

Exploring the Perceived Effects of Integrating Unloader Braces and Exercise Therapy Interventions in Orthopedics and Sports Medicine: An Investigation Among Athletes with Knee Osteoarthritis

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¹An Applied Research Report Presented in Partial Fulfillment of the Requirements for the Degree Include the degree here

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Received: 06 October 2024; **Accepted:** 15 October 2024; **Published:** 18 October 2024

Citation: Lerome Pratt, (2024). Exploring the Perceived Effects of Integrating Unloader Braces and Exercise Therapy Interventions in Orthopedics and Sports Medicine: An Investigation Among Athletes with Knee Osteoarthritis. *Orthopaedics and Pain Management*. 3(1)

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Abstract

The purpose of this doctoral applied research project was to examine the perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine, specifically focusing on athletes diagnosed with knee osteoarthritis (OA). The problem addressed by this study is the limited understanding of how combined treatment modalities can enhance functional abilities, alleviate pain, and improve overall well-being in this population. This research was driven by the rationale that existing conventional treatments often provide limited efficacy, necessitating a more comprehensive and personalized approach. The central research question explored how athletes with knee OA perceive the impact of unloader braces and exercise therapy on their functional abilities, pain management, and overall well-being.

The study employed a descriptive research approach, utilizing one form of data collection, semi-structured interviews. Data analysis involved thematic coding of interview transcripts and qualitative data analysis of responses. The findings revealed that integrating unloader braces with exercise therapy significantly enhanced functional abilities and pain relief, contributing positively to overall well-being. Based on these findings, the study recommends expanding sample size and diversity, implementing longitudinal studies, integrating complementary interventions, enhancing technological and methodological approaches, and strengthening collaborative healthcare models. The culmination of this research offers evidence-based recommendations aimed at optimizing treatment strategies for knee OA patients, particularly athletes, to improve patient outcomes and quality of life.

Keywords degenerative diseases, knee osteoarthritis, unloader braces, exercise therapy, physical therapy, therapeutic interventions, rehabilitation, orthopedics, sports medicine, functional abilities, pain management, well-being, treatment strategies, athletes, patient, patient care.

I dedicate this accomplishment, the completion of my Doctorate, to my heritage, my culture, and my community — to the spirit of resilience that has been passed down through generations and the essence of my people that flows through my veins. To my tribe — my family, my friends, and every person who has shown up and shown love, no matter where I find myself in this world — I am only as good as the collective strength you give me. Thank you for believing in me, for standing with me, and for reminding me that our roots run deep, and our

possibilities are boundless.

To the Gullah & Caribbean community that raised me, this is a celebration of our journey, a recognition of our strength, and an affirmation of our dreams. This achievement is far greater than anything I could have imagined as a kid from a small, tight-knit community. It stands as a testament to how far we can go when we honor where we come from and walk in it with pride.

I extend my heartfelt gratitude to Dr. Olson, my chair, and the entire committee for your guidance, wisdom,

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and unwavering commitment to my growth throughout this doctoral journey. Your challenge to me was never just about academic rigor, but about expanding my mind, pushing my limits, and staying true to my purpose and I thank you.

Above all, I give thanks to the Great Almighty, the author of my life's path, for the humble beginnings, the diversity of experiences, and the growth mindset that have shaped me into who I am today. This milestone is not mine alone; it belongs to every person who has walked alongside me, believed in me, and contributed to the fabric of this journey. May this achievement inspire others from humble beginnings to dream without limits, to strive beyond borders, and to know that we are capable of achieving more than we ever imagined. With profound gratitude and love, Rome.

Role of the Researcher

Lerome Pratt, a Biotech Scientist Scholar, holds credentials that inform this research. Pratt's professional background includes participation in the Scientist Mentoring & Diversity Program for Biotechnology and the NIDA Clinical Trials Network, as well as certifications in Good Clinical Practice, Design and Conduct of Clinical Trials, Quality Science Education (Medical Devices & Pharmaceuticals), and Clinical Trials Analysis, Monitoring, & Presentation from Johns Hopkins University.

Pratt's journey began as a United States Air Force Medic in the Aerospace Medicine Squadron of the 42nd Medical Group. This foundational experience in medical practice was further enriched through roles in the Medical Device & Engineering industry, where Pratt served as a clinician for notable companies such as Stryker and Miami Orthopedics & Sports Medicine Institute. Currently, Pratt imparts his expertise as a professor at Keiser University in the Allied Health and Health Sciences department, contributing to the academic and professional development of future healthcare practitioners. Pratt's relationship with the research site is grounded in a commitment to advancing clinical practices and patient outcomes within orthopedics and medical technology. His involvement with the site is professional and objective, aimed at investigating the integration of unloader braces and exercise therapy interventions for athletes with knee osteoarthritis.

While Pratt brings a wealth of knowledge and experience to this research, it is recognized that personal and professional experiences may introduce potential biases, such as a predisposition towards integrated treatment modalities. To address these

biases, Pratt employed rigorous methodological approaches and sought extensive peer reviews to ensure the research's objectivity and validity.

Permission to Conduct Research

Permission to conduct this research was obtained from the Institutional Review Board (IRB) at Liberty University. The IRB, under the direction of the program director, reviewed and approved the study protocol, ensuring that all ethical guidelines and standards were met. Detailed documentation of the IRB's approval and written permission is provided in the appendix. This approval facilitated the subsequent steps of data collection and analysis, ensuring compliance with institutional and ethical requirements. The appendix contains the formal permission letter for reference.

Ethical Considerations

This doctoral project adhered to stringent ethical standards to ensure the ethical treatment of all participants. The study focused on athletes diagnosed with knee osteoarthritis. Participants were solicited through social media outreach in collaboration with healthcare facilities and sports medicine organizations, ensuring voluntary participation and informed consent. Comprehensive information about the study's purpose, procedures, potential risks, and benefits was provided to all participants prior to obtaining their consent.

To protect participants' identities, pseudonyms were used throughout the data collection and analysis process. Data were stored securely on password-protected digital devices and encrypted databases, accessible only to authorized personnel involved in the study. Physical documents, if any, were stored in locked cabinets.

The study received permission from the Institutional Review Board (IRB) at Liberty University, confirming that all ethical guidelines and standards were met. Documentation of IRB approval is included in the appendix. These measures ensured the confidentiality, privacy, and protection of all participants, upholding the integrity and ethical rigor of the research.

List of Abbreviations

AOFAS: American Orthopaedic Foot & Ankle Society

COPE: Committee on Publication Ethics

IRB: Institutional Review Board

IJSPT: International Journal of Sports Physical Therapy

OA: Osteoarthritis

Introduction

Overview

In the dynamic field of orthopedics and sports medicine, the integration of bracing and supports with exercise therapy and/or physiotherapy represents a promising frontier, poised to revolutionize the landscape of patient care and rehabilitation. This research embarks on a journey to explore the transformative potential of this integrated approach, illuminating its profound impact on patient outcomes and the quality of life for athletes grappling with knee osteoarthritis (OA).

Despite remarkable advancements in orthopedics and sports medicine, individuals contending with lower extremity conditions often encounter a labyrinth of challenges in their quest for holistic and efficacious solutions. From navigating complex symptomatology to addressing functional limitations, the pursuit of comprehensive care remains an elusive endeavor.

Through examination of the relationship between unloader bracing alongside exercise therapy and/or physiotherapy interventions, this study is used to assess the effectiveness of the unloader brace used in tandem with physical therapeutic interventions. By probing the multifaceted advantages of this integrated approach, aiming to alleviate the burdens of knee OA, optimize recovery trajectories, and bolster the mobility and functional capacities of athletes.

Introduction to the Problem

Despite remarkable advancements in orthopedics and sports medicine, a significant number of individuals with lower extremity conditions continue to encounter hurdles in accessing comprehensive and effective solutions tailored to their specific conditions, symptoms, and functional limitations. Among these innovative solutions, unloader knee braces have emerged as a crucial intervention for those with knee OA and other knee injuries. These braces are designed to reduce the load on the affected part of the knee joint, thereby alleviating pain and improving mobility. This situation highlights the pressing need for innovative approaches to improve patient outcomes and enhance their quality of life, as unloader knee bracing represents a promising yet underutilized option in the management of knee injuries.

According to Kosco et al. (2022), approximately 90% of individuals seeking orthopedics and sports medicine interventions suffer from lower extremity conditions, presenting diverse challenges in diagnosis and treatment. Furthermore, the American Orthopaedic Foot & Ankle Society (AOFAS) reported

that lower extremity conditions contribute to a substantial reduction in overall mobility and significantly impact daily activities and overall well-being (AOFAS Report, 2022).

In the past, conventional treatments predominantly focused on singular interventions, such as bracing or exercise therapy, often resulting in limited efficacy and leaving some aspects of patients' conditions unaddressed (Weber et al., 2022). While these interventions had merit in specific cases, they did not provide a comprehensive and integrated approach that catered to the diverse needs of individuals with knee OA. Presently, some healthcare providers have begun to recognize the importance of combining unloader knee bracing with exercise therapy interventions to offer more personalized and holistic care. The National Institute for Clinical Excellence (NICE) in their 2014 guidelines advocate for a holistic approach to osteoarthritis treatment. They highlight the inclusion of patient education and nonpharmacological treatments such as exercise, weight loss, and the use of aids and devices like knee braces, insoles, and walking sticks (Mistry et al., 2018). Although this integrated approach is gaining traction, it remains underutilized in mainstream sports medicine practices.

Knee (OA) poses a significant challenge in the realm of orthopedics and sports medicine. Affecting patients of all ages, including athletes, knee OA impedes functional abilities and quality of life. The prevalence of this degenerative joint condition necessitates a nuanced exploration of treatment strategies to optimize sports injury management. Various types of braces, such as unloader braces, functional braces, and prophylactic braces, along with diverse exercise therapies including physiotherapy, strength training, and range-of-motion exercises, are commonly utilized. Unloader braces, specifically designed to reduce the load on the knee joint, play a crucial role in managing knee OA by alleviating pain and enhancing mobility.

Recognizing the persistent challenges and obstacles faced by individuals with knee osteoarthritis and the limitations of previous and current methodologies, this introduction lays the foundation for investigating the vast potential of integrating bracing and supports with exercise therapy interventions. This approach has the potential to revolutionize orthopedics and sports medicine by offering patients personalized, efficacious, and comprehensive solutions that elevate their overall well-being and functional capabilities.

The complex interplay between unloader braces and exercise therapy interventions in the sports medicine

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context necessitates a thorough investigation. This project aims to explore the perceived effects of integrating these interventions, examining their efficacy in improving functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis. Through this research, the potential of combining unloader bracing and exercise therapy to address the multifaceted needs of patients with knee OA will be elucidated, paving the way for more effective and holistic treatment strategies.

