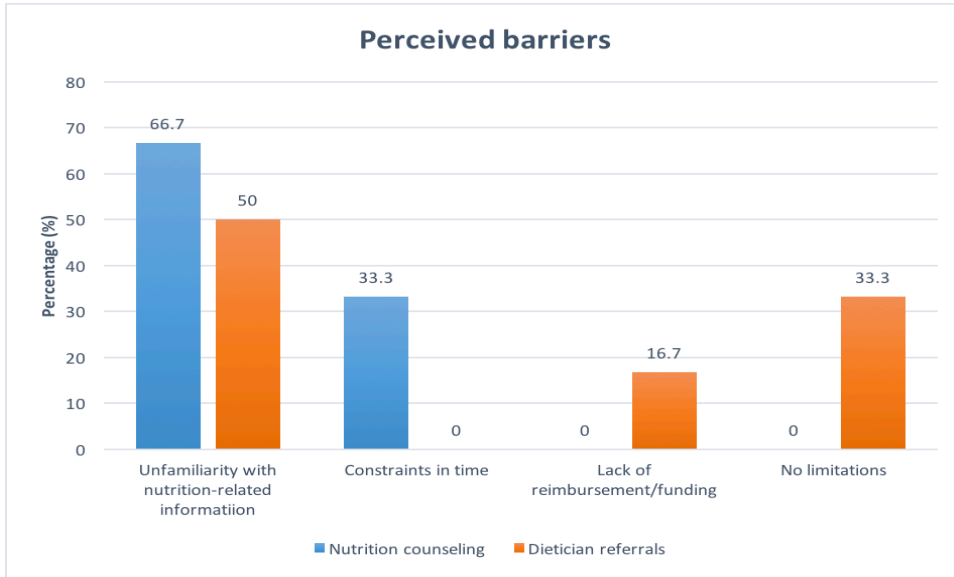


FIGURE 4. Factors affecting participants’ current practice with OA patients.

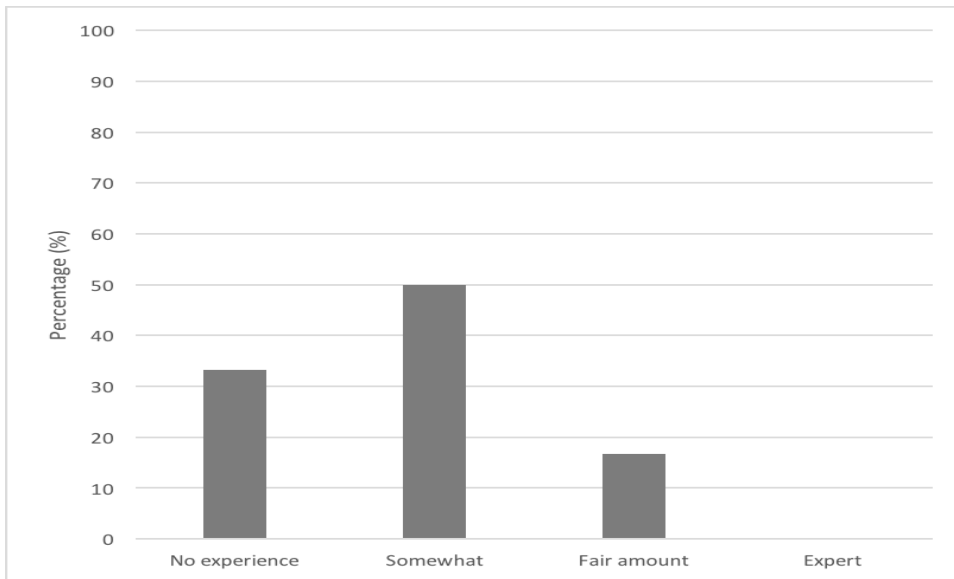


FIGURE 5. Level of comfort in delivering nutrition counseling.

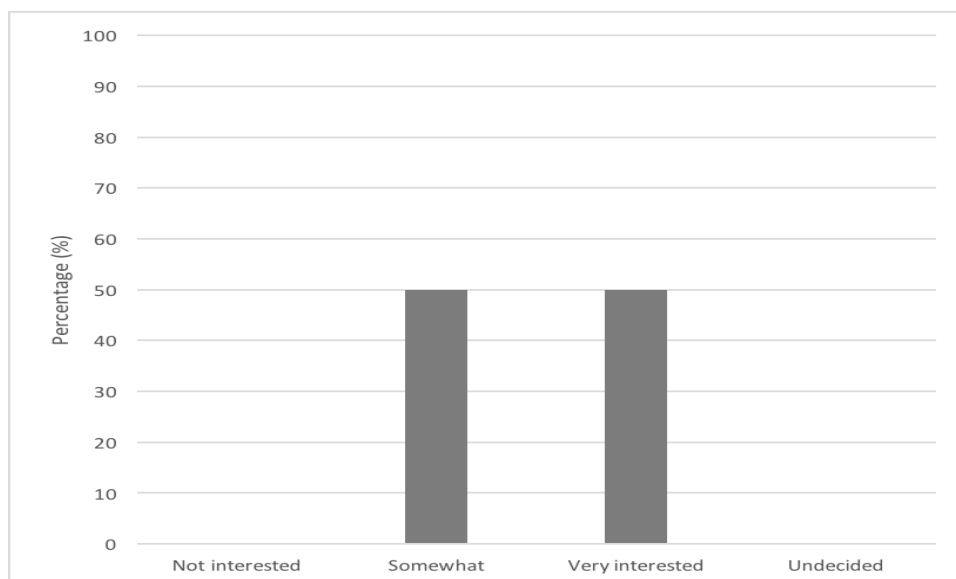


FIGURE 6. Level of interest in providing nutrition counseling for OA patients.

Comparison of Pre-test and Post-test Scores

All six participants completed both the pre-test and post-test questionnaires representing a 100% response rate. There are six multiple-choice questions used to test provider knowledge. One point was assigned for each correct response to a question and scores were calculated out of six points. Given a small sample size, simple analysis of data findings using descriptive statistics was performed. Mean scores were calculated to summarize all of the pre-test and post-test results. Data analysis also included quantifying the lowest score (Min) and the highest score (Max) to determine data range (Spriestersbach et al., 2009). Pre-test mean score was 2.83 (47.2%; range: 2 to 4 correct responses). Mean score for the post-test was '5' (83.3%; range: 3 to 6 correct responses). The percentage change was calculated to analyze improvements between baseline and post-intervention values (Alessandri et al., 2017). The percentage change was 76.7%, which demonstrates the efficacy of the education intervention and its significant impact on participant knowledge. See Table 2 for summarized data of pre-test and post-test scores.

TABLE 2. *Comparison of pre-test and post-test results.*

	Min	Max	Mean
Pre-test	2 (33.3%)	4 (66.7%)	2.83 (47.2%)
Post-test	3 (50%)	6 (100%)	5 (83.3%)
Difference (%Δ)	50%	50%	76.7%

Evaluation of Intervention

Following the intervention, the post-test survey examined the effects of the education session on increasing provider awareness and improving knowledge regarding nutrition and OA. The intervention was reported “somewhat” and “considerably” effective by 66.7% and 33.3% of respondents, respectively. Survey responses on intervention effectiveness of the educational presentation and “It’s Your MOVE” brochure for managing OA patients is shown in Figure 7. Likelihood of current practice change to offer dietician referrals was reported as “unlikely” by 33.3%, “somewhat likely” by 50%, and “absolutely” by 16.7% of respondents. Likelihood of incorporating nutrition counseling in patient care plans for OA patients was reported as “unlikely” by 16.7%, “somewhat likely” by 50%, and “very likely” by 33.3% of participants. In regards to the “It’s Your MOVE” brochure, respondents stated the likelihood of utilizing the tool as “unlikely” by 33.3%, “somewhat likely” by 50%, and “absolutely” by 16.7%. Responses are shown in Figure 8. When asked on whether providing nutrition information in addition to current physical therapy modalities will increase patient self-management of OA symptoms, 33.3% and 66.7% of participants declared “somewhat likely” and “absolutely,” respectively (Figure 9).

