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Home Exercise Therapy For The Treatment Of Knee Osteoarthritis

Kezia Nixon
University of South Carolina

HOME EXERCISE THERAPY FOR THE TREATMENT OF KNEE OSTEOARTHRITIS

by

Kezia Nixon

Bachelor of Science in Nursing
Norfolk State University, 2005

Master of Science in Nursing
University of South Carolina, 2009

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Accepted by:

Alicia Ribar, Major Professor

Shelli Gibbs, Committee Member

Regina Morris, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

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Abstract

Knee pain is the chief complaint of most osteoarthritis patients, and encourages them to seek medical attention. Unfortunately, pharmacological approaches to the treatment of knee osteoarthritis have been found to be inadequate. Given the prevalence and chronicity of osteoarthritic knee pain, there is an obvious need for treatments that can be provided for the course of the disease, with minimal adverse side effects. Exercise therapy has been found to significantly improve both pain and function among individuals with knee osteoarthritis. The primary objective of this quality improvement project was to investigate the effectiveness of a home-based therapeutic exercise program on self-reported knee pain, among individuals suffering from osteoarthritic knee pain. The target population was derived from patients at a local pain clinic. The volunteer participants were asked take part in a home exercise program specially designed for individuals with osteoarthritis of the knee.

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Chapter 1: Introduction and Background

Scope of Problem

Osteoarthritis (OA) is a pressing public health concern (Seed, Dunican, & Lynch, 2009). In 2005, The National Arthritis Data Workgroup estimated the prevalence of OA in the United States as 26.9 million, an astounding rise of nearly 30% since 1995 (Altman & Lozada, 1998). Moreover, arthritis has been found to be the leading cause of physical disability among older adults (Altman & Lozada, 1998). The joint damage and chronic pain associated with OA lead to muscle atrophy, decreased mobility, poor balance, and eventually physical disability (Seed et al., 2009).

While there is no known cure for OA, therapeutic exercise can be used to reduce pain, maintain and/or improve joint mobility, and limit functional disability, with the overarching management goal of improving the patient's quality of life (Seed et al., 2009). Exercise therapy is recommended by all clinical guidelines for the management of knee OA, and is supported by Level 1 evidence (Seed et al., 2009). Both the American College of Rheumatology (ACR) and the European League Against Rheumatism (EULAR) recommend exercise for knee OA (Altman & Lozada, 1998; Seed et al., 2009).

Significance

Knee OA is the most common form of OA, significantly influencing the daily activities of millions of individuals worldwide. It also greatly contributes to morbidity in the OA community at large (Unnar, 2010). Not only is knee OA associated with impaired quality of life, but it also comes with high economic costs (Altman & Lozada, 1998). Direct treatment costs include but are not limited to physician visits, medications, hospitalizations, surgery, and transportation costs (Altman & Lozada, 1998). Indirect costs relate to comorbid conditions and lost productivity at both home and work (Altman & Lozada, 1998). The total annual cost of OA is estimated at $89.1 billion (Bitton, 2009), of which $3.4 billion to $13.2 billion is due solely to job-related OA (Bitton, 2009).

Exercise therapy has been found to significantly improve both pain and function among individuals with knee OA. However, with nearly 44 million uninsured and an increasingly prevalent underinsured population in the United States, many physicians are confronted with patients who simply cannot afford physical therapy (Weiner, 2001). This has become an issue of pressing clinical significance at Pain Management Associates (PMA). Pain associated with OA of the knee is the chief complaint of most patients, accounting for as many as 30% of all doctor visits (Fransen et al., 2015). PMA is no stranger to this phenomenon. Many PMA physicians have noted frequent encounters with patients who are concerned about the financial implications of the care they receive. However, Medicare regulations require that all patients be billed in accordance with the Centers for Medicare and Medicaid Services fee methodology, without consideration of the patient's ability to pay (Weiner, 2001). With knee OA becoming a growing public

health issue, a more affordable approach to its care would be far more attractive (Fransen et al., 2015).

Background

As the United States population ages, and as the well-known obesity epidemic in this country continues to unfold, the prevalence and burden of OA has been steadily increasing (Fransen et al., 2015). Pharmacological approaches to the treatment of knee OA have proven inadequate (Seed et al., 2009). According to Fransen et al. (2015), of all knee OA patients treated pharmacologically, only about half experience a 30% pain reduction. Unfortunately, more often than not, this is void of improved function (Fransen et al., 2015). Given the prevalence and chronicity of osteoarthritic knee pain, there is a need for treatment that can be provided for the course of the disease with minimal adverse side effects, and at an affordable cost.

Exercise has been found to be a safe intervention in patients with knee OA, with few contraindications or adverse events (Fransen et al., 2015). Empirical research evidence now unequivocally demonstrates that exercise improves pain and functioning in individuals affected by knee OA (Fransen et al., 2015; Seed et al., 2009). However, traditional supervised resistance exercise modalities are resource-intensive and dependent on good adherence (Seed et al., 2009). This is challenging to achieve in patients with knee OA. However, research has found that a simple, home-based exercise program can significantly reduce knee pain (Altman & Lozada, 1998; Seed et al., 2009).

Literature Analysis

For the purpose of this Evidence-Based Practice (EBP) project, a comprehensive database search was performed utilizing the Thomas Cooper Library. The overarching

goal of the literature search was to find quality, peer-reviewed evidence relating to the use of exercise as a treatment modality in the management of osteoarthrosis of the knee. An extensive search was conducted utilizing CINAHL, Medline, Pubmed-Medline, and the Cochrane Library databases, employing a combination of the following key words: *home-based exercise, exercise, therapy, knee, pain,* and *osteoarthritis*. Search terms were exploded and article titles and abstracts were reviewed. Duplicates were removed, as were articles failing to meet the inclusion criteria and/or meeting at least one of the exclusion criteria defined below. The remaining articles was reviewed in full, the exclusion and inclusion criteria were reapplied, and non-relevant papers were then discarded. Additional relevant papers were identified from reference lists during the full-text review.

Inclusion Criteria

Articles were included if they were empirical studies about knee pain, specifically knee OA, and exercise for knee OA. There was no limit on research methodology. For this review, a working definition of knee pain was mechanical knee pain, with or without loss of function, and with or without radiographic changes consistent with knee OA. Radiographic confirmation of knee OA was not required due to the many disagreements between pain and OA-related radiographic changes.