Purpose Statement

The purpose of this research is to examine the perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine. This study aims to provide insights that can enhance the management of orthopedic and sports injuries, specifically focusing on athletes diagnosed with knee osteoarthritis. By exploring the interaction between unloader bracing and exercise therapy, the research goal is to offer evidence-based recommendations for optimizing treatment strategies tailored to the unique needs of patients and athletes. To achieve this purpose, a descriptive research approach was employed, comprising interviews with athletes diagnosed with knee osteoarthritis who have undergone integrated approach of unloader bracing and exercise therapy.

Central Research Question

Research Question 1: What are the experiences and perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis?

Research Question 2: How do athletes diagnosed with knee osteoarthritis perceive the impact of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on their functional abilities, pain management, and overall well-being?

Literature Review

Overview and Theoretical Framework

Osteoarthritis (OA) is a common musculoskeletal disease affecting the knee joint across populations. Knee osteoarthritis in particular is a degenerative joint disease that occurs due to the progressive breakdown and loss of articular cartilage in the knee (Semenistaja et al., 2023). While there is no treatment for the disease, several pharmacological, non-pharmacological, and surgical options are available and currently used in patients with knee OA to

manage the condition (Dantas et al., 2021). However, these treatment options have diverse clinical responses and inconsistent conclusions across various professional guidelines. Studies about the effectiveness of integrative approaches to treating knee OA are limited, specifically, those integrating knee unloader braces and exercise therapy and/or physiotherapy interventions as opposed to conventional treatments for knee osteoarthritis in patients and athletes. This chapter examines the literature on knee osteoarthritis interventions, emphasizing studies related to unloader braces and exercise therapy and/or physiotherapy in orthopedics and sports medicine. The literature review is structured around the Transtheoretical Model. Based on this model, the relevant studies in the literature have been analyzed with regard to the use of knee unloader braces and exercise therapy in comparison to conventional approaches to managing knee OA. This theoretical framework is selected because it presents a comprehensive approach to understanding how patients respond through different interventions and can help identify effective strategies that can prompt a widespread adoption of integrative knee unloader braces and exercise therapy and/or physiotherapy intervention in the management of the disease.

Characteristics/Biomechanical Considerations

The primary changes with knee OA occur in the articular cartilage and the subchondral bone. Heijink et al. (2012) highlight that age is a major risk factor for the disease, with the two being interrelated. Little or no cell division or cell death occurs in adult articular cartilage, which is largely avascular because chondrocytes are long-lived cells that can accumulate age-related changes. As time progresses, aging alters the matrix structure and functioning of chondrocytes. In addition, articular cartilage is susceptible to the accumulation of advanced glycation end products from spontaneous nonenzymatic glycation of proteins following a relatively low turn-over rate (Heijink et al., 2012; Loeser, 2010). Modification of collagen by advanced glycation end-products (AGEs) formation leads to high collagen cross-linking, which renders the cartilage more brittle with increased fatigue failure (Loeser, 2010). Shane Anderson and Loeser (2010) mentioned that AGEs could contribute to OA by affecting both the mechanical properties of cartilage and the cellular functions within it. AGE formation modifies collagen, leading to increased cross-linking of collagen molecules. The most prevalent AGE-related cross-link, pentosidine, accumulates in

cartilage with age. Excessive collagen cross-links alter the biomechanical properties of cartilage, resulting in increased stiffness and brittleness, thereby making the tissue more susceptible to fatigue failure. Additionally, elevated levels of AGEs in cartilage are associated with a decline in anabolic activity (Shane Anderson & Loeser, 2010). It is important to understand early in the development of the disease since they could be reversible, thus initiating preventive treatment to reduce the progression of the disease, especially in young patients.

Abnormal or altered knee joint biomechanics, cartilage loading and overloading, cartilage defects, loss of meniscal tissue, malalignment, and joint instability are considered important biomechanical factors that contribute to the development and progression of knee OA (Farrokhi et al., 2013; Heijink et al., 2012). Joint loading triggers metabolic responses in articular cartilage. Normal synovial joints can withstand repetitive loading during various everyday activities, such as walking, running, climbing stairs without the risk of osteoarthritis. The synovial joints are designed to handle the stresses of daily movements. However, if the mechanical loading demand exceeds the tolerance, i.e., the ability of the articular cartilage to self-repair and maintain, the risk of developing all forms of joint degeneration increases. Excessive mechanical surface loading can directly cause damage to articular cartilage and subchondral bone, and also significantly affect the proper functioning of chondrocytes (Zhu et al., 2020). Experimental observations have shown that the maximum impulsive contact stress that cartilage can withstand is 25 MPa (Heijink et al., 2012). Articular cartilage in the knee joint can withstand 100–200 million imposed loading cycles under its lifetime. The tissue can tolerate contact pressures of 3-5 MPa during walking, which involves both compression and shearing forces on the knee joint (Mostakhdemin et al., 2021). Malalignment of the knee is linked to an increased occurrence and progression of structural changes in joint tissues, as detected through radiographic imaging. The tibiofemoral force in a normally aligned knee is directed through the medial side of the knee. The pressure increases to peak during walking and climbing upstairs (Heijink et al., 2012). When varus or valgus deformities occur in the lower extremity, the load distribution across the articulating surfaces of the knee joint (medial and lateral tibiofemoral compartments) is abnormally affected, leading to uneven stress on the knee joint. According to Heijink et al. (2012), cartilage defects

occur as partial-thickness and full-thickness lesions, which often progress into osteoarthritis. The authors affirm that stresses are high at the rim of the defect, contributing to the overloading of the cartilage and predisposition to osteoarthritic changes (Heijink et al. 2012).

Patients with knee OA experience joint laxity and instability. Instability is a condition where the knee feels loose and wobbly. According to Kawabata et al. (2020), joint instability is associated with ligament injury leading to altered knee joint movement and contact mechanics. Muscle weakness contributes to the joint laxity and instability, which is critical for knee stabilization during joint loading and motions such as sliding, rotation, and rolling (Kawabata et al., 2020). The research by van Tunen et al. (2018) has suggested that medial varus laxity is more pronounced than lateral valgus laxity in patients with knee OA. Possible explanations for this include the loss of cartilage and weakening of the medial collateral ligament on the medial compartment, and the increased stress and strain as the varus alignment shifts more weight onto the medial compartment (Ishii et al., 2018). In addition, a significant loss of structural tissues, such as ligaments, cartilage, and menisci, resulting from injury or iatrogenic meniscectomy, can permanently alter the biological and biomechanical environment of the knee joint. These tissues play a role in maintaining joint stability distributing load and facilitating smooth movement. When these tissues are damaged or removed, it disrupts the normal function and balance within the knee, leading to changes in the joint's mechanical properties, which can result in increased stress, abnormal wear, and potential progression of degenerative conditions such as osteoarthritis.

Effectiveness of Unloader Braces

Knee braces are widely utilized in both the prevention and treatment of knee injuries. The American Academy of Orthopaedic Surgeons categorizes knee braces into four distinct types based on their function: Prophylactic, Functional, Rehabilitative, and Unloader/off-loader braces. Each type serves a unique purpose and is designed to address specific needs of individuals with knee conditions.

Prophylactic Braces

Prophylactic braces are designed to protect the knee from injuries during high-risk activities, particularly in contact sports such as football and hockey. These braces are typically worn by athletes to reduce the likelihood of knee injuries by providing external support to the knee joint. They are constructed with

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materials that offer rigidity and durability, effectively absorbing and distributing forces that could otherwise cause harm to the knee ligaments and surrounding structures.

Functional Braces

Functional braces are used to provide stability and protection to the knee ligaments following an injury or surgical repair. These braces are commonly recommended for individuals who have undergone ligament reconstruction, such as an anterior cruciate ligament (ACL) surgery. Functional braces are designed to support the knee during rehabilitation and everyday activities, helping to prevent further injury while allowing for a gradual return to normal function. They are often adjustable and can be tailored to provide the appropriate level of support needed during different stages of recovery (Hewlett & Kenney, 2019).

Rehabilitative Braces

Rehabilitative braces are used during the early stages of healing after a knee injury or surgery. These braces are designed to control knee movement, restricting harmful motions while allowing safe range of motion necessary for healing. Rehabilitative braces are often prescribed to limit knee flexion and extension, preventing excessive strain on the healing tissues. They are typically worn for a specified period, during which they help to protect the knee, reduce pain, and facilitate a more controlled and effective rehabilitation process (Hewlett & Kenney, 2019).

Unloader/off-loader Braces

Unloader or off-loader braces are primarily used for individuals with knee osteoarthritis (OA). These braces are specifically designed to relieve pain and improve physical function by redistributing the load away from the damaged compartment of the knee. They apply a gentle force to shift the weight-bearing load from the affected area to a healthier part of the knee, thereby reducing mechanical stress on the arthritic compartment. Unloader braces are used in managing symptoms of knee OA, providing pain relief, and slowing the progression of the disease. They are particularly beneficial for patients seeking non-surgical options to manage their condition.

Each type of knee brace is tailored to address specific needs, offering targeted support and protection to enhance knee function, alleviate pain, and aid in the recovery process. According to Ramsey and Russell (2009), pain relief occurs via the distraction of the compartment experiencing the applied forces. The applied load is shifted from the degenerative compartment to reduce mechanical stresses.

Ramsey and Russell (2009) investigated the evidence in the literature regarding the efficacy of unloader knee braces for improving the symptoms associated with knee OA. Their findings suggested that unloader knee braces can effectively reduce knee pain, improve stability, and reduce the risk of falling for knee OA patients (Ramsey & Russell, 2009). Thus, bracing can be used before considering joint realignment or replacement surgery. These findings are also supported by the results of a similar study conducted by Beck et al. (2023) on the effect of unloader bracing on damaged cartilage in patients with OA. The study findings revealed that unloader bracing reduces pain and improves knee function by improving the biomechanical properties of the damaged cartilage. This is achieved through increased collagen and proteoglycan concentration, and reduced cartilage edema.

In another study, Holden et al. (2021) designed a trial to determine the effectiveness of combined knee bracing intervention and a package of guided advice, exercise therapy, and adherence support in managing knee OA. The outcomes of the study suggested that tibiofemoral unloading braces can provide short-term improvements in knee pain and function. Hsieh et al. (2020) compared the effect of unloading a knee brace with physical therapy in Asian patients with knee OA in the short term. The results of this comparative study showed that there were no significant differences between the two treatment approaches in terms of pain relief, patient satisfaction, and function and quality of life. Gueugnon et al. (2021) also conducted a study to compare the effectiveness, safety, and cost-efficiency of a knee brace against usual care over twelve months in medial knee OA. The findings of this study demonstrated that an unloader custom-made knee brace provides significant benefits in terms of pain relief, improved knee function, and improved quality of life, and is cost-effective over twelve months in medial knee OA. Many other studies (Briggs et al., 2012; DeRogatis et al., 2019; Holden et al., 2021; Parween et al., 2019; Robert-Lachaine et al., 2020) support these findings. A study by Ostrander et al. (2016) reported that an unloader brace for knee OA helps reduce pain and arthritis symptoms, and the ability to perform physical activities.