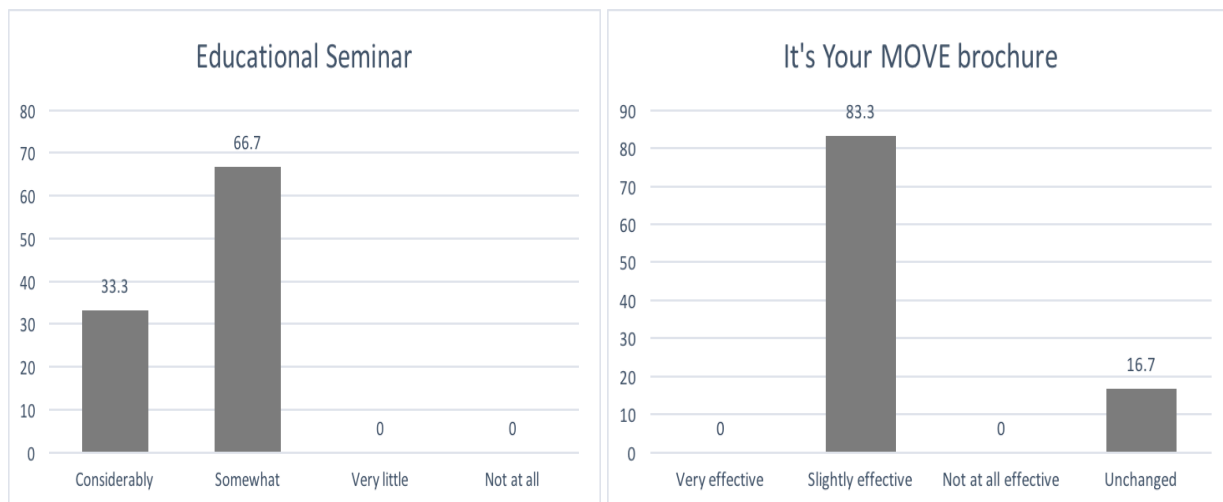


FIGURE 7. Level of effectiveness in intervention.

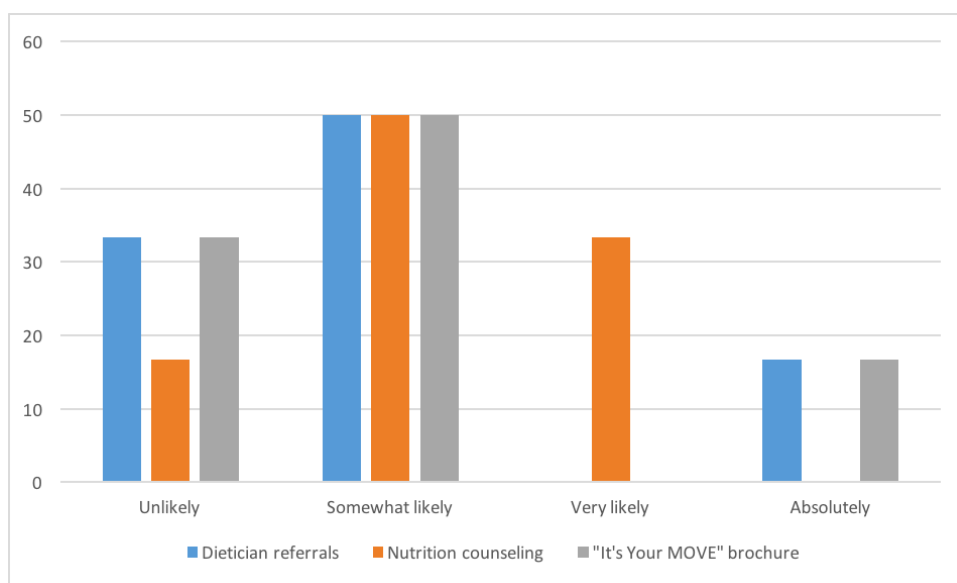


FIGURE 8. Likelihood to incorporate into current practice.

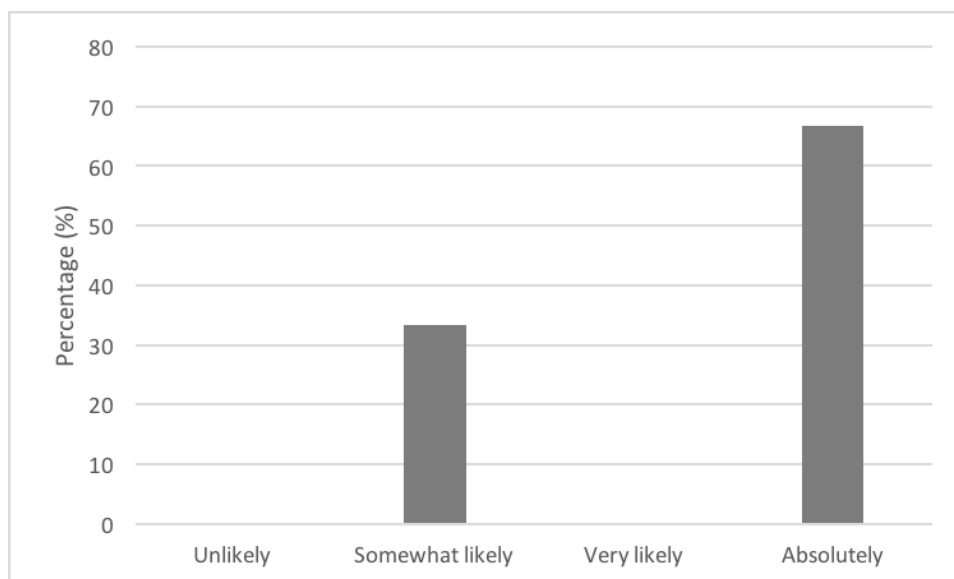


FIGURE 9. Perceptions on the use of nutrition counseling as an approach to improve OA management.

Participant Feedback

The remainder three questions on the post-test questionnaire consisted of open-ended questions to provide an opportunity for participant feedback. Responses provided useful information on areas for project improvements and explanation of answer selections to the close-ended questions (Singer & Couper, 2017).

The first question asked, “Is there something you would like to learn more about in regards to nutrition, inflammation, and osteoarthritis?” Topics provided by participants were alternative anti-inflammatory diets other than the MD, race/ethnicities prone to OA development, diet options tailored to activity level, contact information of providers to refer patients, additional resources to reference the MD, and food list of anti-inflammatory foods. The second question asked for comments on changes that could be made to improve the “It’s Your MOVE” brochure. Common themes of responses were inclusion of sample MD meal plans, inclusion of anti-

inflammatory foods, examples of improper diets, and no changes. The last question asked participants about anticipated barriers or challenges that will affect their intention on providing nutrition counseling or using the brochure in OA patient care plans.

Most participants identified limited PT scope of practice as a major barrier. Participants reported that recommending specific diets to treat a condition is prohibited from their scope of practice contributing to their hesitancy on nutrition counseling. However, participants were aware of the two components in the California PT practice act that permit the practice of providing general nutrition information for the purpose of encouraging healthy eating and lifestyle changes. Other barriers identified were lack of time, unfamiliarity with proper referral sources, and budget constraints with stocking of brochures.

DISCUSSION

OA is a chronic condition that is a leading contributor to disability, pain, and loss of productivity (Teo et al., 2019). There is no known cure for OA and the symptoms are expected to worsen as the disease progresses. Management of OA can be done effectively by modifying behaviors and risk factors associated to disease progression. Prevalence of OA is anticipated to increase significantly due to the aging population and anticipated increase in obesity rates (Teo et al., 2019). The disease burden in OA and its impact on quality of life makes it urgent to identify effective strategies for OA management. Various clinical practice guidelines outline the components of diet and weight loss to complement physical therapy exercises for improving OA symptoms (AAOS, 2013). Although PTs are key providers of conservative management for patients with OA, practice gaps have been identified between OA guidelines and PT practice. In

efforts to address the practice gap, a focus of this project has been placed on supporting PTs with their role in addressing diet and nutrition assessments in OA patients.

This DNP project surveyed the knowledge, perceptions, and current practices of PTs towards management of OA patients. An educational intervention was developed with the intention to increase provider awareness towards the issue between nutrition and OA, educate them on benefits of anti-inflammatory dietary behaviors in the MD, and encourage PTs to play a bigger role in OA management by changing current practices to offer dietician referrals and deliver appropriate nutrition counseling. Considering that PTs are key players in OA patient management, they are well positioned to promote health and wellness by encouraging patients to adopt proper eating habits, manage ideal weight, and engage in daily exercise to reduce OA symptoms.

Change of current PT practice requires recognizing influences that may alter provider perceptions, knowledge, and health behaviors. Inclusion of demographics were used to observe for influences on participant perceptions and attitudes. All participants belonged in the age range of 20 to 34 years, with the vast majority having 1 to 4 years of experience in practice. Considering the number of years in practice, the results revealed the frequency of working with OA patients was high. Patients with OA represent the most common medical condition managed by PTs in the outpatient setting. Our finding was confirmed with supporting data from studies demonstrating the high prevalence of OA due to the alarming rates of obesity and aging population, and its impact on the musculoskeletal system resulting in the need for PT management (Teo et al., 2019). Despite participants reporting a high frequency of managing OA

patients and a moderate amount of interest on nutrition, our findings show that almost all participants provide little to no nutrition counseling or dietician referrals.