Exclusion Criteria

Studies were excluded if they referred to patellofemoral pain syndrome; to knee OA resulting from trauma, malignancy, infection, or inflammatory arthritis; or to knee OA secondary to other diseases. Studies of knee pain in prosthetic joints were also excluded. Studies were also excluded if they were not available in free full-text form or

were not available in English. As a final exclusion criterion, studies that addressed both exercise and diet therapy as interventions were excluded, as this EBP project focused on the single intervention of exercise alone.

Literature Synthesis

High-quality evidence for the benefits of home exercise programs in improving pain and function, for those with lower-limb OA, is well-established (Fransen et al., 2015). The literature chosen for this review addressed home-based exercise programs in the management of OA of the knee. Myriad research designs were chosen, including experimental studies, randomized control trials (RCTs), non-experimental studies, expert opinion articles, clinical practice guidelines, and reviews of the literature, to provide an assortment of evidence-based literature. Only articles graded A or B on the Johns Hopkins Nursing Evidence-based Practice Rating Scale were utilized, to increase the validity of provided evidence (Dearholt & Dang, 2012). The literature provided a strong platform to strengthen the evidence that the intervention of prescribing a home exercise program for knee OA patients provides a considerable recommendation for practice innovation.

Chronic pain associated with osteoarthritis of the knee is well-documented and thoroughly researched. Reduction of pain and improvement of function are the main aims of any treatment approach in the management of knee OA (Fransen et al., 2015). Combinations of treatment approaches, including both pharmacological and nonpharmacological methods, are often preferred over a single approach (Fransen et al., 2015). The Osteoarthritis Research Society International (OARSI) recommends nonpharmacological methods, including patient education programs, weight reduction,

coping strategies, and exercise programs, in the treatment of knee OA (Jordan et al., 2003). Rehabilitation programs, both with and without supervised clinic-based exercises, were shown to reduce pain and improve function in individuals with knee OA (Jordan et al., 2003). However, home exercise programs have advantages over supervised clinic-based exercise programs in that they are inexpensive and require little to no equipment (Jordan et al., 2003).

There are multiple means of exercise modalities utilized in the treatment of knee OA. These include aerobic exercise, various forms of land-based exercise, aquatic exercise, and walking programs (Jordan et al., 2003). There is overwhelming evidence that prescribing simple home exercises improves pain in individuals with knee OA (Jordan et al., 2003; O'Reilly, Muir, & Doherty, 1999). The relevance of home-based exercise therapy was found throughout this literature review. Knee OA puts an increasing fiscal burden on patients' health. As such, it is prudent that exercise be implemented in the most cost-effective and influential way. Easily applicable home exercise programs with no economic burdens and side effects are becoming increasingly popular (Jordan et al., 2003). Studies consistently showed that a simple home-based exercise program is beneficial for improving strength and function in individuals with knee OA, while also significantly reducing their pain (Evcik & Sonel, 2002; O'Reilly, Muir, & Doherty, 1999; Thomas et al., 2002).

One of the greatest trends emphasized in this review was the role of strengthening the quadriceps and hamstring muscles in the treatment of knee OA (Evcik & Sonel, 2002; O'Reilly, Muir, & Doherty, 1999; Thomas et al., 2002). There is a strong correlation between the decrease of quadriceps muscle strength and osteoarthritis of the knee (Evcik

& Sonel, 2002; O'Reilly, Muir, & Doherty, 1999; Thomas et al., 2002). Weakened quadriceps muscles are a primary risk factor for the development and progression of knee OA (Hernández Rosa et al., 2012). As shown by Hernández Rosa et al. (2012), the hamstring and quadriceps muscles around the knees have preventive and shock-absorbing effects on the joint, in proportion to their strength. Increased muscle mass was reported to be strongly associated with the volume of medial tibia cartilage. Since muscle-strengthening exercises are of crucial significance in the treatment of knee OA, the home-based exercise program utilizing quadriceps and hamstring exercises is an appropriate treatment approach for individuals suffering from knee OA.

Home exercise programs, when performed regularly, were often reported to have positive effects on muscle strength and functional capacity in knee OA patients (Evcik & Sonel, 2002; O'Reilly, Muir, & Doherty, 1999). In a study performed by Tunay, Baltaci, and Atay (2010) on 60 patients with knee OA, six-week home- and hospital-based strengthening and proprioception exercises were determined to be effective for decreasing pain. In another study performed with 113 knee OA patients, O'Reilly et al. (1999) performed a home exercise program including six-week quadriceps strengthening exercises, and determined a significant decrease in pain and improvement in physical functions. Similarly, Shakoor, Furmanov, Nelson, Li, and Block (2008) gave a home exercise program with eight-week quadriceps strengthening exercises to 38 knee OA patients. The authors reported a marked decrease in patient pain and an increase in quadriceps muscle mass (Shakoor et al., 2008).

Moreover, quadriceps strengthening exercises were demonstrated to have positive effects on levels of pain and disability, need for analgesics, and frequency of seeking

medical help. In a prospective long-term study conducted by Deyle et al. (2005), the effects of a home exercise program on lower extremity function were almost equal to those of supervised clinic-based exercise programs, even at a one-year follow-up. In the present EBP project, individuals were given the opportunity to participate in a similar home exercise program that utilizes quadriceps strengthening, designed to decrease knee pain, increase convenience, and reduce cost to the patient. This personalizes each patient's experience while also giving patients the opportunity to participate in their own care by making decisions that affect their overall health outcomes.

Land-based exercises, as opposed to their water-based counterparts, represent another consistent trend in the literature. A systemic review addressing exercise for osteoarthritis of the knee, conducted by three teams of two review authors, concluded that there is high-quality evidence indicating that land-based therapeutic exercise, including home exercise, provides pain relief of knee OA (Fransen et al., 2015). This was noted in a meta-analysis of RCT conducted by Fransen and McConnell (2009), and in another systemic review conducted by Jamtvedt et al. (2008). The study conducted by Fransen and McConnell (2009), however, was weakened by the fact that the studies mainly included participants with early or mild symptomatic disease. Land-based exercises were also described in an evidence-based consensus systemic review conducted by thirteen clinical experts (McAlindon et al., 2014). In a similar fashion, a multidisciplinary guideline development team concurred with existing guidelines emphasizing the already convincing body of research evidence that strongly supports the beneficial effect of land-based exercise for knee OA (Roddy et al., 2005).