Exercise therapy and/or physiotherapy & Rehabilitation Interventions

Exercise therapy and/or physiotherapy and rehabilitation interventions are widely recommended in primary care settings for the treatment and management of knee OA. Rehabilitation

interventions for knee OA primarily comprise non-pharmacological and nonsurgical treatment approaches. These include exercise therapy, biomechanical interventions, physical activities and strength training, weight management, and patient education (Nguyen et al., 2016). Biomechanical interventions include assistive devices, orthoses, taping, knee braces, and other physical modalities (Küçükdeveci, 2023). Exercise therapy for knee OA is divided into two modalities: aerobic exercise and analytic exercise. Aerobic exercise aims to improve physical performance, while analytic exercise aims to improve range of motion, increase muscle strength, and reduce loading of the symptomatic joint compartment. Nguyen et al. (2016) highlight that analytic exercise should be based on the evaluation of the knee joint and muscle impairment. Exercise therapy for OA aims to improve the range of motion of the joint, lengthen muscle and tendon, increase strength and endurance, and reduce pain and loading on the symptomatic compartment (Nguyen et al., 2016; Suzuki et al., 2019; Zeng et al., 2021). Consequently, functional improvements are expected in daily activities, including walking and sport. There are various modalities of exercise treatments available, the choice of which depends on the rhythm, duration, type/technique, and whether the exercise is supervised by a physiotherapist.

Mo et al. (2023) meta-analysis identified the most effective exercises for knee OA by considering pain, stiffness, joint function, and quality of life. The study involved randomized controlled trials in which the effectiveness of five different land – and water-based exercise therapies on knee OA was investigated. The five types of exercise therapies were traditional exercise, aquatic exercise, resistance training, stationary cycling, and yoga. Based on the findings of all the studies included in the meta-analysis, it was concluded that all five types of exercise were effective in ameliorating knee OA. However, aquatic exercise and yoga were the most effective types of exercise therapies. Several other studies have demonstrated the effectiveness of physical exercise in improving pain and functionality in patients with knee OA (Goh et al., 2019; Raposo et al., 2021; Rocha et al., 2020; Zeng et al., 2021; Young et al., 2023). Various self-guided and group-based knee OA exercise therapy programs are currently available around the world for OA patients (Young et al., 2023).

Chao et al., (2021) compared the effect of exercise rehabilitation and conventional treatment in patients with knee OA. The experimental group was subjected to systematic exercise rehabilitation, while the control

group received pharmacological interventions of naproxen, diclofenac, or celecoxib. The outcomes in the two groups were measured by considering improvement in symptoms, knee function, and quality of life. After twelve weeks of follow-up, it was found that patients exposed to exercise rehabilitation recorded improved symptoms and quality of life than those achieved with pharmacological drug interventions. Exercise therapy helps reduce pain and the breakdown of articular cartilage, and improves knee function and quality of life. While this study concluded that exercise rehabilitation is better in the treatment of patients presenting with knee OA than treatment with conventional drugs, it is thought that an integrated approach that combines pharmacological and non-pharmacological interventions would provide a more effective and optimized knee OA treatment. In another study, Webb et al. (2023) demonstrated that pain and functional outcomes were better or the same in group exercise therapy and rehabilitation programs than in individual therapies. In addition, physiotherapists require fewer clinical hours per patient to deliver. This could help address the problem of underutilizing physical therapy for knee OA due to the high demand for the service and the limited availability of physiotherapists in some healthcare settings.

Common Interventions

Knee OA cannot be reversed, but there are interventions designed to reduce pain and improve knee function. Current interventions are broadly classified into four types: pharmacological interventions, non-pharmacological interventions, adjunct therapies, and surgical procedures. Pharmacological interventions include the use of drugs such as non-steroidal anti-inflammatory drugs (NSAIDs), opioids, and nutraceuticals (Cai et al., 2021; Primorac et al., 2021; Richard et al., 2023). Non-pharmacological interventions include strategies such as patient education, exercise therapy, and weight management (Ettlin et al., 2021; Moseng et al., 2024; Sharma et al., 2019). Adjunct therapy interventions used in treating knee OA include thermal modalities, laser therapy, manual therapy, taping, acupuncture, therapeutic ultrasound, and transcutaneous electrical nerve stimulation, among other techniques. Dantas et al., (2021) highlighted physical exercise, weight management, and patient education as the first-line knee osteoarthritis approaches which are critical for the progressiveness of potential treatment of OA patients.

Surgical procedures are typically considered the last option for OA treatment after the other interventions

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prove ineffective. According to Fukui et al., (2022), patient reluctance and the cost of surgery also influence the decision for surgical options. Common arthroscopic knee surgery options include arthroscopic joint lavage, realigning bones, and knee joint replacement. Although orthoscopic joint lavage is among the most commonly used surgical procedures, Dantas et al., (2021) note that several studies have demonstrated the poor effect of this intervention in terms of pain relief and physical function improvement in patients with knee OA. Arthroscopic joint lavage also increases the chances of performing a knee replacement surgery and associated risks. Osteotomy is a bone realignment surgical procedure that involves cutting the bone to remove or add a wedge bone to shift the applied force from the injured part (Palmer et al., 2019). Joint replacement involves the removal and replacement of the damaged joint surfaces with metallic or plastic parts. The artificial joints may wear out over time and need replacement (Mayo Clinic, 2021). For severe, end-stage knee OA, total knee replacement or joint arthroplasty using plastic or metallic parts is the only established surgical option (Madry, 2022). However, arthroplasty is associated with an increased risk of postoperative infection (Peng et al., 2021). Other procedures include cortisone injections and lubrication injections. However, these injections provide short-term pain relief.

Functional Improvements in Population

The prevalence of knee OA varies by geographic region and the types of activities an individual is frequently engaged in. Sporting activities involve frequent knee flexion, and the pressure exerted on the knee can trigger OA. The risk factors for the development of knee OA in most countries are older age, sex, obesity, meniscal injuries and altered joint alignment, contralateral osteoarthritis, muscle weakness, occupational kneeling, squatting, and previous knee trauma (Bakirhan et al., 2017; Driban et al., 2020; Haider et al., 2022; Moghimi et al., 2019). The management and prevention of knee OA as a health problem in the general population begins by addressing these risk factors.

According to Dantas et al. (2021), education and exercise can improve knee function in persons with knee OA. A randomized trial study by Rezende et al., (2021) suggested that adding a two-day educational program to usual care improved knee function and strength in patients with OA. Other studies also report that integrating patient education with exercise therapy improves knee pain and function in patients with OA (Goff et al., 2021; Zeng et al., 2021). Duong

et al. (2021) emphasize that for knee OA interventions to benefit people, adherence is critical. Higher adherence to treatments has been identified as one of the key predictors of better outcomes for people with knee OA in the long term.

Measuring Impact

The impact of evidence-based practice on the rehabilitation of knee OA in patients can be evaluated using appropriate outcome measures. Researchers have employed various outcome measures in their trial studies for diagnosis, prognosis, and rehabilitation of patients with knee OA. Samuel & Kanimozhi, (2019) have highlighted some of the commonly used outcome measures used under radiological, arthroscopic, and functional classifications. The table below (Table. 1) provides a summary of the outcome measures that are used as knee OA scales for measuring impact.

The outcome measures under radiological classification are used in the diagnosis of knee OA. Arthroscopic classification provides outcome measure scales with detailed chondropathy, including the size, consistency, and location of lesions in knee OA. The impact measurement scales under functional classification are used to measure the functional benefit of knee OA interventions (Samuel & Kanimozhi, 2019). Measuring outcomes of treatment interventions in clinical settings is an age-long evidence practice. It provides the mechanism by which healthcare providers, patients, and researchers can assess the outcomes of a treatment intervention and its effect on the health of a patient and society. The overall goal is to improve patient care and advance healthcare delivery systems (Pantaleon, 2019). Healthcare professionals and researchers must use appropriate scales for documenting patient progression. This is important in the health care delivery system for clinical decision-making.

Limitations

Most studies in the literature have considerably small samples of knee OA patients to study various aspects of the condition. Future studies should provide a larger sample size to further validate the effectiveness of different interventions for knee OA. Although some studies have focused on an integrative approach to the treatment of knee OA, no study has specifically considered the integration of unloader braces and exercise therapy and/or physiotherapy/rehabilitative interventions within the orthopedics and sports medicine domain. Although there is a consensus on the effectiveness of using unloader braces in managing knee OA, Beck et al., (2023) note that the

effect mechanism of bracing has been surrounded by a debate. Does the benefit of bracing justify the potential cost and discomfort? This question can be evaluated in the context of the use and purpose of using a knee brace. Currently, there is no quantitative evidence in the literature supporting the use of braces as an effective treatment for knee OA, and how it

affects the knee joint ligaments, cartilages, and bones in both short-term and long-term. In addition, there was a lack of systematic studies that examine the effects of braces on soft tissues and the biomechanical impact of these devices on the different compartments of the knee joint.

Table 1: Knee OA scales for impact/outcome measures (Samuel & Kanimozhi, 2019)

Classification	Impact/outcome measure scales
Radiological	Kellgren and Lawrence (K&L) system
	Ahlbäck
	International Knee Documentation Committee (IKDC)
	Fairbank system
	Osteoarthritis Research Society International Joint Space Narrowing (OARSIJSN)
	Whole-Organ Magnetic Resonance Imaging Score (WORMS)
	Brandt radiographic grading scale
	Ultrasonographic Grading Scale for Severity of Primary Knee Osteoarthritis (UGSSPKOA)
	Jager-Wirth system
Arthroscopic	French Society of Arthroscopy (FSA)
	Collins classification system
	Modified Collins system
	Outerbridge system
Functional	Western Ontario and McMaster University (WOMAC)
	Knee Osteoarthritis Outcome Score (KOOS)
	Community Balance and Mobility Scale (CBM)
	Short Form 36 Arthritis Specific (SF 36 ASHI)
	Functional Status Index (FSI)
	Knee Society Scoring System (KSSS)
	Knee Osteoarthritis Fears and Beliefs Questionnaire (KOFBeQ)
	Osteoarthritis Severity Indices of Lequesne (LEQUESNE)
	Arthritis Impact Measurement Scales (AIMS)
	Ibadan Knee Osteoarthritis Outcome Measure (IKHOAM)
	Comprehensive osteoarthritis test (COAT)
	Medical Outcomes Study Questionnaire Short Form 36 Health Survey (MOS SF-36)
	Tegner lysholm knee scoring scale (TLKSS)
	Oxford knee score (OKS)

Summary

Osteoarthritis (OA), the most prevalent joint disorder in the United States, stands as a leading cause of disability among mostly the elderly population. This chronic condition, primarily affecting weight-bearing joints like the knee, manifests through pain, impaired physical function and other adverse effects significantly impacting quality of life. Radiographically present in 33% of the population aged over 60, symptomatic knee OA (SOA) is reported in approximately 10% of men and 13% of women in this age group (Dhillon et al., 2023).