Assessment of the participants' baseline attitudes and perceptions toward the influence of nutrition on OA was found to be positive. An agreement about the importance of nutrition on OA was observed among PTs regardless of their various range of comfort levels in providing basic nutrition information for health promotion. Previous research suggested various barriers exist to incorporating health promotion and wellness in PT practice (Benzner, 2015). Common barriers to delivering nutrition counseling and offering dietician referrals were identified lack of knowledge, lack of time, lack of reimbursement, limited counseling skills, and limited scope of practice. Many of these findings are consistent with the study by Benzner (2015) that examined on barriers in PT health promotion practices.

Demographic data revealed high level of degree qualifications among all participants. The findings reflect the advanced education levels possessed by the participants and the rigorous academic training they have received in order to obtain licensure to practice as a PT. The advanced level degrees among the participants indicate their competency to provide basic nutrition information and dietary counseling specifically to encourage weight loss (Morris, Kitchin, & Clark, 2009). Although our findings show that PTs have the qualifications to screen and address nutrition issues, the uncertainty surrounding their scope of practice with nutrition care was reported as one of the major barriers. Interestingly, there was a lack of emphasis on dietician referrals regardless of the participants' moderate amount of interest in nutrition. Barriers to initiating dietician referrals included lack of reimbursement and lack of information

resources for dietician providers. Possibly, due to practice barriers, many PTs do not address the component of nutrition even for the general purpose of promoting health and wellbeing.

The mean knowledge score of the participants prior to the intervention was low (mean score= 2.83/6). Low scores among the PTs were anticipated considering the MD involves a specific dietary recommendation. The participants were most knowledgeable on the statement regarding the impact of inflammation contributing to OA. On the other hand, participants were least knowledgeable on the effects of obesity on OA and the components of the MD. The mean knowledge score increased significantly after the intervention (mean score=5/6) with half of the total participants answering all questions correctly. The results demonstrated a 76.7% improvement in knowledge after intervention. Additionally, results show that there was even an improvement in the lowest score (50% gain). The significant magnitude of change in score suggests effectiveness of the education intervention on provider knowledge.

The project was successful in meeting the aims to increase provider knowledge regarding nutrition and OA. The improvement in knowledge is found to be a result of the educational presentation. Findings revealed that the “It’s Your MOVE” brochure was only slightly effective on changing PT practice with OA patients. These findings were consistent with the reported likelihood of utilizing the tool, which ranged from “unlikely” to “absolutely.” On the other hand, the educational presentation was given a stronger rating of effectiveness. The findings suggest that the education intervention had a stronger influence on PTs’ likelihood to incorporate nutrition counseling into practice. Likelihood for dietician referrals was also influenced by the intervention. Notably, the intervention had a larger impact on influencing participants on the use of an alternative nutrition guide rather than the “It’s Your MOVE” brochure. Given this finding,

changing to the brochure to discuss general nutrition information for health and wellness promotion may be more appropriate to support PT practice. Future quality improvement project endeavors are warranted to include alternative educational materials. In summary, regardless of the intervention efficacy to influence PT practice behavior change, reservations regarding state practice laws impeded the providers' readiness to participate in nutrition promoting actions.

Strengths

There are several strengths in this QI project that should be noted. First, the project demonstrated that delivering an educational intervention and providing education materials are useful tactics to influence PT practice behaviors and broaden clinical perspectives. While PTs are specialists in rehabilitation and symptomatic management of patients with OA, they may not feel equipped in their role to discuss nutrition or to initiate a conversation about weight management. Thus, PTs often overlook the component of nutrition. The feasibility of the educational seminar indicated that this platform had the capability to inform practice and increase provider confidence to address nutrition by offering guidance to screen and role model healthy eating habits with tailored educational materials. A brochure was developed in efforts to reduce barriers for practice change by supporting PTs with an easily accessible resource outlining anti-inflammatory information.

A second strength included the positive impact of the educational intervention on improving knowledge. The significant improvement in knowledge suggests improved perceptions about the interplay between dietary behaviors and obesity on eliciting OA symptoms. Gain in knowledge represents improved provider capability of identifying poor nutrition status and furthermore, strengthened their ability to recognize appropriate situations to

offer dietician referrals. The educational presentation was effective on conveying a message to a sizable amount of participants in a single setting. Other participants in attendance of the presentation included various rehabilitation team members involved in the collaborative efforts of OA management. There was a potential for these team members to find the delivered information engaging and informative.

The high level of acceptability and receptiveness towards the education material suggests that printed informational handouts were an acceptable tool to support PT practice. Ideally, informational handouts should avoid specific dietary advice such as the MD, but rather offer general nutrition information to promote wellness and advocate healthy lifestyles consistent with achieving ideal body weight. Lastly, the emphasis on integrating dietician referrals in PT practice have the potential to improve interprofessional collaboration. Initiating dietician referrals by PTs would create a collaborative working partnership between the two different disciplines to facilitate coordinated approach to patient-centered care.

Limitations

A major limitation to the study was the small sample size. Aggregate results with small sample sizes are not representative of a sample population; therefore, the data cannot be generalized (Etz & Arroyo, 2015). A larger sample would be needed to provide better interpretation of data results and determine whether the effects of the intervention was statistically significant (Etz & Arroyo, 2015). Another limitation was the exclusion of PT doctoral students in the data. The target population in consideration during the planning phase of this QI project was limited to only licensed PT providers. Although the PT doctoral students were completing their clinical residency at CORE, they were not formally licensed to practice.

Consideration could be given to include PT students if this QI project were to be replicated in the future. PT students will eventually become licensed providers who treat patients with OA; therefore equipping PT students with nutrition knowledge may be a beneficial strategy to address practice behaviors in OA management prior to the start of their PT practice.

The use of various types of Likert scale questions in the questionnaires were another limitation. There were several questions on the pre-test and post-test that were not consistent for comparison, which made it difficult to analyze. As a result, each question was treated as its own category and illustrated for general knowledge. Furthermore, dietary recommendations addressed on the brochure in regards to the MD made it difficult for PTs to use in practice. Development of educational materials for future use should only comprise basic nutrition information to prevent hindrance from delivering nutrition counseling due to PT practice laws.

Clinical Implications

The findings from his QI project demonstrated a need to engage PTs on taking a more active role in nutrition and health promotion strategies for OA patients. Regardless of limitations in scope of practice surrounding nutrition, PTs in California should take advantage of the two components of state practice law to allow general nutrition counseling in conjunction of rehabilitation treatments. Long-term rehabilitation treatment is needed for the management of OA; therefore, endorsing additional approaches to improve self-management are essential. Nutritional intervention when coupled with physical therapy rehabilitation in OA management is not only a cost effective treatment, but is also non-invasive and beneficial to overall health. Nutrition care is well recognized as an important component in health management regardless of any condition. PTs should be encouraged to seek out opportunities to build essential

competencies in nutrition so they can effectively screen for dietary concerns or recognize need to consult with dietitians for their patients. Perhaps endorsing continuing education courses that focus on nutrition may be beneficial.

In order for PTs to integrate the entirety of nutrition care within PT practice, changes to local and federal PT practice acts will be required. Promotion of health and wellness poses a great challenge when providers are limited to provide nutrition recommendations. PTs are already well qualified to address issues regarding nutrition. They all possess the credentials and advanced level of education to adequately discuss nutrition recommendations. There is a great need to advocate for PT practice change to broaden their scope of practice to include the component of nutrition.

Lastly, the findings from this project serves as a call for action and points out an invaluable opportunity to improve interprofessional collaboration. PTs should be encouraged to consult with dietitians regarding nutrition advice and work collaboratively to optimize intervention strategies in OA management. A collaborative approach to care is not only beneficial for patient outcomes, but also for encouraging the development of interprofessional relationships. Furthermore, collaborating with a dietitian has the added benefit of arming PTs with specialized nutrition competencies and skills to address nutritional concerns among various patient and disease populations. Given the nationwide efforts to transform the current health care system, improving interprofessional collaboration is instrumental in ameliorating fragmented care and in reducing health care costs that is currently burdening the nation.

Conclusion

The project suggested feasibility of an educational intervention on PTs to influence their health behaviors. Knowledge and attitudes are modifiable factors that appear to have a strong influence on behavior change. Despite the increase in provider knowledge from the intervention, the issue of nutrition care within PT scope of practice remains a challenge and complicates ideal strategies for OA patient care. The fact that two components of nutrition law exist in California offers PTs with an invaluable opportunity to identify nutrition concerns affecting health. Unfortunately, PTs have been discouraged from incorporating nutrition into practice because of various barriers not limiting to restrictions in time or lack of knowledge. Methods to assist PTs in overcoming barriers in practice are warranted if this project were to be repeated in the future. Some strategies to consider include developing a generalized nutrition brochure, offering providers with continuing education courses that focus on nutrition, initiating organization policy changes concerning general nutrition, and supplying the CORE organization with a referral network to increase dietician collaborations.