Another research trend of grave importance involves the attitudes of general practitioners (GPs) towards prescribing exercise for individuals with knee OA. It was noted that GPs' attitudes and beliefs are strongly associated with their use of exercise for patients with knee OA, particularly their beliefs about their role, responsibility, and even the skill set in initiating exercise (Cottrell, Roddy, Rathod, Porcheret, & Foster, 2016). Adjusting these beliefs in prescribing home-based exercise is prudent to ensure patients are receiving the best evidence-based care, and further emphasizes the substantiated need for this EBP project. Considering adverse drug interactions, cost-effectiveness, and the mortality and morbidity of surgeries, GPs following-up with knee OA patients should take home exercise programs into account, including quadriceps and hamstring strengthening exercises, regardless of their personal attitudes and beliefs.

Exercise beliefs and behaviors among OA patients were likewise reviewed at length. In a qualitative study using semi-structured interviews, it was noted that exercise behavior among knee OA patients depend on physical capacity as well as exercise beliefs, among other factors such as enjoyment, social support, priority setting, and context (Hendry, Williams, Markland, Wilkinson, & Maddison, 2006). The study went on to describe the importance of GP referrals, especially when exercising for the first time (Hendry et al., 2006).

A quantitative study conducted by Krauss, Katzmarek, Rieger, and Sudeck (2017) contributed to the development of person-oriented personalized exercise recommendations with regard to motives for exercise participation. Lee, Lee, and So (2016) also concluded that tailor-made exercise programs improve exercise adherence and health outcomes in older individuals with knee OA. These results further substantiate

the need for this EBP project in which the prescribed home exercises regimen is personalized, so patients are given the freedom to engage in self-care by carrying out exercises from the comfort of their own homes.

In another vein of research, a non-experimental research study by Fraenkel and Fried (2008), uniquely titled "If you want patients with knee osteoarthritis to exercise, tell them about NSAIDs," found that knee OA patients often actually prefer exercise as a treatment option for knee OA. It should be pointed out that this study was conducted after patients were given the risk and adverse effects associated with non-steroidal anti-inflammatory drugs, a setting which can limit its findings (Fraenkel & Fried, 2008).

The use of the Transtheoretical Model (TTM) was common to several studies (e.g., Dobson et al., 2016; Joseph, Daniel, Thind, Benitez, & Pekmezi, 2016). In a study conducted by Dobson et al. (2016), their aim was to identify modifiable barriers and facilitators to initiating exercise for knee OA, utilizing behavior change theory. They noted that the greatest barriers were environments, context, and resources (Dobson et al., 2016). Many of these barriers were related to beliefs about consequences and/or their capabilities. The authors stressed that providers should utilize personalized approaches to exercise prescriptions, and also use reinforcement strategies (Dobson et al., 2016). In the present EBP project, one such strategy entailed utilizing routine frequent phone calls to follow up with participants who were undergoing the therapeutic exercise program.

Overall, previous research consistently supports the use of exercise as an effective means for relieving pain in individuals with knee OA (Nejati, Farzinmehr, & Moradi-Lakeh, 2015; Susko & Fitzgerald, 2013; Tanaka, Ozawa, Kito, & Moriyama, 2013).

Based on this review of EBP literature there was a clear need for therapeutic exercise programs to be translated into practice, further confirming that that this EBP project has both validity and purpose.

Recommendations for Practice Innovation

Based on the review of literature and the analysis of the supporting evidence, it is clear that there is substantial data in support of practice innovation. The overwhelming majority of the journal articles reviewed for this study had a high or good quality rating. This provides a relevant set of supporting literature to determine innovative practice recommendations. Exercise therapy is recommended by all EBP clinical guidelines for the management of knee OA, and is supported by Level 1 evidence (Altman & Lozada, 1998; Seed et al., 2009). As with any established EBP guideline, designing a study that translates this evidence into clinical practice and assesses how it affects patient outcomes, such as pain, makes it a viable and necessary study.

Much of the reviewed literature that was specific to the management of knee OA focused on therapeutic home exercise programs as a safe and effective treatment modality (Fransen et al., 2015; McAlindon et al., 2014). As such, the practice innovation for this study focused on implementing a simple home-based exercise program with close observation, motivation throughout, and appropriate follow-up. This treatment approach was explained in detail to the management personnel of PMA to gain buy-in from the appropriate stakeholders. Having this buy-in was essential to the success of this EBP project, as it ensured that this treatment approach was utilized in accordance with PMA policies.

Statement of the Purpose

High-quality evidence for the benefits of exercise in improving pain and function for those with lower-limb osteoarthritis is well-established (Altman & Lozada, 1998; Seed et al., 2009). However, exercise is globally underutilized (Altman & Lozada, 1998; Seed et al., 2009). Considering the adverse effects of drug therapy and the limited efficacy of surgical intervention, there is a noteworthy need to incorporate therapeutic exercise into the treatment plan for those suffering with knee OA, in order to improve patient care. As such, the purpose of this project was to determine if prescribing a simple home-based therapeutic exercise program for adult patients suffering from osteoarthritic knee pain, to supplement the patient's current pharmacologic treatment plan, was more effective than solely using pharmacologic treatment measures in improving patient pain levels. This was addressed through an EBP project aimed at demonstrating the importance of incorporating therapeutic exercise in the management of knee OA, and was guided by the PICOT question given below.

PICOT Question

In adult chronic osteoarthritic knee pain patients **(P)**, can the addition of a prescribed home exercise program, along with pharmacologic management **(I)**, result in improved self-reported knee pain **(O)** over a four-week time frame **(T)**, compared to solely pharmacologic management of chronic knee pain **(C)**?