This literature review explores the intricate landscape of interventions for knee osteoarthritis, emphasizing the imperative need for effective and cohesive approaches for the orthopedic and sports medicine population. The current interventions fall into four categories: pharmacological, non-pharmacological, adjunct therapies, and surgical procedures. Pharmacological options involve drugs like non-

steroidal anti-inflammatory drugs (NSAIDs), opioids, and nutraceuticals, while non-pharmacological strategies encompass patient education, exercise therapy, and weight management. Additionally, adjunct therapies, such as thermal modalities and acupuncture, are used alongside surgical procedures.

As the review progresses, a critical examination of existing treatments reveals diverse clinical responses and inconclusive outcomes within professional guidelines. The significant gap in understanding integrative approaches, specifically the combination of knee unloader braces and exercise therapy and/or physiotherapy interventions, emerges as an area ripe for exploration and advancement in orthopedics and sports medicine. Building upon existing knowledge and clarifying the role of integrative interventions, this review navigates through the literature with a focused lens on studies related to unloader braces and exercise therapy and/or physiotherapy/exercise therapy.

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Methodology

Overview

This chapter discusses the methodology employed in investigating the integration of unloader braces and exercise therapy and/or physiotherapy interventions for the management of knee osteoarthritis (OA) among athletes. Orthopedics and sports medicine recognize knee OA as a significant challenge that hinders the well-being of many people, including athletes, because it limits their functional capabilities (Thelin et al., 2006). Despite the advanced technology enabling healthcare settings to make tremendous advancements regarding knee OA treatment, some care centers are facing difficulties in comprehending the comparative effectiveness of integrated interventions versus conventional treatments (Dantes et al., 2021). The study adopts a descriptive research methodology involving interviews to comprehensively explore the perspectives of the participants. The study utilized a descriptive research design, leveraging a qualitative research approach utilizing interviews to examine diverse perspectives related to athletes diagnosed with knee OA. The researcher qualitatively measured variables, including functional abilities and overall well-being, to gain objective insights into the efficacy of the integrated approach compared to conventional treatments. Many local, regional, and global healthcare providers and professionals in the realm of orthopedics and sports medicine will utilize the study findings to potentially inform their clinical practice guidelines and optimize treatment approaches that will optimally benefit the well-being and performance of athletes.

Research Questions

RQ1: What are the experiences and perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis?

RQ2: How do athletes diagnosed with knee osteoarthritis perceive the impact of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on their functional abilities, pain management, and overall well-being?

Research Design

The study adopted a descriptive research design comprising interviews. Descriptive research design allows researchers and scientists to collect

information regarding a specific phenomenon or group (Aggarwal & Ranganathan, 2019). A qualitative approach was employed, utilizing interviews, to capture a qualitative perspective on the experiences and opinions of the participants. Descriptive research methodology was utilized, aligning with the approach of describing and analyzing phenomena as they naturally unfold without intervention in variables (Aggarwal & Ranganathan, 2019). Semi-structured interviews were conducted to gain a deeper perspective into emergent themes and further explore participants' experiences. As articulated by DeJonckheere and Vaughn (2019), semi-structured interviews afford researchers the opportunity to employ predetermined open-ended questions supplemented with probes and comments (DeJonckheere & Vaughn, 2019). To guide the interviews, the researcher developed an interview guide focusing on perceived benefits, encountered challenges, treatment experiences, and recommendations for enhancement, drawing insights from the survey results and relevant literature.

Participants/Population

A purposive sampling method was employed to ensure a diverse representation of experiences among athletes with knee osteoarthritis (OA). Recruitment continued until data saturation was reached, defined as the point at which no new themes or significant information emerged from subsequent interviews. The research involved recruiting people who self-identify as athletes experiencing knee osteoarthritis, primarily sourced from professional networking platforms such as LinkedIn and various social media channels. The recruitment phase spanned from June 12, 2024, to June 29, 2024. To maintain homogeneity and alignment with the research objectives, rigorous inclusion criteria were established. Eligible participants were 18 years or older, ability to walk unaided, and have been diagnosed with knee osteoarthritis. Additionally, participants must have been willing to participate in an interview regarding their experiences with knee osteoarthritis and integrated interventions. Athletes included in this cohort were defined as individuals actively engaged in sporting or physical activities despite their knee osteoarthritis diagnosis, either clinically or radiographically confirmed. Exclusion criteria encompassed a history of other knee joint disorders other than osteoarthritis (OA), inability to walk unaided, and any condition or circumstance that may compromise the participant's ability to provide informed consent or participate meaningfully in interviews.

Study Procedure

Researchers must plan and prepare before conducting their studies to determine the attendance of all the members involved, and the steps that the team will take to navigate the practicalities of the study, including the documentation of the results (Asenahabi, 2019). Ethical clearance for the research protocol was obtained from the institutional review board (IRB), and informed consent was obtained from each participant prior to their engagement in their interview, ensuring adherence to ethical guidelines and principles of research conduct. The study was conducted with minimal risks and optimal benefits while safeguarding the safety, rights, and well-being of all human subjects involved. Recruitment and engagement of participants was facilitated through social media platforms, particularly LinkedIn, which offered access to diverse backgrounds and a streamlined approach to reaching a large pool of potential participants efficiently (Darko et al., 2022). The method allowed for the definition of diversity criteria, screening and selection of participants, motivation, and accommodation of their needs, thereby enhancing the recruitment process. Recruitment advertisements or calls for participation was posted on LinkedIn, targeting orthopedics professional groups, sports-related communities, rehabilitation, and sports medicine enthusiasts.

Interactive and visually appealing content was utilized in recruitment posts to attract more traffic and capture the attention of participants. Additionally, personalized outreach messages was sent to individuals matching the desired participant profile to build trust, enhance lead generation, and establish relationships with potential participants, thereby increasing participation potential (Hartemo, 2021). Ethical considerations were paramount throughout the recruitment process, ensuring informed consent, confidentiality, and confidentiality of participant responses, in strict adherence to ethical guidelines governing research involving human participants.

Interviews were conducted to gather a deeper perspective into participants' experiences, opinions, and perspective regarding integrated interventions for knee osteoarthritis management. These interviews were scheduled at mutually convenient times for both the researcher and the participants, allowing for in-depth exploration of individual perspectives. Prior to the interviews, participants provided a signed copy of their consent form and were provided with an overview of the interview process and informed about their rights, confidentiality measures, and the purpose of the study.

The interviews were semi-structured, allowing for flexibility while ensuring that key topics were covered consistently across all interviews. Open-ended questions were used to encourage participants to share their experiences freely, while probing questions were employed to elicit further detail and clarification as needed. The interviews were written and synthesized with participants' consent to ensure accuracy and facilitate subsequent analysis.

This approach to data collection enabled the ability to capture a qualitative perspective into participants' experiences with integrated interventions for knee osteoarthritis management. By utilizing interviews, a richer understanding of the effectiveness, challenges, and potential improvements of these interventions were attained, facilitating a deeper analysis and interpretation of the study findings.

Data Analysis

The data analysis followed a thematic analysis approach, as outlined by Braun and Clarke (2006), a qualitative method well-suited for exploring the experiences of athletes with knee osteoarthritis. Thematic analysis allowed room to systematically identify, analyze, and report patterns within the data, providing an in-depth understanding of the participants' perspectives on their condition and the integrated interventions they had undergone.

The data analysis procedure began with the transcription of all interview responses. This step involved converting the responses into written text, creating a reliable and accessible record for detailed examination. In terms of tools, NVivo a qualitative data analysis software in congruent with Excel was utilized to assist in the coding and organization of data. This enhanced the transparency of the analysis, making room to manage the datasets effectively and ensuring systematic coding and theme development.

Following transcription, there was the reading and re-reading of the transcripts to become thoroughly familiar with the content in developing an initial understanding of the data and identifying preliminary ideas and patterns. In the coding phase, there was a systematically assigning of labels or subthemes to specific segments of the text that correspond to the research questions. The codes were both deductive, based on the interview questions, and inductive, emerging organically from the data. Responses to questions about the impact of knee osteoarthritis on athletic performance and daily life, initial diagnosis experiences, and the effectiveness of interventions were coded into categories such as "Impact on Athletic Performance," "Experiences with Diagnosis,"

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and "Effectiveness of Interventions."

After coding, there was a search for themes by grouping related codes together which are broader patterns that encapsulate significant aspects of the data. Codes related to the emotional and physical challenges of living with knee osteoarthritis were grouped under a theme titled "Experiences with Diagnosis," while those related to the benefits and barriers of integrated interventions formed a theme titled "Effectiveness of Integrated Interventions." The identified themes were then reviewed and refined which involve checking the themes for coherence and ensuring they accurately represent the data. The themes were merged, split, or redefined as necessary to better capture the essence of the participants' experiences. Once refined, each theme was then clearly defined and named to reflect its content accurately.

Data saturation was achieved after conducting and analyzing six interviews. During the interview process, it became evident that recurring themes and patterns were consistently emerging. An additional interview did not yield new insights, confirming that saturation had been reached. This ensured the robustness and comprehensiveness of the collected data.

Summary

Choosing thematic analysis lies in its ability to capture the depth and complexity of human experiences allowing for a flexible yet structured approach to analyzing the qualitative data, making it ideal for the research objectives and revelations in understanding of how knee osteoarthritis and its management impact athletes, thereby informing more effective and tailored interventions. The coding and theme processes were iterative and involved multiple rounds of review. Themes were identified, reviewed, and refined to ensure they accurately represented the participants' experiences. The analysis continued until no new themes were identified, confirming that data saturation had been reached. The point of saturation was determined during the thematic analysis phase. After coding the first five interviews, it was observed that no new themes were emerging. One additional interview was conducted to ensure thoroughness, and it was confirmed that saturation had been achieved, as no novel information was found. This iterative process validated the comprehensiveness of the data collection.