The findings from this project will be disseminated within the CORE organization. The summarized findings of this QI project will be presented to the clinical supervisor, a key stakeholder, who in turn will disseminate the information in a monthly email announcement or staff meeting. A discussion can be initiated by CORE stakeholders regarding the organization's stance on nutrition in OA management and possibly collaborate with local dietitians to establish a referral network. Considering this QI project fosters intercollaborative practice, it may also be beneficial to disseminate findings at a future intercollaborative conference when both PT and NP

providers attend. Presenting findings on a poster abstract can potentially raise awareness of the issues discussed and offer an opportunity to improve health care practice.

APPENDIX A:
EVIDENCE APPRAISAL TABLE

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
<p>Carmona-Teres, V., Moix-Queralto, J., Pujol-Ribera, E., Lumillo-Gutierrez, I., Mas, X., & ... Berenguera, A. (2017). Understanding knee osteoarthritis from the patients' perspective: A qualitative study. <i>BMC Musculoskeletal Disorders</i>, 18(225), 1-12. Doi:10.1186/s12891-017-1584-3</p>	<p>Qualitative concepts/phenomenon: Identify the influence of individual experiences, values, beliefs, and perceptions in patients with knee OA on self-management practices</p>	<p>Phenomenology Theoretical framework: Lazarus stress model</p>	<p>N=10 -Participants from 4 different primary health care centers in Barcelona -Recruited between February and April 2015 Inclusion criteria: -Clinical diagnosis of knee OA -Radiographic OA grades 1-3 using Kellgren Lawrence classification</p>	<p>-Face to face semi-structured interviews lasting 30 to 60 mins -Open ended questions with 5 sequence interview guide (impact of knee OA, interaction with health providers, coping strategy, recommendation towards intervention, use of information technology) -Interviews recorded and transcribed -Thematic analysis performed from findings -Triangulation of analysis by 4 researchers</p>	<p>-Results structured in 2 categories: experiences and perceptions of participants and experiences of knee OA using Lazarus model Subcategories emerged from experiences and perceptions of participants: -informants reported pt education from health providers -informants understood benefits from diet and exercise Lazarus model components: -cognitive evaluation: influenced by obligation and guilt -values: influenced by family -emotions: reported anxiety, irritability, sadness -beliefs: aware of weight associated to</p>

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
					<p>pain</p> <ul style="list-style-type: none"> -coping strategies: reduction of psychological distress -social support: community involvement
<p>Dyer, J., Davison, G., Marcora, S., & Mauger, A. (2017). Effect of a Mediterranean type diet on inflammatory and cartilage degradation biomarkers in patients with osteoarthritis. <i>Journal of Nutrient Health and Aging</i>, 21(5), 562-566. Doi:10.1007/s12603-016-0806-y</p>	<p>Quantitative research question/hypothesis: What are the effects of a short-term dietary intervention involving a low inflammatory Mediterranean diet on patients with OA?</p>	<p>Double-blinded randomized controlled trial</p>	<p>N= 99</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> -Adults aged 31-90 years of age -clinical diagnosis of OA -16 week intervention <p>-Two groups randomly assigned:</p> <ul style="list-style-type: none"> -Experimental/ diet group (n=50); females=38, males=11 -Control group (n=49); females=44, males=6 	<p>Data collection:</p> <ul style="list-style-type: none"> -Food frequency questionnaire, -Arthritis Impact Measurement Scale (AIMS2) given at pre-intervention, midpoint, and post-intervention -Primary biomarker for serum cartilage oligomeric matrix protein (sCOMP) -Secondary biomarker for inflammatory cytokines, chemokines, and growth factors 	<ul style="list-style-type: none"> -Dietary intervention resulted in significant difference between the two groups in changing eating behaviors and association with weight loss -No significant correlation between experiment and control groups for OA severity -Significant reduction of inflammatory markers in experimental group -Increase range of motion in diet group
<p>Grygielska, J., Klak, A., Raciborski, F., & Manczak, M. (2017). Nutrition and quality of life referring to physical abilities: A comparative</p>	<p>What is the impact of nutrition on quality of life in patients with rheumatoid arthritis and OA?</p>	<p>Longitudinal</p>	<p>N= 397</p> <p>RA=165, OA=107</p> <ul style="list-style-type: none"> -Participants 60 years of age and older 	<ul style="list-style-type: none"> -Anonymous survey -Closed ended questions using questionnaire to assess in five areas: disease and rheumatological care, 	<ul style="list-style-type: none"> -Significant difference in disability level of patients in RA and OA groups -Both groups agreed that eating impacts RA

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
<p>analysis of a questionnaire study of patients with rheumatoid arthritis and osteoarthritis. <i>Reumatologia</i>, 55(5), 222-229. Doi:https://doi.org/10.5114/reum.2017.71629</p>			<p>-Diagnosis of RA or OA -Treatment with rheumatologist</p>	<p>way of eating, dietary supplements, degree of disability, patient characteristics -Health Assessment Questionnaire (HAQ) to determine level of functional limitations in daily activities and quality of life</p>	<p>and OA health -Higher level of disability in RA group on physical limitation -Significant difference in use of dietary supplement between RA and OA patients -Both groups declared biggest symptom to condition was pain -Subjective health assessment similar in both groups</p>
<p>Han, H., Chang, C., Lee, D., & Lee, J. (2016). Relationship between total fruit and vegetable intake and self-reported knee pain in older adults. <i>Journal of Nutritional Health and Aging</i>, 21(7), 750-758.</p>	<p>What are the effects between fruit and vegetable consumption and self-reported knee pain?</p>	<p>Cross sectional study</p>	<p>N=5768 -Participants recruited from the fifth Korean National Health and Nutrition Examination Survey (KNHANES) from 2010-2011 -Sample included randomly selected individuals >50 years old living in Korea Inclusion criteria: -Diagnosis of OA</p>	<p>-Nutrition and health history questionnaire -International Physical Activity questionnaire -Anthropometric (BMI, weight, height) and radiographic measurements (Kellgren-Lawrence scale) -Numerical rating scale (NRS) for severity of knee pain -24 hour dietary recall for total fruit and</p>	<p>-Significant association between fruit and vegetable consumption and severity of knee pain -Micronutrients (vitamins A, B1, B2, B3, and C) showed no significant relationship with incidence of knee pain -Consumption of >4 servings of fruits and vegetables daily is significantly associated</p>

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
			-Completed a nutritional and knee pain questionnaire -No knee replacement surgery	vegetable consumption	with reduced prevalence of severe knee pain
Mears, M., Tussing-Humphreys, L., Cerwinski, L., Tangney, C., Hughes, &... Gomez-Perez, S. (2018). Associations between alternate healthy eating index-2010, body composition, osteoarthritis severity, and interleukin-6 in older overweight and obese African American females with self-reported osteoarthritis. <i>Nutrients</i> , 11(26), 1-11. Doi:10.3390/nu11010026	Quantitative research question/hypothesis: What is association between diet quality, body composition, serum interleukin-6, and osteoarthritis severity in African American adults?	Cross-sectional analysis observational study design	N=126 Eligibility criteria: African American females, 60 years +, overweight or obese (BMI 25-50kg/m2), physical activity less than 150 min per week, diagnosed with OA	Data collection included data collected in parent study (Fit & Strong! Plus comparative effectiveness trial), alternate Healthy Eating Index (AHEI) for dietary quality, body DXA scan for body weight and composition, WOMAC questionnaire for OA severity, IL-6 serum assay, food frequency questionnaire.	-Diet quality and OA severity are significant predictors of systemic inflammation -Diet quality and inflammation have inverse correlations -No significant correlation between diet quality and IL-6 -Significant relationship between diet quality, body composition, and OA severity on inflammation -Adherence to healthy diet may positively impact inflammation (reduction of IL-6 levels)
Strath, L., Jones, C., George, A., Lukens, S., Morrison, S., &...Sorge,	Research question: What are the effects of a low carbohydrate versus	Randomized controlled trial	N=21 -females=12, males= 9	Outcome measures: -body weight, BMI, fat mass using body	-Significant reduction in weight and BMI in low carb and low fat groups

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
<p>R. (2019). The effect of low-carbohydrate and low-fat diets on pain in individuals with knee osteoarthritis. <i>Pain Medicine</i>, 0(0), 1-11. Doi:10.1093/pm/pnz022</p>	<p>a low fat diet on the reduction of knee OA?</p> <p>Hypothesis: Reduction of thiobarbituric acid reactive substances (TBARS) that measures oxidative stress will improve functional pain</p>		<p>-Adults ages 65 and 75 years -Clinical diagnosis of knee OA -Recruited from research databases and community advertisements</p> <p>Inclusion criteria: -Ability to read/speak English -Have no preexisting metabolic conditions -Currently not on prescribed diet -No history of joint replacement, eating disorders, difficulty chewing/swallowing</p> <p>Randomization of participants to three groups: -Experimental groups followed low carbohydrate or low fat diet -Control group had no restrictions on diet</p>	<p>composition analyzer -waist circumferences and height</p> <p>Data collection performed every 3 weeks for total of 12 weeks: -Self recorded food log, blood pressure, heart rate, temp, weight loss/gain, symptoms -Functional pain testing with Brief Pain Inventory for severity of pain -Knee Injury and Osteoarthritis Outcome Score questionnaire for self-reported problems and symptoms for OA -Blood serum analysis at baseline, 6 weeks, and 12 weeks</p>	<p>-Significant improvement in pain, quality of life, pain intensity, TBARS, and leptin levels from functional testing in low carb group -No significant reduction in low fat or control groups -Relationship between change in TBARS and pain intensity</p>