Methodology

Study Design

According to Melnyk & Fineout-Overholt (2015), the design of a clinical study serves as its foundation. As such, a quasi-experimental design served as the foundation for this EBP project. The overarching goal of this project was to assess the effectiveness

of a prescribed therapeutic exercise program on self-reported pain in adult patients with OA of the knee. Melnyk & Fineout-Overholt (2015) defined a quasi-experimental study as one where the independent variable (i.e. exercise treatment intervention) is introduced but there is a lack of random assignment or a control group, making this design an appropriate fit for this EBP project.

Research Model Utilization

Behavioral theories provide an excellent framework for researchers to design and evaluate health promotion. Physicians and other healthcare providers can play a key role in encouraging individuals with arthritis to become more physically active. However, psychological readiness to begin exercising is also an important consideration. Theories of behavior change suggest that people vary widely in their readiness to adopt new behaviors (Joseph et al., 2016). Fortunately, research has found that brief doctor-patient discussions about exercise do translate into behavior change among patients (Joseph et al., 2016). As such, the Transtheoretical Model of Change was chosen as a most appropriate model for this EBP project.

The TTM describes the stages individuals progress through (Precontemplation, Contemplation, Preparation, Action, and Maintenance) and the cognitive and behavioral processes they use while changing health behaviors, such as starting an exercise program (Joseph et al., 2016). Movement through these stages does not always occur in a linear manner, but can also be cyclical: many individuals must make several attempts at behavior change before their goals are realized (Joseph et al., 2016). This concept was taken into full consideration in this project, with the understanding that providers should

provide constant reinforcement to encourage the osteoarthritic knee pain patient population to exercise.

The strength and validity of the TTM have been well-tested and documented since the model's conception (Joseph et al., 2016). It is based on principles developed from years of scientific research, intervention development, and scores of empirical studies. In a systemic review conducted by Joseph et al. (2016), the authors review 10 studies referencing the use of the TTM; an astounding 80% reported positive outcomes. Five of the studies looked at weight loss, three of the studies addressed exercise/physical activity, and the other two addressed the use of the TTM for smoking cessation (Joseph et al., 2016). These favorable outcomes provide promising support for the use of the TTM to promote exercise therapy in osteoarthritic knee pain patients, and served as a theoretical framework to guide this EBP project.

Sample

Creating a representative sample is a challenging task, as samples are rarely if ever perfectly representative of the population of interest (Melnyk & Fineout-Overholt, 2015). However, every effort was made to develop an appropriate and representative sample to carry out this EBP project. Purposive sampling was utilized by requesting volunteers. Both written and verbal informed consent were obtained, to adhere with the Institutional Review Board (IRB) guidelines and to protect the rights of each participant. The goal was to employ a minimum of 30 volunteer participants. The purpose of the study was explained in detail to each participant prior to obtaining consent. Volunteer participants were required to be over 21 years old, and both male and females were accepted. There were no exclusion criteria based on racial or ethnic background. A built-

in study attrition drop-out rate was anticipated, as many studies conducted in the health professions result in nonsignificant findings as a result of too small a sample size (Melnyk & Fineout-Overholt, 2015). However, to reduce attrition, appropriate monitoring and close follow-up with routine phone calls were used, and compliance was recorded.

Setting

Choosing the most appropriate facility setting to carry out an evidence-based project is key to its success (Melnyk & Fineout-Overholt, 2015). It is prudent to choose a setting that targets the representative sample, as discussed above. As such, Pain Management Associates was chosen as the setting of choice for this EBP project. PMA is a Tri-State specialty group, with locations in South Carolina, North Carolina, and Tennessee. They are recognized for specializing in medical pain management, interventional pain management, and rehabilitation for pain management (PMA, 2017). Like many other pain clinics, PMA is often tasked with managing chronic knee OA. Current modalities of treatment include pharmacologic approaches with non-steroidal anti-inflammatory drugs (NSAIDs), cortisone injections, and long-term opiates (PMA, 2017).

Despite these pharmacological approaches and the best efforts of the PMA providers, many patients continue to complain of uncontrolled pain. The need for an adjustment in treatment plans to include a nonpharmacological approach to care, such as exercise, is evident. As such, PMA made for an appropriate setting to carry out this EBP project. Administrative approval was obtained from the Chief Executive Office and Medical Director prior to initiating the project. The proposed evidence-based project was

carefully evaluated to ensure its consistency with PMA's philosophy, as the project challenged both the facility staff's and patients' willingness to change.

Description of Intervention

Research has shown that strengthening the muscles that support the knee provides significant pain relief for individuals suffering from knee OA (Altman & Lozada, 1998). As such, the intervention for this EBP project entailed implementing an evidence-based Knee Conditioning Program exercise brochure, made available through the American Academy of Orthopedic Surgeons (AAOS) (see Appendix A). The knee conditioning program provides a wide range of exercises that improve both strength and flexibility. It is designed to strengthen the muscles supporting the knee, thus reducing stress on the knee joints. The program also places emphasis on improving flexibility by stretching those same muscles to improve range of motion and prevent injury. The exercises target the quadriceps, hamstrings, abductors, and adductors, as well as both the gluteus medius and gluteus maximus. The brochure was made available to knee OA sufferers at PMA.

Evaluation Tool

Evaluating the process and the results of an intervention was a crucial step in this EBP project. In accordance with the provided PICOT question, pain was evaluated as the outcome measure following the above intervention, utilizing the pain Visual Analog Scale (VAS) (see Appendix B). The pain VAS is a unidimensional measure of pain intensity which has been widely used in diverse adult populations, making it suitable for the EBP project setting. The scale measures 10cm in length and is anchored by 2 verbal descriptors for pain, one for each symptom extreme. For pain intensity, the scale is most commonly anchored by "no pain" (score of 0) and "worst imaginable pain" (score of 10).

Action Plan

The patients at PMA are seen every four weeks for the evaluation and management of their chronic pain. The previously described VAS was utilized to evaluate pain levels at the onset of patient visits. Individuals were instructed to perform the exercises demonstrated in the knee conditioning program brochure, daily for the next four weeks, until their next follow-up visit. Each individual's demographic data was collected at the time of brochure dissemination, and each exercise was demonstrated. As with any intervention-based project, compliance was crucial to increasing the validity of the results. As such, adherence to the prescribed therapeutic exercise regimen was monitored and recorded.