Delimitations, Assumptions, and Limitations

Delimitations

This research specifically centered around athletes

diagnosed with knee OA who have undergone integrated interventions of unloader braces and exercise therapy and/or physiotherapy. This approach delimits the study to a specific population subset because it excludes non-athletic individuals and those with different treatment approaches. Additionally, time constraints had propelled the researcher to conduct the study within a certain timeframe which had delimit the ability to capture long-term outcomes or trends associated with the subject under study.

Assumptions

The researcher assumed that integrated interventions of unloader braces and exercise therapy are effective and safe for managing knee OA among athletes. The researcher based this assumption on existing literature and clinical evidence supporting the efficacy of these interventions individually (Ostrander, et al., 2016; Weber et al., 2022; Young et al., 2023). The researcher assumed that the participants had accurately reported their experiences, and adherence to treatment protocols and outcomes related to integrated interventions. These assumptions rely on the reliability and honesty of participant self-reports. The researcher also assumed that the selected outcome measures, data collection methods, and assessment tools, are valid and reliable indicators of the effects of integrated interventions on the various variables measured among athletes with knee OA.

Limitations

Despite the descriptive approach adopted in this study, several limitations merit consideration. Firstly, the sample recruited through LinkedIn did not fully represent the diversity of athletes diagnosed with knee osteoarthritis, potentially limiting the generalizability of study findings to broader populations. Additionally, challenges associated with social media recruitment, such as verifying participant eligibility criteria and ensuring a diverse and representative sample, may have affect the validity of the study results. Furthermore, logistical constraints related to conducting qualitative interviews, particularly in remote settings, may impact the depth and quality of data collected.

Summary

This study had investigated the integration of unloader braces and exercise therapy interventions for managing knee osteoarthritis (OA) among athletes. Adopting a descriptive research design, the study employed interviews to gather insights from participants. Leveraging social media platforms like LinkedIn facilitated the recruitment of a diverse

participant pool. Comprehensive interpretation of findings is achieved through descriptive statistics, comparative analysis, and qualitative analysis. Delimitations, assumptions, and limitations were identified to clarify the study's scope, context, and constraints. These encompass the focus on athletes, descriptive study design, and limitations like sample size constraints and data availability. Ultimately, the study aimed to provide a valuable perspective into the efficacy and safety of integrating interventions for knee OA management among athletes, contributing to enhanced clinical practice and improved quality of care in this population by addressing these gaps in knowledge.

Findings

Overview

In this chapter, the results of the study are reported. A description of participant demographics is provided, along with an introduction to individual participants. The researcher elaborates on themes that emerged from the thematic analysis of the interviews conducted with athletes managing knee osteoarthritis (OA) using unloader braces and exercise therapy. The thematic analysis identified several key themes, including Experiences with Diagnosis, Effectiveness of Integrated Interventions, Adherence to Treatment Plans, Overall Quality of Life, and Significant Improvements and Changes. Data saturation was achieved after 6 interviews, ensuring that the findings comprehensively represent the participants' experiences.

Demographics and Participant Introductions

Recruitment for the study proved challenging throughout the data collection phase. Archard and O'Reilly (2022) highlighted the challenges associated with recruiting participants for qualitative research, noting that recruitment can be hindered by systemic barriers and participants' reluctance to engage in what they perceive as time-consuming and burdensome research, especially when the study explores sensitive topics. This reluctance may stem

Table 1.1: Participant Demographics

Participant #	Age	Gender	Activity/Sport	Knee OA Location
1	30	Male	Running	Medial
2	28	Female	Basketball	Lateral
3	35	Female	CrossFit/Swimming	Medial
4	40	Male	Weightlifting	Lateral
5	32	Female	Soccer	Medial
6	27	Female	CrossFit	Lateral

Participant 1

Participant 1 is a 30-year-old male who is an avid runner and recreational athlete. He discovered he

from concerns about privacy, the perceived intrusiveness of the research process, or apprehensions about discussing personal experiences or sensitive issues openly. These factors contribute to the complexities researchers face in attracting and retaining participants, particularly in studies that delve into personal or emotionally charged subjects (Archard & O'Reilly, 2022).

Initially, traction through social media was minimal however, several potential participants expressed interest in the study. However, when asked to sign a consent form, many became hesitant about providing their signatures, resulting in their decision not to schedule an interview. This reluctance to sign the document presented difficulties in recruiting participants for research involving personal health information. Despite these obstacles, recruitment efforts through LinkedIn and the practicum preceptor's customers/patients network proved successful, ultimately leading to the recruitment of six individuals who met the study's inclusion criteria.

All participants reside within the continental United States, a geographically diverse sample (Table 1.1.). The participants range in age from 27 to 40 years old, which provided a varied perspective on the experiences of athletes across different stages of adulthood. The gender distribution includes both male and female participants, further contributing to the diversity of the sample.

The participants are actively involved in a variety of sports, including running, basketball, swimming, weightlifting, soccer, and CrossFit which captured a broad spectrum of athletic experiences and the impact of knee osteoarthritis (OA) across different physical activities. The location of knee OA among participants is also diverse, with some individuals experiencing medial knee OA and others dealing with lateral knee OA. The table below summarizes the demographic information of the participants, including their age, gender, sport, and the location of their knee OA:

had medial knee osteoarthritis after experiencing persistent pain during and after his runs. Determined to continue his passion for running, he sought medical

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advice and received his diagnosis. Participant 1 wanted to share his story to raise awareness about the condition and to contribute to research that could help other athletes manage their symptoms and continue their athletic pursuits.

Participant 2

Participant 2 is a 28-year-old female who played basketball at the college level and continues to engage in the sport recreationally. She noticed pain and swelling in her knee after games and practice sessions, leading her to seek a medical evaluation. The diagnosis of lateral knee osteoarthritis was initially disheartening, but her determination to remain active drove her to explore treatment options. By participating in this study, she hopes to shed light on the challenges faced by athletes with OA and to support the development of effective management strategies.

Participant 3

Participant 3 is a 35-year-old female who enjoyed recreational CrossFit in her early 20s and also swimming both competitively in her youth and now as a recreational activity. She began experiencing pain and stiffness in her knee, which interfered with her swimming routines. A medical consultation revealed she had medial knee osteoarthritis. Sharing her experiences in this study is important to her as she wants to help others understand the impact of OA and to advocate for better treatment options that allow athletes to maintain their activity levels.

Participant 4

Participant 4 is a 40-year-old male who has been actively involved in weightlifting as a recreational athlete. The intense nature of his training sessions led to significant discomfort in his knee, prompting him to seek medical advice. He was diagnosed with lateral knee osteoarthritis. Eager to continue weightlifting, he explored various interventions to manage his condition. By contributing to this research, Participant 4 aimed to highlight the physical and emotional challenges of living with OA and to encourage the development of supportive resources for athletes.

Participant 5

Participant 5 is a 32-year-old female who played soccer competitively in college and continues to play recreationally. She experienced chronic knee pain, which eventually led to a diagnosis of medial knee osteoarthritis. The diagnosis motivated her to find ways to manage her symptoms while staying active in the sport she loves. Participant 5 decided to participate in the study to share her journey and to

help others navigate the complexities of managing OA while remaining engaged in physical activities.

Participant 6

Participant 6 is a 27-year-old female who participates in CrossFit recreationally. She began noticing pain and stiffness in her knee during workouts, which was later diagnosed as lateral knee osteoarthritis. Despite the challenges posed by her condition, she has remained committed to her fitness routine. Participant 6 chose to share her story to provide insights into the effectiveness of various interventions and to contribute to a greater understanding of how athletes can continue their activities despite having OA.

Research Questions

Two research questions guided this study:

Research Question 1: What are the experiences and perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis?

Research Question 2: How do athletes diagnosed with knee osteoarthritis perceive the impact of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on their functional abilities, pain management, and overall well-being?

Introduction to the Themes

Thematic analysis is a qualitative method that involves assigning data to various codes, grouping these codes into themes, and then identifying patterns and interconnections between these themes (Jowsey et al., 2021). The thematic analysis of the interviews revealed several key themes that encapsulate the experiences, challenges, and perceptions of athletes managing knee osteoarthritis (OA). These themes—Experiences with Diagnosis, Effectiveness of Integrated Interventions, Adherence to Treatment Plans, Overall Quality of Life, and Significant Improvements and Changes—were selected based on recurring patterns and significant perspectives that emerged from the participants' responses.

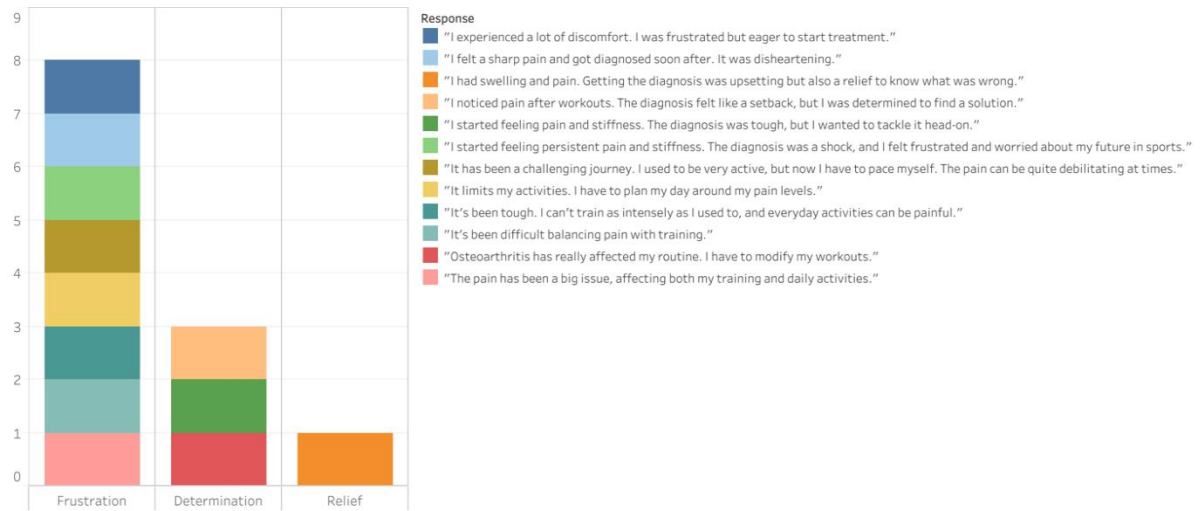
Experiences with Diagnosis

"Experience with Diagnosis" theme captured the participants' initial reactions to their knee OA diagnosis, including feelings of frustration, relief, and determination. The selection of this theme was driven by the consistent expression of emotional and psychological impacts across interviews. Sub-themes include initial reactions, emotional impact, and the

decision to seek treatment. Table 2.1 reveals prevalent subthemes of frustration, relief, and determination among participants. Many reported feelings of disbelief and concern about the impact of their diagnosis on athletic performance and daily life,

underscoring the profound emotional and practical effects of receiving such news. This emotional journey reflects the complexity of coping with knee OA and highlights the participants' resilience and adaptive strategies in managing their condition.