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
<p>Vergis, S., Schiffer, L., White, T., McLeod, A., Khudeira, N., &... Tussing-Humphreys, L. (2018). Diet quality and nutrient intake of urban overweight and obese primarily African American older adults with osteoarthritis. <i>Nutrients</i>, 10(485), 1-16. Doi:10.3390/nu10040485</p>	<p>What is the association between diet quality and nutrient intake and self-reported OA?</p> <p>What is the association between sociodemographic and health-related factors with diet quality?</p>	Cross sectional study	<p>N= 413</p> <p>-Participants recruited from Fit & Strong! Plus comparative effectiveness trial</p> <p>-Recruited from advertisements and presentations at community facilities and senior centers</p> <p>Inclusion criteria: female African Americans, diagnosis of lower extremity OA, symptoms of OA pain in past 6 months, no current participation in physical activity or weight management program, less than 150 mins of physical activity weekly, BMI 25-50kg/m², 60 years or older</p>	<p>-Dietary intake using Block 2005 food frequency questionnaire</p> <p>-HEI-2010 to measure diet quality</p> <p>-Sociodemographic characteristics</p> <p>-Anthropometric measures</p> <p>-OA severity using WOMAC</p>	<p>-Significant differences in HEI-2010</p> <p>-Significant differences between age, BMI, and WOMAC</p> <p>-Findings of mean intake of fiber, calcium, and vitamin D were lower than daily recommendations</p>
<p>Veronese, N., Koyanagi, A., Stubbs, B., Cooper, C. Guglielmi, G.</p>	<p>Quantitative research question/hypothesis: Does the adherence to</p>	Longitudinal cohort study	<p>N=4330</p> <p>-participants from OA</p>	<p>-Collection of data obtained from follow-up period of 4 years</p>	<p>-Adherence to Mediterranean diet associated with</p>

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
&...Maggi, S. (2018). Mediterranean diet and knee osteoarthritis outcomes: A longitudinal cohort study. <i>Clinical Nutrition</i> , 1-5. https://doi.org/10.1016/j.clnu.2018.11.032	Mediterranean diet associated with lower risk of radiographic OA (ROA), radiographic symptomatic knee OA (SxOA), and worsening pain?		initiative database were recruited from 4 clinical sites across the US -females= 2510 (58.0%), males=1820 (42.0%) -mean age 61.1 years Inclusion criteria: -Individuals living in North America -Knee OA with knee pain for 30-day period in past 12 months -high risk of developing knee OA	-Block Brief 2000 food frequency questionnaire foe diet patterns obtained at baseline -Kellgren and Lawrence (KL) grade for knee assessment -WOMAC index for knee pain -Data collection at baseline, 12 months, 24 months, 36 months, and 48 months to assess knee OA outcomes	significantly lower risk of worsening knee pain and symptomatic knee OA -No significance for radiographic knee OA
Veronese, N., Stubbs, B., Noale, M., Solmi, M., Luchini, C., & Maggi, S. (2016). Adherence to the Mediterranean diet is associated with better quality of life: Data from the osteoarthritis initiative. <i>American Journal of Clinical Nutrition</i> , 104(5), 1403-1409.	Is a higher adherence to a Mediterranean diet associated with better quality of life in OA patients?	Cross-sectional longitudinal study	N=4470 -participants from OA initiative database were recruited from 4 clinical sites across the US from February 2004 and May 2006 -men= 1865, female=2605 Inclusion criteria: -North American adults	Data collection: -Block Brief 2000 food frequency questionnaire for dietary pattern -Mediterranean diet score to evaluate adherence to Mediterranean diet and consumption Outcome measures: -Short-form Health Outcome Survey to	- Higher adherence to Mediterranean diet scores significantly associated with higher quality of life -Significantly lower WOMAC scores in participants with higher adherence to Mediterranean diet -No significant association between adherence to

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
https://doi.org/10.3945/ajcn.116.136390			with high risk for knee OA diagnosed for knee OA -Reported knee pain in 30day period in past 12 months -Risk factors for developing knee OA	assess quality of life -WOMAC to assess OA severity and pain	Mediterranean diet and WOMAC scores
Yoshimura, N., Muraki, S. Oka, H., Tanaka, S., Kawaguchi, H., &...Akune, T. (2012). Accumulation of metabolic risk factors such as overweight, hypertension, dyslipidaemia, and impaired glucose tolerance raises the risk of occurrence and progression of knee osteoarthritis: A 3-year follow-up of the ROAD study. <i>Osteoarthritis and Cartilage</i> , 20, 1217-1226. http://dx.doi.org/10.1016/j.joca.2012.06.006	What is the association between incidence and progression of radiographic knee OA and metabolic syndrome among men and women?	Prospective cohort study	N= 1690 -Subjects recruited from 2005-2007 ROAD study from Japan resident registration database -men=596, women=1094 -Sample from various residential characteristics from urban, mountainous, coastal regions	-Data collection at baseline and 3 year follow up Baseline data collection: -questionnaire assessing occupation, smoking status, alcohol consumption, physical activity, medical hx, medication -Anthropometric measurements (BMI, BP, height, weight) -Radiographic exam of knees -Blood sample: A1c, lipid profile 3 year follow up data collection:	-251 out of 1690 baseline participants dropped out of follow-up study -remaining sample n=1384 -Knee OA incidence and progression significantly increased with age -Prevalence of knee OA in baseline participants was 46.8% -BMI, BP, A1c and HDL cholesterol levels significantly associated with knee OA occurrence -Metabolic syndrome significantly associated with knee OA

Author/Article	Qualitative: Concepts or phenomena Quantitative: Key variables Hypothesis Research question	Design	Sample (N)	Data Collection (Instrument/Tools)	Findings
				-Same measurements from baseline -Kellgren-Lawrence grading scale for OA severity.	

APPENDIX B:
THE UNIVERSITY OF ARIZONA INSTITUTIONAL REVIEW BOARD APPROVAL
LETTER


 Human Subjects
 Protection Program

 1618 E. Helen St.
 P.O.Box 245137
 Tucson, AZ 85724-5137
 Tel: (520) 626-6721
<http://rgw.arizona.edu/compliance/home>

Date: October 28, 2019

Principal Investigator: Lisa Shuk Lam

Protocol Number: 1910094453

Protocol Title: An Educational Intervention for Physical Therapists to Promote Dietary Counseling in Patients with Osteoarthritis

Determination: Human Subjects Review not Required

Documents Reviewed Concurrently:
HSPP Forms/Correspondence: *determination_v2019-08-15.pdf*

Regulatory Determinations/Comments:

- Not Human Subjects Research as defined by 45 CFR 46.102(e): as presented, the activities described above do not meet the definition of research involving human subjects as cited in the regulations issued by the U.S. Department of Health and Human Services which state that "Human subject means a living individual about whom an investigator (whether professional or student) conducting research: (i) Obtains information or biospecimens through intervention or interaction with the individual, and uses, studies, or analyzes the information or biospecimens; or (ii) Obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens. "

The project listed above does not require oversight by the University of Arizona.

If the nature of the project changes, submit a new determination form to the Human Subjects Protection Program (HSPP) for reassessment. Changes include addition of research with children, specimen collection, participant observation, prospective collection of data when the study was previously retrospective in nature, and broadening the scope or nature of the study activity. Please contact the HSPP to consult on whether the proposed changes need further review.

The University of Arizona maintains a Federalwide Assurance with the Office for Human Research Protections (FWA #00004218).

APPENDIX C:

CORE PHYSICAL THERAPY INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



October 1, 2019

University of Arizona Institutional Review Board
 c/o Office of Human Subjects
 1618 E Helen St
 Tucson, AZ 85721

Please note that Ms. Lisa Lam, UA Doctor of Nursing Practice student, has the permission of Core Physical Therapy allowing her to conduct a quality improvement project entitled, "An Educational Intervention for Physical Therapists to Promote Dietary Counseling in Patients with Osteoarthritis" at our facility.

Ms. Lam will conduct a survey of our health care providers. She will recruit 5+ of our physical therapists, conduct a verbal presentation, and distribute materials for data collection. We understand that the project will include brochures, pre-tests, and post-tests. Individuals' participation will be voluntary and at their own discretion.