In order to aid participants in tracking adherence to the regimen, participants were provided with a log sheet, where they were asked to record each day that they were compliant with the directed exercises. The participants were each contacted two weeks later by phone to follow up on their progress and compliance. Following the completion of the prescribed four-week home exercise regimen, the patients' pain levels were reassessed, again utilizing the pain VAS. This took place during each participant's routine four-week follow-up visit. Pre- and post-intervention pain levels were compared to evaluate the outcomes of the EBP project intervention.

Timeline

Spring 2017

- Select topic for EBP project
- Develop PICOT question
- Conduct literature review

- Develop and complete evidence table
- Complete CITI training

Summer 2017

- Build committee for proposed DNP project
- Further synthesize the literature review

Fall 2017

- Develop proposal PowerPoint
- Present DNP proposal
- Complete IRB submission process
- Implement proposed intervention

Spring 2018

- Collect data
- Evaluate data
- Develop manuscript

Budget

One of the greatest benefits of home exercise programs is their affordability. The knee conditioning program made available through AAOS requires no exercise equipment. As such, no monetary budget was allotted to carry out this EBP project. The staff at PMA agreed to allow the researcher to use their office supplies, in order to make pamphlets readily available to patients who agreed to participate in the home exercise program.

While a monetary budget was not allotted for this EBP project, use of personal time was. In accordance with the delineated syllabus for NURS 897, a minimum of 24 hours per week, for 14 weeks, was budgeted for clinical practicum hours to carry out this EBP project.

Protection of Human Subjects

With any evidence-based project one must account for legal and/or ethical constraints. The protection of human subjects was of paramount importance in the development of this EBP project. In order to ensure the protection of participants in this project, University of South Carolina Internal Review Board (IRB) approval was obtained prior to initiating this project. The official IRB Determination Form was submitted upon the approval of the project. Moreover, prior consent was obtained from each participant. It should be stressed that patients were notified that they had the right to refuse, and that no reprimands would be issued for doing so. All participants were protected by the Health Insurance Portability and Accountability Act of 1996 (HIPAA), which among other guarantees, protects the privacy of patients' health information. Additionally, no information collected from the project participants included any potential patient identifiers. Participant confidentiality was assured by coding the participants using individual identification numbers. The list of participants and their identifying numbers were kept in a locked filing cabinet, only accessible to the project coordinator. Any electronic files containing identifiable information was password protected to prevent access by unauthorized users. Only the project coordinator had access to the passwords.

Chapter 2: Home Exercise Therapy for the Treatment of Osteoarthritic Knee Pain[1]

[1] Nixon, K., Ribar, A., Gibbs, S., & Solis, R. (2018). *Home Exercise Therapy for the Treatment of Osteoarthritic Knee Pain*. (Unpublished doctoral dissertation.) University of South Carolina, Columbia, SC.

Abstract

Knee osteoarthritis (OA) is a pressing public health concern. Pain associated with osteoarthritis of the knee is the chief complaint of most OA patients, encouraging them to seek medical attention. Unfortunately, pharmacological approaches to the treatment of knee OA have been found to be inadequate. Given the prevalence and chronicity of osteoarthritic knee pain, there is an obvious need for treatments that can be provided for the course of the disease with minimal adverse side effects. Exercise therapy has been found to significantly improve both pain and function among individuals with knee osteoarthritis. The primary objective of this quality improvement project was to investigate the effectiveness of a home-based knee conditioning program on self-reported knee pain, among individuals suffering from osteoarthritic knee pain. The target population was derived from volunteer patients at a local pain clinic. The volunteers were asked to take part in a home exercise program especially designed for individuals with osteoarthritis of the knee. The knee conditioning program had a positive impact on self-reported knee pain after just four week.

Introduction and Background Knowledge

As the United States population ages, and as the well-known obesity epidemic in this country continues to unfold, the prevalence and burden of osteoarthritis (OA) has been steadily increasing (Fransen et al., 2015). Knee osteoarthritis (KOA) is the most common form of OA and greatly contributes to morbidity in the OA community at large (Unnar, 2010). Pain associated with KOA is the chief complaint of most patients, accounting for as many as 30% of all doctor visits (Fransen et al., 2015). Not only is KOA associated with impaired quality of life, it also comes with high economic costs

(Altman & Lozada, 1998). Direct treatment costs include but are not limited to physician visits, medications, hospitalizations, surgery, and transportation costs, while indirect costs relate to comorbid conditions and lost productivity at both home and work (Altman & Lozada, 1998).

Pharmacological approaches to the treatment of KOA have been found to be inadequate (Seed et al., 2009). According to Fransen et al. (2015), among patients treated pharmacologically, only about half experience a 30% pain reduction. Unfortunately, more often than not, this is void of improved function (Fransen et al., 2015). Given the prevalence and chronicity of osteoarthritic knee pain, there is a need for treatment that can be provided for the course of the disease with minimal adverse side effects and at an affordable cost, since many patients are concerned about the financial implications of the care they receive.

Exercise has been found to be a safe intervention in patients with KOA with few contraindications or adverse events (Fransen et al., 2015). Empirical research evidence unequivocally demonstrates that exercise improves pain and functioning in individuals affected by KOA (Fransen et al., 2015; Seed et al., 2009). But traditional supervised resistance exercise modalities are resource-intensive, costly, and dependent on good adherence (Seed et al., 2009). This is challenging to achieve in patients with KOA. However, other research has found that a simple, home-based exercise program can significantly reduce knee pain (Altman & Lozada, 1998; Seed et al., 2009).

Literature Review

High-quality evidence for the benefits of home exercise programs in improving pain and function for those with lower-limb OA is well-established (Fransen et al., 2015).

The literature chosen for this review specifically addressed home-based exercise programs in the management of KOA. A myriad of research designs, including experimental studies, randomized control trials (RCTs), non-experimental studies, expert opinion articles, clinical practice guidelines, and reviews of the literature were chosen to provide an assortment of evidence-based literature. Only articles graded A or B on the Johns Hopkins Nursing Evidence-based Practice Rating Scale were utilized, so as to increase the validity of the provided evidence (Dearholt & Dang, 2012). The literature provided a strong platform to strengthen the evidence that the intervention of prescribing a home exercise program for KOA patients represents a considerable recommendation for practice innovation.