Table 2.1: Emotional Responses to Knee OA Diagnosis



Response
"It has been a challenging journey. I used to be very active, but now I have to pace myself. The pain can be quite debilitating at times."
"I started feeling persistent pain and stiffness. The diagnosis was a shock, and I felt frustrated and worried about my future in sports."
"It's been tough. I can't train as intensely as I used to, and everyday activities can be painful."
"I noticed pain after workouts. The diagnosis felt like a setback, but I was determined to find a solution."
"It limits my activities. I have to plan my day around my pain levels."
"I had swelling and pain. Getting the diagnosis was upsetting but also a relief to know what was wrong."
"The pain has been a big issue, affecting both my training and daily activities."
"I experienced a lot of discomfort. I was frustrated but eager to start treatment."
"It's been difficult balancing pain with training."
"I felt a sharp pain and got diagnosed soon after. It was disheartening."
"Osteoarthritis has really affected my routine. I have to modify my workouts."
"I started feeling pain and stiffness. The diagnosis was tough, but I wanted to tackle it head-on."

Effectiveness of Integrated Interventions

The theme of the "Effectiveness of Integrated Interventions" emerged from frequent discussions about the efficacy of various treatments, such as unloader braces and exercise therapy, in managing knee OA symptoms. This theme was chosen based on participants' detailed accounts of substantial pain relief, improved mobility, and enhanced functional abilities. Sub-themes include pain relief, improved mobility, and functional abilities, showing a gradual improvement from an initial average of 1 to 2.7 on a scale of 0 to 3, with 0 representing no improvement, 1 representing slight improvement, 2 representing moderate improvement, and 3 representing significant improvement (see Figure 3.1). Participants consistently emphasized the critical role these interventions played in helping them remain active and manage their symptoms effectively, highlighting

the significant positive impact on their overall quality of life.

Use of Unloader Braces

Unloader braces were frequently cited as beneficial. Participant 4 shared, "I use unloader braces and do specific exercises. They've been helpful, especially the braces during workouts."

Exercise Therapy

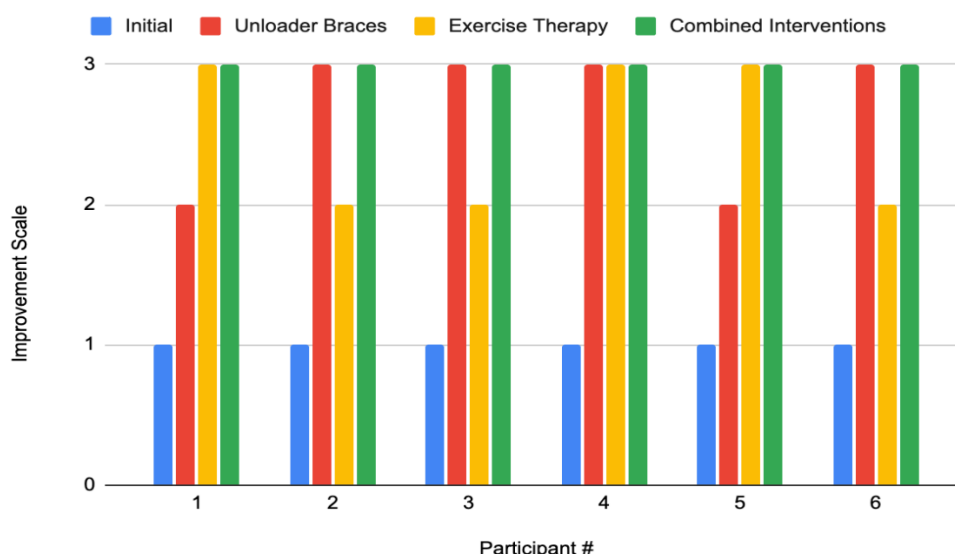
Participants found exercise therapy vital in managing their symptoms. Participant 2 noted, "The braces are very supportive, and therapy helps with flexibility."

Overall Perception of Combined Interventions

The integrated interventions generally helped manage pain and maintain activity levels. Savion stated, "They've definitely helped, especially in reducing pain and increasing mobility."

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Table 3.1: Perception Effectiveness of Integrated Interventions

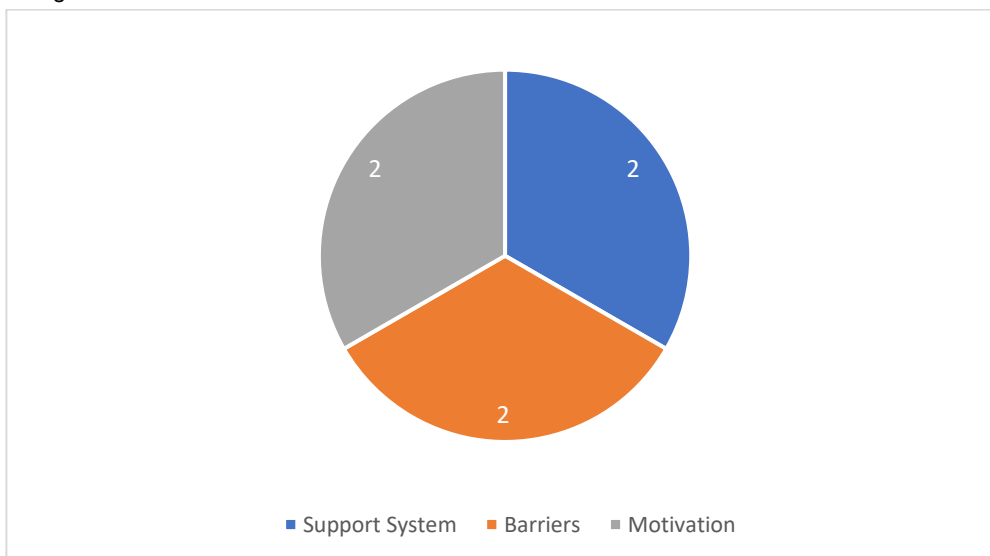


Adherence to Treatment Plans

The theme of "Challenges in Adherence" was selected due to the recurring references to the difficulties and strategies participants used to maintain consistency in their treatment plans. Adherence issues were a prominent theme, particularly regarding the challenges of sticking to exercise regimens. Sub-themes include motivation,

barriers, and support systems (see Table 4.1). Participants often discussed the critical need for structured routines, consistent reminders, and robust support from healthcare providers to remain compliant with their prescribed interventions. These insights underscore the importance of support systems in overcoming adherence challenges and achieving successful treatment outcomes.

Table 4.1: Challenges in Adherence



Overall Quality of Life

The theme "Improvement in Quality-of-Life Metrics" emerged from participants' reflections on how managing knee OA significantly affected their overall well-being. This theme encompasses physical, emotional, and social aspects of life, chosen for its profound impact on participants' quality of life. Sub-themes include pain relief, functional improvement,

and overall well-being, with participants reporting high to moderate pain relief, high functional improvement, and overall well-being ranging from improved to significantly improved (see Table 5.1). Effective symptom management was frequently linked to enhanced mood, increased energy levels, and better social engagement, highlighting the far-reaching effects of knee OA management on daily life.

Table 5.1: Improvement in Quality-of-Life Metrics

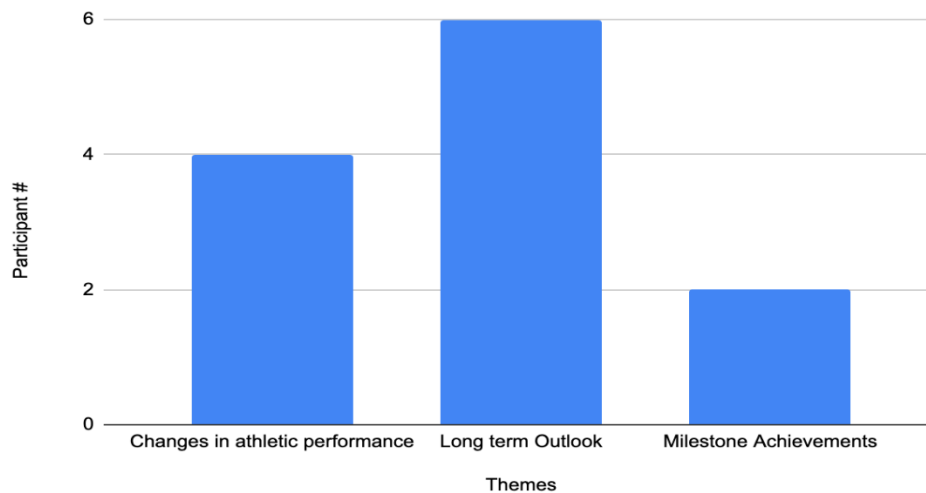
Participant #	Pain Relief	Functional Improvement	Overall Well Being
1	High	High	Significantly Improved
2	High	High	Significantly Improved
3	Moderate	High	Improved
4	High	High	Significantly Improved
5	High	High	Significantly Improved
6	Moderate	High	Improved

Significant Improvements and Changes

The theme "Significant Improvements and Changes" focuses on specific instances of noticeable progress in participants' conditions and athletic performance. This theme was selected due to frequent mentions of milestone achievements and significant progress in symptom management. Sub-themes include milestone achievements, changes in athletic

performance, and long-term outlook (see Table 6.1). Participants shared compelling stories of personal milestones, such as completing full training sessions without breaks and experiencing less pain during competitions. These achievements provided a profound sense of accomplishment and optimism for future management, highlighting the transformative impact of effective interventions on their athletic and daily lives.

Table 6.1 "Significant Improvements and Changes"



Themes	Responses
Changes in athletic performance	"During a recent game, I noticed I could move more freely without pain. It was a huge relief"
Changes in athletic performance	"I noticed less pain and more mobility during walks and light jogging"
Changes in athletic performance	"I've had moments where my performance improved noticeably."
Changes in athletic performance	"I've noticed less pain and better movement during workouts."
Long term Outlook	"I hope for continued improvements and to stay as active as possible."
Long term Outlook	"I hope to stay active and avoid further deterioration"
Long term Outlook	"To maintain my current level of activity and continue managing symptoms effectively."
Long term Outlook	"To continue managing my symptoms effectively and stay active"
Long term Outlook	"To keep improving and avoid further issues."
Long term Outlook	"I hope to maintain my current activity level and avoid surgery. I want to continue playing sports for as long as possible."
Milestone Achievements	"I managed a full training session without needing breaks, which was a big win."
Milestone Achievements	"Significant reduction in pain during activities."