We reserve the right to withdraw from the study at any time if our circumstances change. I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the DNP team without permission from the University of Arizona IRB.

Ms. Lam has agreed to provide to my office a copy of the University of Arizona IRB-approved, consent document before she recruits participants. She will also will provide a copy of any aggregate results.

If there are any questions, please contact my office.

Signed,

Jonathon Myers, PT, DPT, OCS

Clinical Supervisor - Fullerton, Director of Clinical Education

CORE Physical Therapy

jmyers@corept.net

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ORANGE

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 fx. 951.587.8405

APPENDIX D:
OSTEOARTHRITIS PRE-TEST

Osteoarthritis Pre-test

Section 1:

1. What is your gender?

- a. Male
- b. Female
- c. I do not wish to identify

2. What is your age group?

- a. 20 – 34
- b. 35 – 44
- c. 45 – 54
- d. 55 & above

3. What is your highest degree qualification?

- a. Diploma
- b. Graduate degree
- c. Post-graduate degree
- e. Doctoral degree

4. How many years have you been in practice?

- a. Less than 1 year
- b. 1-4 years
- c. 5-10 years
- d. Greater than 10 years

5. How often do you work with patients with osteoarthritis?

- a. Never
- b. Sometimes
- c. Often
- d. Always

6. How often do you include patient education on diet and/or weight loss in your care plan for overweight patients?

- a. Never
- b. Sometimes
- c. Often
- d. Always

7. How often do you refer patients with osteoarthritis to dieticians for nutritional counseling?

- a. Never
- b. Sometimes
- c. Often
- d. Always

8. Nutrition is an important aspect contributing to osteoarthritis symptoms.

- a. Agree
- b. Neutral
- c. Disagree

9. Barriers in delivering patient education on diet and nutrition are due to:

- a. Unfamiliarity with nutrition-related information
- b. Constraints in time
- c. Lack of reimbursement and/or funding
- d. No limitations

10. Barriers in providing patient referrals to a dietician are due to:

- a. Unfamiliarity with nutrition-related information
- b. Constraints in time
- c. Lack of reimbursement and/or funding
- d. No limitations

11. How would you describe your level of confidence in providing nutrition information for patients?

- a. No experience
- b. Somewhat
- c. Fair amount
- d. Expert

12. How would you describe your level of interest in diet and nutrition for OA patients?

- a. Not interested
- b. Somewhat interested
- c. Very interested
- d. Undecided

Section 2:

1. Risk factors associated to the development of osteoarthritis are all of the following EXCEPT:

- a. Aging
- b. Exercise
- c. Gender
- d. Diet
- e. Body weight

2. Which of the following is categorized as a proinflammatory diet?

- a. DASH diet
- b. Mediterranean diet
- c. Ketogenic diet
- d. Plant-based diet

3. Example of foods in a proinflammatory diet are all of the following EXCEPT:

- a. Ribeye steak
- b. Margarine spread
- c. Pinto beans
- d. Cheddar cheese

4. Systemic inflammation has little impact on worsening osteoarthritis.

- a. True
- b. False

5. What is the effect of obesity on osteoarthritis? (Select all that apply):

- a. Over-loading of joints
- b. Lower distribution of lean body mass
- c. Calcium deficiencies
- d. Metabolic dysregulation inducing inflammation

6. What is the Mediterranean diet rich in?

- a. Hydrogenated oils
- b. Saturated fats
- c. Monounsaturated fatty acids
- d. Bisphenols

APPENDIX E:
OSTEOARTHRITIS POST-TEST

Osteoarthritis Post-test

1. How has the educational intervention improve your knowledge in nutrition contributing to inflammatory OA?

- a. Not at all
- b. Very little
- c. Somewhat
- d. Considerably

2. How useful did you find the “It’s Your MOVE” brochure for your practice or your forthcoming treatment plans for OA?

- a. Very effective
- b. Slightly effective
- c. Not at all effective
- d. Unchanged

3. Do you plan on referring OA patients to a dietician following the intervention?

- a. Unlikely
- b. Somewhat likely
- c. Very likely
- d. Absolutely

4. Do you plan on including dietary education information in your patient care plans for OA?

- a. Unlikely
- b. Somewhat likely
- c. Very likely
- d. Absolutely

5. Do you plan on utilizing the “It’s Your MOVE” brochure as an informational handout in your patient care plans for OA?

- a. Unlikely
- b. Somewhat likely
- c. Very likely
- d. Absolutely

6. Compared to current practices with only physical therapy modalities, do you feel that providing nutrition information such as the use of a brochure will improve patient self-management in OA symptoms?

- a. Unlikely
- b. Somewhat likely
- c. Very likely
- d. Absolutely

7. Is there something that you would like to learn more about in regards to nutrition, inflammation, and OA? (Please comment)

8. Are there any changes that could be made to improve the “It’s Your MOVE” brochure? (Please comment)

9. Do you anticipate any barriers or challenges that would affect your ability to provide nutrition counseling and/or use the brochure in your care plan for OA patients? (Please comment)

Section 2: (Answers are in bold)

1. Risk factors associated to the development of osteoarthritis are all of the following EXCEPT:

- a. Aging
- b. Exercise**
- c. Gender
- d. Diet
- e. Body weight

2. Which of the following is categorized as a proinflammatory diet?

- a. DASH diet
- b. Mediterranean diet
- c. Ketogenic diet**
- d. Plant-based diet

3. Example of foods in a proinflammatory diet are all of the following EXCEPT:

- a. Ribeye steak
- b. Margarine spread
- c. Pinto beans**
- d. Cheddar cheese

4. Systemic inflammation has little impact on worsening osteoarthritis.

- a. True
- b. False**

5. What is the effect of obesity on osteoarthritis? (Select all that apply):

- a. Over-loading of joints
- b. Lower distribution of lean body mass
- c. Calcium deficiencies
- d. Metabolic dysregulation inducing inflammation**

6. What is the Mediterranean diet rich in?

- a. Hydrogenated oils
- b. Saturated fatty acids
- c. Monounsaturated fatty acids**
- d. Bisphenols

APPENDIX F:
“IT’S YOUR MOVE” EDUCATIONAL BROCHURE

FACTS:

Osteoarthritis is the leading cause of disability in healthy adults globally. Currently, there is no cure for the disorder.

**Over
30 million**

Americans suffer from osteoarthritis

**Approximately
10%**

adults in United States will be affected by the age of 60

**Reported
1 in 4**

adults with osteoarthritis experience severe pain

REFERENCES

American Heart Association. (2018). Mediterranean diet. Retrieved from <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics/mediterranean-diet>.

Arthritis Foundation. (2015). The ultimate arthritis diet. Retrieved from <https://www.arthritis.org/living-with-arthritis/arthritis-diet/anti-inflammatory/the-arthritis-diet.php>

Bortoluzzi, A., Furini, F., & Scire, C. (2018). Osteoarthritis and its management: Epidemiology, nutritional aspects and environmental factors. *Autoimmunity Reviews*, 17(1), 1097-1104. <https://doi.org/10.1016/j.autrev.2018.08.002>

Centers for Disease Control and Prevention. (2019). Osteoarthritis (OA). Retrieved from <https://www.cdc.gov/arthritis/basics/osteoarthritis.htm>

Ellulu, M., Patimah, I., Khazali, H., Rahmat, A., & Abed, Y. (2016). Obesity and inflammation: The linking mechanism and the complications. *Archives of Medical Science*, 13(4), 851-863. [doi:10.5114/aoms.2016.58928](https://doi.org/10.5114/aoms.2016.58928)

Morales-Ivorra, I., Romera-Baures, M., Roman-Vinas, B., & Serra-Majem, L. (2018). Osteoarthritis and the mediterranean diet: A systematic review. *Nutrients*, 10(8), 1030. [doi:10.3390/nu10081030](https://doi.org/10.3390/nu10081030)

Wang, T., & He, C. (2018). Pro-inflammatory cytokines: The link between obesity and osteoarthritis. *Cytokine and Growth Factor Reviews*, 44, 38-50. <https://doi.org/10.1016/j.cytogfr.2018.10.002>

LISA LAM
UNIVERSITY OF ARIZONA
COLLEGE OF NURSING
DNP PROJECT

RESOURCES

www.cdc.gov/arthritis/index.htm
www.arthritis.org
www.rheumatology.org

**It's Your
MOVE**

Managing Osteoarthritis
Via Eating



**GUIDE TO
UNDERSTANDING
INFLAMMATION AND
OSTEOARTHRITIS**

WHAT IS OSTEOARTHRITIS?

Osteoarthritis (OA) is a common debilitating joint disease. The cartilage that protects the end of bones wear away and breaks down. Common symptoms include joint pain, swelling, and stiffness. Symptoms tend to become worse over time as OA progresses. There are many factors that increases your risk for OA.