Chronic pain associated with osteoarthritis of the knee is well-documented and thoroughly researched. Reduction of pain and improvement of function are the main aims of any treatment approach in the management of KOA, and treatments combining pharmacological and nonpharmacological methods are often preferred over a single approach (Fransen et al., 2015). The Osteoarthritis Research Society International has recommended nonpharmacological methods, including patient education programs, weight reduction, coping strategies, and exercise programs, in the treatment of KOA (Jordan et al., 2003). Rehabilitation programs both with and without supervised clinic-based exercises were shown to reduce pain and improve function in individuals with KOA. However, home exercise programs have advantages over supervised clinic-based exercise programs in that they are inexpensive and require little to no equipment (Jordan et al., 2003).

There is overwhelming evidence that prescribing simple home exercise improves pain in individuals with KOA (Jordan et al., 2003; O'Reilly et al., 1999). The relevance of home-based exercise therapy was confirmed by a detailed literature review. Easily applicable home exercise programs with no economic burdens and side effects are becoming increasingly popular (Jordan et al., 2003). Studies consistently showed that a simple home-based exercise program is beneficial for improving strength and function in individuals with KOA, while also significantly reducing pain (Evcik & Sonel, 2002; O'Reilly, Muir, & Doherty, 1999; Thomas et al., 2002).

One of the greatest trends emphasized in the review of literature was the role of quadriceps and hamstring muscle strengthening in the treatment of KOA (Evcik & Sonel, 2002; O'Reilly, Muir, & Doherty, 1999; Thomas et al., 2002). A review of the current literature revealed a strong correlation between the decrease of quadriceps muscle strength and KOA (Evcik & Sonel, 2002; O'Reilly, Muir, & Doherty, 1999; Thomas et al., 2002). Weakness in the quadriceps muscles is a primary risk factor for the development and progression of KOA (Hernández Rosa et al., 2012). Muscle strengthening exercises are thus of crucial significance in its treatment. As such, a home-based exercise program utilizing quadriceps and hamstring strengthening exercises makes for an appropriate treatment approach, for individuals suffering from KOA.

Another important research finding involves the attitudes of general practitioners (GPs) towards prescribing exercise for individuals with KOA. It was noted that GPs' attitudes and beliefs are strongly associated with their use of exercise for patients with KOA, particularly their beliefs about their role, responsibility, and even the skill set in initiating exercise (Cottrell et al., 2016). Adjusting these beliefs when prescribing home-

based exercise is prudent to ensure patients are receiving the best evidence-based care, and further substantiates the need for this EBP project. Patient beliefs regarding exercise for KOA were likewise reviewed at length. This review revealed that exercise behavior among KOA patients depends on both physical capacity and exercise beliefs, among other factors such as enjoyment, social support, priority setting, and context (Hendry, Williams, Markland, Wilkinson, & Maddison, 2006).

Overall, research consistently supports the use of exercise as an effective means for relieving pain in individuals with KOA (Nejati et al., 2015; Susko & Fitzgerald, 2013; Tanaka et al., 2013). Based on the review of EBP literature, there was a clear need for therapeutic exercise programs to be translated into practice, thus confirming that that this EBP project has both validity and purpose.

Purpose

High-quality evidence for the benefits of exercise in improving pain and function for those with lower-limb osteoarthritis is well-established. However, exercise is globally underutilized (Altman & Lozada, 1998; Seed et al., 2009). Considering the adverse effects of drug therapy and the limited efficacy of surgical intervention, there is a noteworthy need to incorporate therapeutic exercise into the treatment plan for those suffering from KOA, in order to improve patient care. As such, the purpose of this project was to determine if prescribing a therapeutic exercise program for adult patients suffering from osteoarthritic knee pain, to supplement each patient's current pharmacologic treatment plan, would improve patients' pain levels versus solely pharmacologic treatment measures. This was addressed through an EBP project aimed at demonstrating

the importance of incorporating therapeutic exercise in the management of KOA, and was guided by the PICOT question below.

PICOT Question

In adult chronic osteoarthritic knee pain patients **(P),** can the addition of a prescribed therapeutic exercise program along with pharmacologic management **(I)** result in improved self-reported knee pain **(O)** over a four-week time frame **(T)**, compared to solely pharmacologic management of chronic knee pain **(C)**?

Methods

Sample

Every effort was made to develop a representative sample most appropriate to carrying out this EBP project. Purposive sampling was utilized by requesting volunteers at a local pain clinic. Both written and verbal informed consent was obtained, to adhere with the Institutional Review Board (IRB) guidelines and to protect the rights of each participant. The purpose of study was explained in detail to each participant prior to obtaining consent. Volunteer participants were required to be over 21 years old. Both males and females were accepted, and there were no exclusion criteria based on racial or ethnic background. A built-in study attrition drop-out rate was anticipated, as many studies conducted in the health professions result in nonsignificant findings as a result of too small a sample size (Melnyk & Fineout-Overholt, 2015). The goal was to employ a minimum of 30 volunteer participants. However, the final sample size included 25 willing volunteers.

Setting

Pain Management Associates (PMA) was chosen as the setting for this EBP project. PMA is a Tri-State specialty group, with locations in South Carolina, North

Carolina, and Tennessee. They are recognized for specializing in medical pain management, interventional pain management, and rehabilitation for pain management (PMA, 2017). Like many other pain clinics, PMA is tasked with managing chronic KOA. Current modalities of treatment include pharmacologic approaches with non-steroidal anti-inflammatory drugs (NSAIDs), cortisone injections, and long-term opiates (PMA, 2017).

Despite these pharmacological approaches and the best efforts of the providers, many patients continue to complain of uncontrolled pain. The need for an adjustment in treatment plans to include a nonpharmacological approach to care, such as exercise, is evident. As such, PMA made for an appropriate setting to carry out this EBP project. Administrative approval was obtained from the Chief Executive Office and Medical Director prior to initiation of the project. The proposed evidence-based project was carefully evaluated to ensure that it was consistent with PMA's philosophy, as the project challenged both the facility staff's and patients' willingness to change.