Research Questions Findings

The findings from the qualitative study investigating the experiences and perceptions of athletes

diagnosed with knee osteoarthritis (OA) regarding the integration of unloader braces and exercise therapy interventions within orthopedics and sports medicine

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provided some valuable insights. The study was guided by two primary research questions aimed at elucidating the impacts and perceptions of these interventions on functional abilities, pain relief, and overall well-being among athletes coping with knee OA.

Research Question 1: What are the experiences and perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis?

Participants in this study consistently reported significant benefits from the integration of unloader braces and exercise therapy. The use of unloader braces was universally acknowledged for its immediate and tangible impact on pain relief during physical activities. Athletes expressed that wearing braces allowed them to continue participating in sports and daily activities with reduced discomfort, thereby preserving their functional abilities and enhancing overall well-being. Exercise therapy, in conjunction with braces, was identified as crucial in improving joint flexibility, muscle strength, and overall physical resilience. Participants highlighted the tailored nature of exercise programs, which addressed their specific needs and contributed significantly to managing OA symptoms over time.

Research Question 2: How do athletes diagnosed with knee osteoarthritis perceive the impact of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on their functional abilities, pain management, and overall well-being?

Participants' perceptions of integrating unloader braces and exercise therapy were overwhelmingly positive and emphasized both physical and psychosocial dimensions of their well-being. Athletes described feeling empowered and in control of their condition through these interventions, highlighting the importance of actively engaging in treatment decisions and receiving personalized care from healthcare providers. Beyond physical improvements, participants articulated enhanced mental well-being and quality of life as key outcomes of their integrated treatment experiences. They expressed increased confidence in their ability to cope with the challenges posed by knee OA, fostering a positive outlook on their athletic futures.

The study provided a comprehensive perspective into the experiences and perceptions of athletes managing knee OA with integrated unloader braces

and exercise therapy interventions. The findings showcased the transformative impacts of personalized, multidimensional care approaches within orthopedics and sports medicine; addressing both physical symptoms and psychosocial dimensions, these interventions not only alleviate pain and enhance functional abilities but also empower athletes to lead active and fulfilling lives despite the challenges of knee OA.

Discussion

The findings of this study align closely with the theoretical and empirical literature reviewed in Chapter Two, particularly concerning the use of knee braces and exercise therapy as interventions for knee osteoarthritis (OA). The thematic analysis identified key themes that emerged from the data, including Experiences with Diagnosis, Effectiveness of Integrated Interventions, Adherence to Treatment Plans, Overall Quality of Life, and Significant Improvements and Changes. These themes support and extend the existing body of knowledge on knee OA management.

The study participants reported significant pain relief and functional improvements from using unloader braces in conjunction with exercise therapy. This finding corroborates the literature, particularly the studies by Ramsey and Russell (2009) and Beck et al. (2023). Ramsey and Russell found that unloader knee braces effectively reduce knee pain, improve stability, and decrease the risk of falls by redistributing mechanical loads away from the degenerative compartment. Beck et al. (2023) further supported these findings, demonstrating that unloader bracing improves the biomechanical properties of damaged cartilage, leading to enhanced knee function. The participants' positive experiences with these integrated interventions highlight the practical benefits of combining unloader braces with exercise therapy, as advocated in the literature.

Adherence to prescribed treatment plans varied among participants, influencing their outcomes. Those who adhered closely to their regimens reported better results, aligning with the literature emphasizing the importance of patient education and support systems (Küçükdeveci, 2023). Effective patient education and support enhanced adherence, leading to more consistent and favorable outcomes in knee OA management.

Participants reported substantial improvements in their quality of life following the integration of unloader braces and exercise therapy. These improvements included reduced pain, increased mobility, and better

engagement in daily activities, consistent with the findings of Nguyen et al. (2016). The literature underscores the significant impact of effective knee OA management on overall well-being, highlighting the importance of these interventions in improving patients' quality of life.

The study participants noted significant improvements in pain levels, knee stability, and functional abilities, positively affecting their daily activities and reducing the risk of further injury. These findings are supported by the existing literature, particularly the studies by Beck et al. (2023) and Ramsey and Russell (2009). The evidence suggests that unloader braces and exercise therapy can effectively manage knee OA symptoms, reducing pain and improving knee function. The varied experiences with the diagnostic process reported by participants highlight the need for timely and accurate diagnosis for effective management and treatment planning. This theme aligns with the literature, emphasizing the critical importance of early and precise diagnostic protocols (Hewlett & Kenney, 2019).

Summary

This chapter has presented the key themes identified from the thematic analysis, highlighting the lived experiences of athletes with knee OA. The findings of this study align well with the existing theoretical and empirical literature on knee OA management. The integration of unloader braces and exercise therapy proves to be effective in reducing pain, improving knee function, and enhancing the overall quality of life for individuals with knee OA. These insights contribute to the existing body of knowledge and have practical implications for improving knee OA management strategies.

Recommendations

Introduction to the Problem

Despite remarkable advancements in orthopedics and sports medicine, a significant number of individuals grappling with lower extremity conditions continue to encounter hurdles in accessing comprehensive and effective solutions tailored to their specific conditions, symptoms, and functional limitations. Among these innovative solutions, unloader knee braces have emerged as a crucial intervention for those with knee osteoarthritis and other knee injuries. These braces are designed to reduce the load on the affected part of the knee joint, thereby alleviating pain and improving mobility. This situation highlights the pressing need for innovative approaches to improve patient outcomes and

enhance their quality of life, as unloader knee bracing represents a promising yet underutilized option in the management of knee injuries.

According to Kosco et al. (2022), approximately 90% of individuals seeking orthopedics and sports medicine interventions suffer from lower extremity conditions, presenting diverse challenges in diagnosis and treatment. Furthermore, the American Orthopaedic Foot & Ankle Society (AOFAS) reported that lower extremity conditions contribute to a substantial reduction in overall mobility and significantly impact daily activities and overall well-being (AOFAS Report, 2022).

In the past, conventional treatments predominantly focused on singular interventions, such as bracing or exercise therapy, often resulting in limited efficacy and leaving some aspects of patients' conditions unaddressed (Weber et al., 2022). While these interventions had merit in specific cases, they did not provide a comprehensive and integrated approach that catered to the diverse needs of individuals with knee osteoarthritis. Presently, some healthcare providers have begun to recognize the importance of combining unloader knee bracing with exercise therapy interventions to offer more personalized and holistic care. Although this integrated approach is gaining traction, it remains underutilized in mainstream sports medicine practices.

Knee osteoarthritis (OA) poses a significant challenge in the realm of orthopedics and sports medicine. Affecting patients of all ages, including athletes, knee OA impedes functional abilities and quality of life. The prevalence of this degenerative joint condition necessitates a nuanced exploration of treatment strategies to optimize sports injury management. Various types of braces, such as unloader braces, functional braces, and prophylactic braces, along with diverse exercise therapies including physiotherapy, strength training, and range-of-motion exercises, are commonly utilized. Unloader braces, specifically designed to reduce the load on the knee joint, play a crucial role in managing knee OA by alleviating pain and enhancing mobility.

Recognizing the persistent challenges and obstacles faced by individuals with knee osteoarthritis and the limitations of previous and current methodologies, this introduction lays the foundation for investigating the vast potential of integrating bracing and supports with exercise therapy interventions. This approach has the potential to revolutionize orthopedics and sports medicine by offering patients personalized, efficacious, and comprehensive solutions that elevate their overall well-being and functional capabilities.

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The complex interplay between unloader braces and exercise therapy interventions in the sports medicine context necessitates a thorough investigation. This project aims to explore the perceived effects of integrating these interventions, examining their efficacy in improving functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis. Through this research, the potential of combining unloader bracing and exercise therapy to address the multifaceted needs of patients with knee OA will be elucidated, paving the way for more effective and holistic treatment strategies.

Significance of the Research

The significance of this research will extend to a wide array of stakeholders and organizations within the field of orthopedics and sports medicine. Patients with knee OA conditions will be among the primary beneficiaries, as the integrated approach of combining unloader with exercise therapy interventions promises to yield tailored and effective solutions for their specific conditions and needs. This can result in improved pain management, enhanced mobility, increased strength, and overall better quality of life for these individuals (Weber et al., 2022).

Healthcare providers, including orthopedic surgeons, orthopedic and sports medicine specialists, podiatrists, and physical therapists, will also greatly benefit from this research. By implementing the integrated approach they can offer more comprehensive and patient-centered care leading to better treatment outcomes and increased patient satisfaction. Additionally, healthcare organizations and institutions stand to gain by enhancing their treatment protocols and services, positioning themselves as leaders in providing cutting-edge solutions for lower extremity conditions.

Furthermore, researchers and academics in the field will find value in this research as it will contribute to the growing body of evidence supporting the efficacy and potential of integrating bracing and supports with exercise therapy interventions. This research can serve as a foundation for further studies and investigations into refining and expanding the integrated approach, ultimately advancing the knowledge and practice in the orthopedics and sports medicine domain.

Looking into the future, insurance companies and policymakers may also find merit in the findings of this research. As the integrated approach will prove its effectiveness in improving patient outcomes, it has the potential to lead to cost savings in healthcare by reducing the need for multiple and less effective

treatments. Policymakers can use this coming evidence to inform decisions regarding the integration of these interventions into healthcare policies and guidelines, thus ensuring broader access to innovative and efficient treatments.

The significance of this research pursuit will reach various stakeholders and organizations, benefiting patients, healthcare providers, researchers, institutions, and the healthcare system at large. By embracing the integrated approach of bracing and supports with exercise therapy, the potential for positive change in sports medicine becomes evident, assisting in paving the way for improved care and enhanced well-being for individuals with lower extremity conditions.

Purpose Statement

The purpose of this research is to examine the perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine. This study aims to provide insights that can enhance the management of orthopedic and sports injuries, specifically focusing on athletes diagnosed with knee osteoarthritis. By exploring the interaction between unloader bracing and exercise therapy, the research goal is to offer evidence-based recommendations for optimizing treatment strategies tailored to the unique needs of patients and athletes. To achieve this purpose, a descriptive research approach was employed, comprising interviews with athletes diagnosed with knee osteoarthritis who have undergone integrated approach of unloader bracing and exercise therapy.

Central Research Question

RQ1: What are the experiences and perceived effects of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on functional abilities, pain relief, and overall well-being among athletes diagnosed with knee osteoarthritis?

RQ2: How do athletes diagnosed with knee osteoarthritis perceive the impact of integrating unloader braces and exercise therapy interventions within orthopedics and sports medicine on their functional abilities, pain management, and overall well-being?