RISK FACTORS

NON-MODIFIABLE

Age - chances for developing OA increases with advancing age.

Gender - women are more likely to be affected.

Genetics - certain genes passed down from family members can increase your risk.

MODIFIABLE

Overweight/obesity - excess weight puts more stress on joints while being in a constant state of inflammation damages cartilage.

Dietary habits - a high fat diet contributes to obesity, inflammation, and cartilage destruction.

THE MOVE APPROACH

The Role of Obesity and Inflammation

Having excessive weight places you at a constant state of systemic inflammation. Inflammation is your body's protective response to tissue injury where substances work to restore tissues back to its original condition. Fat tissue is the main source of proinflammatory molecules. These molecules increases the activity of inflammation in the circulatory system. As a result of obesity, high levels of body fat negatively contributes to destruction of joint tissue, cartilage, and bone. Current research support the evidence that OA is considered a metabolic disease rather a disease of aging. Losing weight reduces inflammation and relieves OA symptoms.

The Role of Diet and Nutrition

The standard American diet is characterized by eating food products that are high in saturated fat, sugar, salt, and processed meats, while having a low intake of dietary fiber with fruits and vegetables. Dietary fiber provides numerous health benefits such as reducing the risk for obesity and OA. Even in the absence of obesity, poor diet with saturated fatty acids (SFAs) stimulates the inflammatory process that is involved in OA leading to pain. Eating more fiber rich foods promotes gut health and reduces inflammation. Studies have found a positive correlation between a high fiber diet and decrease in OA symptoms.

Mediterranean Diet

The Mediterranean Diet (MD) is a pattern of eating that is characterized by foods rich in polyphenols and monounsaturated fatty acids (MUFAs). These compounds are associated with having anti-inflammatory properties, thus reducing OA-related inflammation. MD promotes eating foods high in fruits, vegetables, nuts, seeds, and MUFAs. Extra virgin olive oil is the main source of MUFAs, which are good types of fat. Fish, poultry, and dairy products are only recommended in low to moderate amounts. Adopting to a MD has a protective role against OA and found to limit symptoms.

MOVE Objectives

The MOVE (Managing Osteoarthritis Via Eating) approach emphasizes a dietary pattern based on the MD to reduce OA symptoms. Current treatment for OA include weight loss, physical therapy, and medications. Following the MOVE approach provides a safe and non-pharmacological way of reducing inflammation and managing OA pain. Changing dietary habits and adapting to a Mediterranean-style diet can offer overall improvements to quality of life.

APPENDIX G:
DISCLOSURE FORM

Disclosure Statement

Project Title: An Educational Intervention for Physical Therapists to Promote Dietary Counseling in Patients with Osteoarthritis

Principal Investigator: Lisa Lam

My name is Lisa Lam; I am a Doctor of Nursing Practice (DNP) graduate student at the University of Arizona. I am asking you to participate in a quality improvement (QI) project. This QI project will gather data for my project to serve as partial fulfillment of requirements for an advanced degree.

The purpose of this project is to assess the efficacy of an educational intervention implemented on physical therapists (PT) at CORE physical therapy clinics in southern California, through informational handouts to promote dietary counseling and effects of the Mediterranean diet (MD) in patients with osteoarthritis (OA).

If you choose to take part in this project, you will be involved to participate in a 10-15 minute in-person verbal training and a brochure will be provided. After the informational session, you will be asked to complete two questionnaires, which will be distributed to you in person. It will take approximately 5 minutes to complete each survey. There are no foreseeable risks associated with participating in this project and you will receive no immediate benefit from your participation. Survey responses will be anonymous.

If you choose to participate in the project, participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw at any time from the project. In addition, you may skip any question that you choose not to answer. By participating, you do not give up any personal legal rights you may have as a participant in this project.

For questions, concerns, or complaints about the project, you may call Lisa Lam, DNP graduate student at 626-379-6711, lislam@email.arizona.edu.

REFERENCES

- Abaraogu, U., Ogaga, M., Odidika, E., & Frantz, J. (2016). Promotion of healthy nutrition in clinical practice: A cross-sectional survey of practices and barriers among physiotherapists in southeast Nigeria. *Hong Kong Physiotherapy Journal*, 35, 21-29.
- Alessandri, G., Zuffiano, A., & Perinelli, E. (2017). Evaluating intervention programs with a pretest-posttest design: A structural equation modeling approach. *Frontiers in Psychology*, 8, 223. doi:10.3389/fpsyg.2017.00223
- American Academy of Orthopaedic Surgeons. (2013). Treatment of osteoarthritis of the knee: Evidence-based guidelines (2nd ed.). Rosemont, IL: American Academy of Orthopaedic Surgeons.
- Barbour, K., Moss, S., Croft, J., Helmick, C., Theis, K., & ... Wang, Y. (2018). Geographic variations in arthritis prevalence, health-related characteristics, and management – United States, 2015. *MMWR Surveillance Summary*, 67(No. SS-4), 1-28.
- Bezner, J. (2015). Promoting health and wellness: Implications for physical therapist practice. *Physical Therapy*, 95(10), 1433-1444.
- Bliddal, H., Leeds, A., & Christensen, R. (2014). Osteoarthritis, obesity and weight loss: Evidence, hypotheses and horizons – A scoping review. *Obesity Reviews*, 15(7), 578-586. doi:10.1111/obr.12173
- Bortoluzzi, A., Furini, F., & Scire, C. (2018). Osteoarthritis and its management – Epidemiology, nutritional aspects and environmental factors. *Autoimmunity Reviews*, 17(11), 1097-1104. doi:10.1016/j.autrev.2018.06.002
- Botchlett, R. & Wu, C. (2018). Diet composition for the management of obesity and obesity-related disorders. *Journal of Diabetes Mellitus and Metabolic Syndrome*, 3, 10-25.
- Brakke, R., Singh, J., & Sullivan, W. (2012). Physical therapy in persons with osteoarthritis. *The American Academy of Physical Medicine and Rehabilitation*, 4(5S), S53-S58. doi:10.1016/j.pmrj.2012.02.017
- Brennan-Olsen, S., Leech, S., Bowe, S., Kowal, P., Naidoo, N., & ... Mohebbi, M. (2017). Prevalence of arthritis according to age, sex and socioeconomic status in six low and middle income countries: Analysis of data from the World Health Organization study on global AGEing and adults health (SAGE) wave 1. *BMC Musculoskeletal Disorders*, 18(271), 1-12. doi:10.1186/s12891-017-1624-z
- California Laws and Regulations Related to the Practice of Physical Therapy, § 2068 Ch. 1313, Sec. 2 (1980).

- Carmona-Teres, V., Moix-Queralto, J., Pujol-Ribera, E., Lumillo-Gutierrez, I., Mas, X., & ... Berenguera, A. (2017). Understanding knee osteoarthritis from the patients' perspective: A qualitative study. *BMC Musculoskeletal Disorders*, *18*(225), 1-12. doi:10.1186/s12891-017-1584-3
- Centers for Disease Control and Prevention [CDC]. (2019). *Osteoarthritis*. Retrieved from <https://www.cdc.gov/arthritis/basics/osteoarthritis.htm>
- Centers for Disease Control and Prevention [CDC]. (2018). *State-specific 2015 BRFSS arthritis prevalence estimates*. Retrieved from https://www.cdc.gov/arthritis/data_statistics/state-data-current.htm
- Chen, J., Lin, X., Bu, C., & Zhang, X. (2018). Role of advanced glycation end products in mobility and considerations in possible dietary and nutritional intervention strategies. *Nutrition & Metabolism*, *15*(72), 1-18. <https://doi.org/10.1186/s12986-018-0306-7>
- Core Physical Therapy. (2019). *Physical therapy*. Retrieved from <https://corept.net/>
- Dean E. & Hansen, R. (2012). Prescribing optimal nutrition and physical activity as “first-line” interventions for best practice management of chronic low-grade inflammation associated with osteoarthritis: Evidence synthesis. *Arthritis*, *2012*, 1-28.
- Dimitrov, D. & Rumrill, P. (2003). Pretest/posttest designs and measurement of change. *Work*, *159*-165.
- Dyer, J., Davison, G., Marcora, S., & Mauger, A. (2017). Effect of a Mediterranean type diet on inflammatory and cartilage degradation biomarkers in patients with osteoarthritis. *Journal of Nutrient Health and Aging*, *21*(5), 562-566. doi:10.1007/s12603-016-0806-y
- Etz, K. & Arroyo, J. (2015). Small sample research: Considerations beyond statistical power. *Prevention Science*, *16*(7), 1033-1036.
- Han, H., Chang, C., Lee, D., & Lee, J. (2016). Relationship between total fruit and vegetable intake and self-reported knee pain in older adults. *Journal of Nutritional Health and Aging*, *21*(7), 750-758.
- Harasymowicz, N., Dicks, A., Wu, C., & Guilak, F. (2019). Physiological and pathologic effects of dietary free fatty acids on cells of the joint. *Annals of the New York Academy of Sciences*, *2019*, 1-18. doi:10.1111/nyas.13999
- Garfinkel, R., Dilisio, M., & Agrawal, D. (2017). Vitamin D and its effects on articular cartilage and osteoarthritis. *Orthopaedic Journal of Sports Medicine*, *5*(6), 1-8. doi:10.1177/2325967117711376