Project Design

The overarching goal of this project was to assess the effectiveness of a prescribed therapeutic exercise program on self-reported pain, in adult patients with KOA. Melnyk & Fineout-Overholt (2015) defined quasi-experimental study designs as those in which the independent variable (i.e. exercise treatment intervention) is introduced but there is a lack of random assignment or a control group, making this design an appropriate fit for this EBP project.

Method of Evaluation

Evaluating the process and the results of an intervention was a crucial step in this EBP project. In accordance with the provided PICOT question, pain was evaluated as the outcome measure, following the administration of a knee conditioning exercise program. Pain levels were assessed utilizing the pain Visual Analog Scale (VAS) (see Appendix B). The pain VAS is a unidimensional measure of pain intensity which has been widely used in diverse adult populations, making it suitable for the EBP project setting. The scale measures 10 cm in length and is anchored by 2 verbal descriptors for pain, one for each symptom extreme. For pain intensity, the scale is most commonly anchored by "no pain" (score of 0) and "worst imaginable pain" (score of 10).

Description of Intervention

Research has shown that strengthening the muscles that support the knee provides significant pain relief for individuals suffering from KOA (Altman & Lozada, 1998). As such, the intervention for this EBP project entailed implementing an evidence-based exercise Knee Conditioning Program brochure, made available through the American Academy of Orthopedic Surgeons (AAOS) (see Appendix A). The knee conditioning program provides a wide range of exercises to improve both strength and flexibility. It is designed to strengthen the muscles supporting the knee, thus reducing stress on the knee joints. The program also places emphasis on improving flexibility by stretching those same muscles, so as to improve range of motion and prevent injury. The exercises target the quadriceps, hamstrings, abductors, and adductors, as well as both the gluteus medius and gluteus maximus. The brochure was made available for KOA sufferers at PMA.

Action Plan

The patients of PMA are seen every four weeks for the evaluation and management of their chronic pain. The previously described VAS was utilized to evaluate pain levels at the onset of patient visits. Individuals were instructed to perform the exercises demonstrated in the knee conditioning program brochure, daily for the next four weeks, until their next follow-up visit. Each individual's demographic data was collected at the time of brochure dissemination, and each exercise was demonstrated.

As with any intervention-based project, compliance was of crucial importance to increase the validity of the results. As such, adherence to the prescribed therapeutic exercise regimen was monitored and recorded. In order to aid participants in tracking adherence to the regimen, they were provided with a log sheet and asked to record each day that they were compliant with the directed exercises. The participants were each contacted two weeks later by phone, to follow up on their progress and compliance. Following the completion of the prescribed four-week home exercise regimen, pain levels were reassessed, again utilizing the pain VAS. This took place during the participant's routine four-week follow up visit. Pre- and post-intervention pain levels were compared to evaluate the outcomes to the EBP project intervention. Results of the intervention are detailed in the next section.

Results

The project design was quasi-experimental, comparing pre-intervention and post-intervention data to evaluate this EBP project. Patients' levels of self-reported knee pain (based on the pain VAS) after the implementation of an evidence-based knee conditioning program were evaluated and compared to pre-program levels. The comparison reflected improvement in self-reported knee pain after just four weeks. Of the

25 initial volunteers, 20 completed the exercises as directed. The five remaining volunteers did not return for their four-week follow-up, so their post-intervention pain levels could not be assessed accurately. A paired t-test was used to analyze the results, and showed that the average pain level before starting the exercise regimen was 6.85. The average pain level following the exercise intervention was 4.60. As Table 2.1 shows, this was a statistically significant decrease in pain (p=<0.0001).

Table 2.1. *Analysis of Results*. P= <0.0001.

	N	**Mean**	**Max**	**Min**	**SD**
Pre-intervention	20	6.85	10	5	1.57
Post-intervention	20	4.60	8	2	1.67

Conclusion

This was a quality improvement project that proposed a practice change for the current management and treatment of chronic pain associated with KOA at a local pain clinic. This practice change was founded on current evidence-based guidelines that support the use of home exercises in the treatment of KOA. To prepare the quality improvement project, the coordinator identified KOA as a clinical problem and searched for the best evidence. From there, the evidence was critically appraised and synthesized. The extrapolated evidence from an extensive literature review was then translated into clinical practice at PMA. This was done by implementing the use of an evidence-based

knee conditioning program for patients suffering from KOA. Finally, outcomes were measured in terms of self-reported pain by utilizing a pain VAS. The knee conditioning program had a positive impact on self-reported knee pain in all the participants.

Implications for Future Research

This EBP project examined the pain-relieving effects of exercise. However, it did not explore the particular mechanisms by which pain relief may occur. Thus, it was limited in its ability to determine the optimal mode and dosage of exercise. Future research is suggested in order to understand the mechanisms by which exercise reduces pain, and to determine appropriate exercise parameters to maximize pain relief**.** Pain in OA has also been found to be related to a number of psychological variables (Susko & Fitzgerald, 2013). These variables include but are not limited to factors such as anxiety, depression, poor pain-coping skills, and even fear (Susko & Fitzgerald, 2013). Thus, future research should examine the specific effects of these variables on the outcomes of exercise and pain.

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Chapter 3: Conclusion

Implications for Future Research

This EBP project examined the pain-relieving effects of exercise. However, it did not explore the particular mechanisms by which pain relief may occur. Thus, it was limited in its ability to determine the optimal mode and dosage of exercise. Future research is suggested in order to understand the mechanisms by which exercise reduces pain, and to determine appropriate exercise parameters to maximize pain relief**.** Pain in OA has also been found to be related to a number of psychological variables (Susko & Fitzgerald, 2013). These variables include but are not limited to factors such as anxiety, depression, poor pain-coping skills, and even fear (Susko & Fitzgerald, 2013). Thus, future research should examine the specific effects of these variables on the outcomes of exercise and pain.

Sustainability

Sustained delivery of evidence-based interventions is essential to truly impact the lives of patients. The challenge of sustaining any type of clinical practice change spans all of healthcare, including pain management. As such, great measures were taken to ensure that the utilized knee conditioning program will continue to be carried out at PMA following the completion of the project. By speaking with key stakeholders including the office manager and medical director, the coordinator was granted permission to make the knee conditioning program brochures readily available and on display in every exam room, even after the project's conclusion. PMA management is confident that

implementing an evidence-based knee conditioning program will have promising results for the PMA patients suffering from osteoarthritic knee pain.

In closing, this EBP project identified KOA as a clinical problem, located and critically appraised the best evidence, and synthesized that evidence to establish clinical practice at PMA. This was done by implementing the use of an evidence-based knee conditioning program for patients suffering from KOA. Finally, outcomes were measured in terms of self-reported pain, by utilizing a pain VAS.

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Appendix A: Knee Conditioning Program

Getting Started

Warmup: Before doing the following exercises, warm up with 5 to 10 minutes of low-impact activity, like walking or riding a stationary bicycle.

Stretch: After the warm-up, do the stretching exercises shown on Page 1 before moving on to the strengthening exercises. When you have completed the strengthening exercises, repeat the stretching exercises to end the program.

Do not ignore pain: You should not feel pain during an exercise. Talk to your doctor or physical therapist if you have any pain while exercising.

Ask questions: If you are not sure how to do an exercise, or how often to do it, contact your doctor or physical therapist.

1. Heel Cord Stretch

Main muscles worked: Gastrocnemius-soleus complex
You should feel this stretch in your calf and into your heel

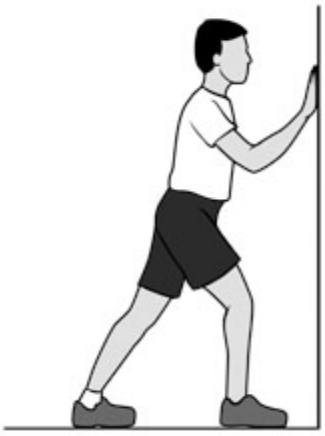
Equipment needed: None

Repetitions 2 sets of 4
Days Per Week 6 to 7

Step-by-step directions

- Stand facing a wall with your unaffected leg forward, with a slight bend at the knee. Your affected leg should be straight and behind you, with the heel flat and the toes pointed in slightly.
- Keep both heels flat on the floor and press your hips forward toward the wall.
- Hold this stretch for 30 seconds and then relax for 30 seconds. Repeat.

Tip Do not arch your back.



2. Standing Quadriceps Stretch

Main muscles worked: Quadriceps
You should feel this stretch in the front of your thigh

Equipment needed: None

Repetitions 2 to 3
Days Per Week 4 to 5

Step-by-step directions

- Hold on to the back of a chair or a wall for balance.
- Bend your knee and bring your heel up toward your buttock.
- Grasp your ankle with your hand and gently pull your heel closer to your body.
- Hold this position for 30 to 60 seconds.
- Repeat with the opposite leg.

Tip Do not arch or twist your back.

3. Half Squats

Main muscles worked: Quadriceps, gluteus, hamstrings
You should feel this exercise at the front and back of your thighs, and your buttocks

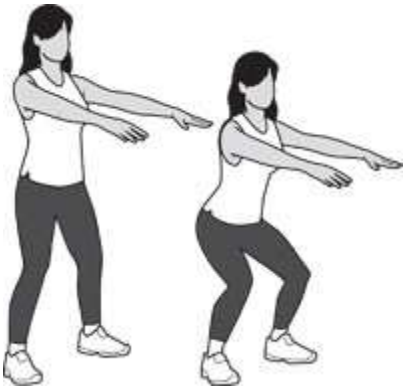
Equipment needed: As the exercise becomes easier to perform, gradually increase the resistance by holding hand weights. Begin with 5-lb. weights and gradually progress to a greater level of resistance, up to 10-lb. weights.

Repetitions 3 sets of 10
Days Per Week 4 to 5

Step-by-step directions

- Stand with your feet shoulder-distance apart. Your hands can rest on the front of your thighs or reach in front of you. If needed, hold on to the back of a chair or a wall for balance.
- Keep your chest lifted and slowly lower your hips about 10 inches, as if you are sitting down into a chair.
- Plant your weight in your heels and hold the squat for 5 seconds.
- Push through your heels and bring your body back up to standing.

Tip Do not bend forward at your waist.



4. Hamstring Curls

Main muscles worked: Hamstrings
You should feel this exercise at the back of your thigh

Equipment needed: As the exercise becomes easier to perform, gradually increase the resistance by adding an ankle weight. Begin with a 5-lb. weight and gradually progress to a greater level of resistance, up to a 10-lb. weight. If you have access to a fitness center, this exercise can also be performed on a weight machine. A fitness assistant at your gym can instruct you on how to use the machines safely.

Repetitions 3 sets of 10
Days Per Week 4 to 5

Step-by-step directions

- Hold onto the back of a chair or a wall for balance.
- Bend your affected knee and raise your heel toward the ceiling as far as possible without pain.
- Hold this position for 5 seconds and then relax. Repeat.

Tip Flex your foot and keep your knees close together.

5. Calf Raises

Main muscles worked: Gastrocnemius-soleus complex
You should feel this exercise in your calf

Equipment needed: Chair for support

Repetitions 2 sets of 10
Days Per Week 6 to 7

Step-by-step directions

- Stand with your weight evenly distributed over both feet. Hold onto the back of a chair or a wall for balance.
- Lift your unaffected foot off of the floor so that all of your weight is placed on your affected foot.
- Raise the heel of your affected foot as high as you can, then lower.
- Repeat 10 times.

Tip Keep your weight centered on the ball of your working foot.

6. Leg Extensions

Main muscles worked: Quadriceps
You should feel this exercise at the front of your thigh

Equipment needed: As the exercise becomes easier to perform, gradually increase the resistance by adding an ankle weight. Begin with a 5-lb. weight and gradually progress to a greater level of resistance, up to a 10-lb. weight. If you have access to a fitness center, this exercise can also be performed on a weight machine. A fitness assistant at your gym can instruct you on how to use the machines safely.

Repetitions 3 sets of 10
Days Per Week 4 to 5

Step-by-step directions

- Sit up straight on a chair or bench.
- Tighten your thigh muscles and slowly straighten and raise your affected leg as high as possible.
- Squeeze your thigh muscles and hold this position for 5 seconds. Relax and bring your foot to the floor. Repeat.

Tip Do not swing your leg or use forceful momentum to lift it higher.

(American Academy of Orthopedic Surgeons, 2012)

Appendix B: Pain Visual Analog Scale