- Glanz, K., Rimer, B., & Viswanath, K. (2008). *Health behavior and health education: Theory, research, and practice* (4th ed.). San Francisco, CA: Jossey-Bass.
- Grygielska, J., Klak, A., Raciborski, F., & Manczak, M. (2017). Nutrition and quality of life referring to physical abilities: A comparative analysis of a questionnaire study of patients with rheumatoid arthritis and osteoarthritis. *Reumatologia*, *55*(5), 222-229. doi:<https://doi.org/10.5114/reum.2017.71629>
- Houchberb, M., Altman, R., April K., Benkhalti, M., Guyatt, G., & ... Tugwell, P. (2012). American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care & Research*, *64*(4), 465-474. doi:10.1002/acr.21596
- Institutional Review Board. (2019). *Templates*. Retrieved from <https://research.umn.edu/units/irb/toolkit-library/templates>
- Jones, C., Jensen, J., Scherr, C., Brown, N., Christy, K., & Weaver, J. (2015). The health belief model as an explanatory framework in communication research: Exploring parallel, serial, and moderated mediation. *Health Communication*, *30*(6), 566-576. doi:10.1080/10410236.2013.873363
- Litwic, A., Edwards, M., Dennison, E., & Cooper, C. (2013). Epidemiology and burden of osteoarthritis. *British Medical Bulletin*, *105*(1), 185-199. doi:<https://doi.org/10.1093/bmb/lds038>
- Lu, D., Driban, J., & Chang, X., Lapane, K., McAlindon, T., & Eaton, C. (2016). Dietary fat intake and radiographic progression of knee osteoarthritis: Data from the osteoarthritis initiative. *Arthritis Care & Research*, *69*(3), 368-375.
- Mears, M., Tussing-Humphreys, L., Cerwinske, L., Tangney, C., Hughes, S., & ... Gomez-Perez, S. (2018). Associations between alternate healthy eating index-2010, body composition, osteoarthritis severity, and interleukin-6 in older overweight and obese African American females with self-reported osteoarthritis. *Nutrients*, *11*(26), 1-11. doi:10.3390/nu11010026
- Morris, D., Kitchin, E., & Clark, D. (2009). Strategies for optimizing nutrition and weight reduction in physical therapy practice: The evidence. *Physiotherapy Theory and Practice*, *25*(5-6), 408-423.
- National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research*. Retrieved from <https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html#xrespect>

- Nelson, A., Allen, K., Golightly, Y., Goode, A., & Jordan, J. (2014). A systematic review of recommendations and guidelines for the management of osteoarthritis: The chronic osteoarthritis management initiative of the U.S. Bone and Joint Initiative. *Seminars in Arthritis and Rheumatism*, 43(6), 701-712. doi:10.1016/j.semarthrit.2013.11.012
- Newhouse, R., Dearholt, S., Poe, S., Pugh, L., & White, K. (2007). *Johns Hopkins nursing: Evidence-based practice model and guidelines*. Indianapolis, IN: Sigma Theta Tau International.
- Phadke, C. (2017). Why should physical therapists care about their patients' diet? *Physiotherapy Canada*, 69(2), 99-101. doi:10.3138/ptc.69.2.GEE
- Polit, D. & Beck, C. (2012). *Nursing research: Generating and assessing evidence for nursing practice*. Philadelphia, PA: Lippincott Williams & Wilkins.
- Rosen, J., Sancheti, P., Fierlinger, A., Niazi, F., Johal, H., & Bedi, A. (2016). Cost-effectiveness of different forms of intra-articular injections for the treatment of osteoarthritis of the knee. *Advances in Therapy*, 33(6), 998-1011. doi:10.1007/s12325-016-0331-8
- Salmon, J., Rat, A., Sellam, J., Michel, M., Eschard, J., & ... Fautrel, B. (2016). Economic impact of lower-limb osteoarthritis worldwide: A systematic review of cost-of-illness studies. *Osteoarthritis and Cartilage*, 24(9), 1500-1508. doi:10.1016/j.joca.2016.03.012
- Singer, M. & Couper, M. (2017). Some methodological uses of responses to open questions and other verbatim comments in quantitative surveys. *Methods, Data, Analyses*, 11(2), 115-134.
- Souza, I., Neta, R., Gazzola, J., & Souza, M. (2017). Elderly with knee osteoarthritis should perform nutritional assessment: Integrative literature review. *Einstein*, 15(2), 226-232. doi:10.1590/S1679-45082017RW3834
- Stanos, S. (2013). Osteoarthritis guidelines: A progressive role for topical nonsteroidal anti-inflammatory drugs. *Journal of Multidisciplinary Healthcare*, 6, 133-137.
- Sokolove, J. & Lepus, C. (2013). Role of inflammation in the pathogenesis of osteoarthritis: Latest findings and interpretations. *Therapeutic Advances in Musculoskeletal Disease*, 5(2), 77-94.
- Spriestersbach, A., Röhrig, B., du Prel, J., Gerhold-Ay, A., & Blettner, M. (2009). Descriptive statistics. *Deutsches Ärzteblatt International*, 106(36), 578-583.
- Strath, L., Jones, C., George, A., Lukens, S., Morrison, S., & ... Sorge, R. (2019). The effect of low-carbohydrate and low-fat diets on pain in individuals with knee osteoarthritis. *Pain Medicine*, 0(0), 1-11. doi:10.1093/pm/pnz022

- Teo, P., Hinman, R., Egerton, T., Dziedzic, K., & Bennell, K. (2019). Identifying and prioritizing clinical guideline recommendations most relevant to physical therapy practice for hip and/or knee osteoarthritis. *Journal of Orthopaedic & Sports Physical Therapy*, *49*(7), 501-519.
- Thorlund, J., Turkiewicz, A., Prieto-Alhambra, D., & Englund, M. (2019). Opioid use in knee or hip osteoarthritis: A region-wide population-based cohort study. *Osteoarthritis and Cartilage*, *27*(6), 871-877. doi:10.1016/j.joca.2019.01.005
- Tick, H. (2015). Nutrition and pain. *Physical Medicine and Rehabilitation Clinics of North America*, *26*(2), 309-320. doi:10.1016/j.pmr.2014.12.006
- Thomas, S., Browne, H., Mobasheri, A., & Rayman, M. (2018). What is the evidence for a role for diet and nutrition in osteoarthritis? *Rheumatology*, *57*, 61-74. doi:10.1093/rheumatology/key011
- U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute. (2005). *Theory at a glance: A guide for health promotion practice* (NIH Publication No. 05-3896). Retrieved from <http://www.sbccimplementationkits.org/demandrmnch/wp-content/uploads/2014/02/Theory-at-a-Glance-A-Guide-For-Health-Promotion-Practice.pdf>
- Vergis, S., Schiffer, L., White, T., McLeod, A., Khudeira, N., & ... Tussing-Humphreys, L. (2018). Diet quality and nutrient intake of urban overweight and obese primarily African American older adults with osteoarthritis. *Nutrients*, *10*(485), 1-16. doi:10.3390/nu10040485
- Veronese, N., Koyanagi, A., Stubbs, B., Cooper, C., Guglielmi, G. & ... Maggi, S. (2018). Mediterranean diet and knee osteoarthritis outcomes: A longitudinal cohort study. *Clinical Nutrition*, 1-5. <https://doi.org/10.1016/j.clnu.2018.11.032>
- Veronese, N., Stubbs, B., Noale, M., Solmi, M., Luchini, C., & Maggi, S. (2016). Adherence to the Mediterranean diet is associated with better quality of life: Data from the osteoarthritis initiative. *American Journal of Clinical Nutrition*, *104*(5), 1403-1409. <https://doi.org/10.3945/ajcn.116.136390>
- World Health Organization. (2018). *Musculoskeletal conditions*. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions>
- Yoshimura, N., Muraki, S., Oka, H., Tanaka, S., Kawaguchi, H., & ... Akune, T. (2012). Accumulation of metabolic risk factors such as overweight, hypertension, dyslipidaemia, and impaired glucose tolerance raises the risk of occurrence and progression of knee osteoarthritis: A 3-year follow-up of the ROAD study. *Osteoarthritis and Cartilage*, *20*, 1217-1226. <http://dx.doi.org/10.1016/j.joca.2012.06.006>