Limitations

Despite the descriptive approach adopted in this study, the researcher encountered several limitations. First, the sample size was relatively small and lacked diversity, which may limit the generalizability of the findings. The participants were primarily recruited

through LinkedIn and social media, which may have introduced selection bias, as those who are more active on these platforms may differ in significant ways from the general population. Additionally, the study relied on self-reported data, which can be affected by recall bias and social desirability bias (Althubaiti et al., 2016). Bias in research data collection can arise from several sources, including social desirability, recall period, sampling approach, or selective recall. When researchers employ surveys, questionnaires, or interviews to gather data, they often address private or sensitive subjects such as medical related topics. Self-reported data, in particular, may be influenced by external biases like social desirability bias, where respondents may provide answers they believe are more socially acceptable rather than accurate. This is especially pertinent when anonymity and confidentiality are not assured during data collection. For example, when assessing drug usage, participants might underreport their consumption due to the perceived stigma associated with drug use, resulting in a potential underestimation of actual usage. This phenomenon exemplifies social desirability bias, which can distort the accuracy of self-reported data (Althubaiti et al., 2016). According to Bispo Júnior (2022) the social desirability bias refers to the tendency of study participants to present themselves or certain situations in a favorable light rather than responding honestly. This bias often leads participants to overstate socially acceptable behaviors, attitudes, and traits while downplaying or underreporting those that might be viewed negatively. Consequently, participants in the study may have provided responses they believed to be the most socially acceptable rather than accurately reflecting their true experiences and perceptions. The short duration of the study also meant that long-term effects of the interventions could not be assessed. Moreover, the study focused only on unloader braces and exercise therapy, neglecting other potentially beneficial interventions such as conventional medicine or pharmacological treatments. Finally, the use of videoconference and phone interviews may have limited the depth of qualitative data collected compared to in-person interviews (Carter et al., 2021). Carter et al. (2021) noted that traditional in-person meetings have significantly influenced how sampling and recruitment strategies are developed for studies. In face-to-face research, researchers use everyday gestures to establish rapport and show empathy, such as engaging in small talk, offering a drink, providing a tissue to a distressed participant, or accompanying them out of the building at the end of

a session. However, online data collection lacks these physical interactions, leading to a loss of this personal connection (Carter et al., 2021).

Interviewing remains the predominant method of data collection in qualitative research. Although remote methods have been widely utilized in quantitative survey research, their application in qualitative research has been relatively limited, and there has been scant methodological discussion on the subject (Keen et al., 2022). Traditionally, qualitative researchers have advocated for face-to-face interactions during interviews, citing concerns that remote meetings may hinder the development of rapport, increase participant fatigue, and limit the depth of interaction (Keen et al., 2022). This historical preference showcases the challenges and potential drawbacks associated with remote qualitative interviews (Keen et al., 2022).

Recommendations

Based on the thorough analysis of the collected data and an extensive review of the existing literature, several actionable recommendations have emerged to enhance the management and treatment of knee osteoarthritis (OA) through the use of unloader braces and exercise therapy. These recommendations aim to address gaps in the current research, improve patient outcomes, and advance the overall understanding of effective interventions for knee OA.

Implement Longitudinal Studies

Implementing longitudinal studies can provide deeper insights into the long-term effects of unloader braces and exercise therapy on knee osteoarthritis (OA) patients. The literature indicates that short-term studies may not fully capture the sustained impact of these interventions (Ramsey & Russell, 2009). Longitudinal research, which involves repeated observations of the same variables over extended periods, can track changes over time, offering a comprehensive view of the interventions' efficacy.

One of the primary advantages of longitudinal studies is their ability to observe and analyze trends and long-term outcomes. By following participants over months or years, researchers can detect patterns and determine the durability of benefits provided by unloader braces and exercise therapy. This approach can reveal whether improvements in pain relief, functional abilities, and overall well-being are maintained, increase, or diminish over time. Such information is invaluable for clinicians seeking to make informed decisions about the most effective long-term treatment strategies for knee OA patients.

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Longitudinal studies also allow for the examination of how different variables interact over time. Researchers can explore how adherence to exercise therapy influences the effectiveness of unloader braces or how changes in physical activity levels impact pain and mobility. This understanding can lead to more personalized treatment plans, tailored to the specific needs and circumstances of each patient. Also, longitudinal research can identify factors that contribute to the success or failure of interventions. By tracking a wide range of variables, such as patient demographics, baseline health status, and psychosocial factors, researchers can determine which factors predict positive outcomes and which might hinder progress. This knowledge can guide the development of more targeted and effective interventions, improving the overall management of knee OA.

However, one significant disadvantage is maintaining participant engagement over extended periods. Keeping participants motivated and committed to the study could be difficult, particularly if the study spans several years. Attrition can be high, which may compromise the validity of the findings. Researchers must implement strategies to minimize attrition, such as regular follow-ups, providing incentives, and maintaining clear and consistent communication with participants (Kearney et al., 2018). Also, the increased complexity in data management and analysis poses another challenge. Longitudinal studies often have less variability, increased statistical power, generating vast amounts of data that require statistical methods to analyze (Garvia & Marder, 2017). Managing these data involves meticulous planning and robust data management systems to ensure accuracy and reliability. Researchers must also account for potential confounding variables and biases that can arise over time, necessitating careful study design and rigorous analytical techniques (Assimon M., 2021).

While longitudinal studies offer the significant advantage of providing comprehensive insights into the long-term effects of unloader braces and exercise therapy on knee OA patients, they also come with challenges related to participant retention and data complexity. Despite these challenges, the detailed and nuanced understanding that longitudinal research can provide makes it a valuable approach for advancing the management and treatment of knee osteoarthritis. By investing in these studies, the research community can develop more effective, evidence-based interventions that enhance the quality of life for individuals living with this chronic

condition.

Integrate Complementary Interventions

Combining unloader braces with other complementary interventions, such as physical therapy and patient education, can enhance overall treatment outcomes. The literature strongly advocates for the integration of multi-modal approaches in the management of knee osteoarthritis (OA), highlighting the synergistic benefits of combining various therapeutic interventions (Küçükdeveci, 2023). Implementing a holistic treatment plan that incorporates different modalities—such as unloader braces, physical therapy, patient education, and lifestyle modifications—addresses the multifaceted nature of knee OA. A significant portion of OA patients—over 40%—turn to complementary and alternative medicine (CAM) therapies in addition to conventional approaches. These CAM strategies include physical therapy, patient education, lifestyle modifications, natural products, and mind-body practices (Vina et al., 2021). This reliance on a broad range of therapies showcase the need for further research into integrating and optimizing both traditional and alternative treatment options to better address the complex and multifaceted nature of OA (Vina et al., 2021). The integration of complementary interventions can significantly enhance pain management, improve joint function, and increase overall quality of life for patients (Vina et al., 2021). By targeting various aspects of the condition, such as biomechanical alignment, muscle strength, and patient knowledge, a multi-modal approach facilitates a more effective and personalized treatment plan. The integration of unloader braces can reduce the load on affected knee compartments, while physical therapy can strengthen the muscles around the knee, enhancing stability and reducing pain. Concurrently, patient education empowers individuals with the knowledge to manage their condition better, promoting adherence to treatment and encouraging proactive involvement in their health care. The recommendation not only optimizes clinical outcomes but also aligns with contemporary trends in personalized and patient-centered care, offering a robust framework for managing the complexities of knee OA in diverse patient populations. The advantage of this recommendation is the comprehensive care it provides, which can improve patient satisfaction and outcomes. However, it may also involve higher costs and require coordinated efforts among different healthcare providers (Geese & Schmitt, 2023).

Enhance Technological and Methodological Approaches

Advancing technological and methodological approaches in research can significantly improve the accuracy and efficiency of data collection and analysis. The incorporation of sophisticated software tools, such as NVivo and ATLAS.ti, can facilitate more precise coding and thematic analysis, thereby addressing and overcoming challenges encountered in the current study. The literature underscores the transformative benefits of leveraging advanced technologies to streamline research processes and enhance data handling capabilities (Beck et al., 2023).

The advantages of these tools can automate and refine the coding process, reduce human error, and provide a more streamlined analysis of complex datasets. They enable researchers to identify patterns and themes with greater accuracy, thereby enriching the depth and breadth of qualitative research. Additionally, these technologies handle large volumes of data efficiently, making it feasible to analyze extensive datasets that could be unmanageable using traditional methods. Also, these advanced technologies can facilitate the integration of diverse data types, such as text, audio, video, and social media content, allowing for a more multifaceted analysis. This capability could be particularly valuable in mixed-methods research, where the combination of quantitative and qualitative data can yield richer insights and more robust conclusions.

However, the disadvantages of integrating advanced technological and methodological approaches in research could be the initial investment in technology and the learning curve associated with new tools may pose challenges. Acquiring and maintaining advanced software tools can be costly, and researchers may need to allocate additional resources for training and technical support. The time and effort required to master these tools can also be substantial, potentially delaying the research process. Furthermore, the rapid pace of technological advancements necessitates continuous learning and adaptation, which can be daunting for researchers who are less familiar with digital tools.

While the integration of advanced technological and methodological approaches in research presents initial challenges, the long-term benefits in terms of data accuracy, efficiency, and quality far outweigh these obstacles. Embracing these innovations can propel research methodologies forward, leading to more reliable and impactful findings that can drive progress in various fields of study.

Strengthen Collaborative Healthcare Models

Strengthening collaborative healthcare models is essential for optimizing patient care in managing knee osteoarthritis (OA). The conclusion reached based upon the interviews conducted indicates that a multidisciplinary approach involving various healthcare professionals, such as orthopedic specialists, physiotherapists, primary care physicians, and nutritionists, can lead to more effective and comprehensive treatment plans. The literature consistently underscores the importance of collaborative models in improving patient outcomes and enhancing the efficiency of care delivery (Hewlett & Kenney, 2019).

A collaborative healthcare model brings together the expertise and perspectives of different specialists to create a holistic and coordinated care plan tailored to the individual needs of patients with knee OA. This model facilitates assessments and interventions that address the multifaceted nature of knee OA, encompassing pain management, functional rehabilitation, lifestyle modifications, and psychological support. While an orthopedic specialist might focus on the structural aspects of the knee joint, a physiotherapist can design specific exercise regimens to improve mobility and strength. Simultaneously, a nutritionist can provide dietary recommendations to support joint health and overall well-being, and a primary care physician can oversee the patient's general health and manage comorbid conditions.

The main advantage of this multidisciplinary approach is the holistic and coordinated care it provides, which can significantly improve patient outcomes and satisfaction. By ensuring that all aspects of the patient's condition are addressed, this model can lead to more effective pain management, enhanced functional abilities, and overall better quality of life for patients with knee OA. Also, the collaborative model can streamline care delivery, reduce redundancies, and improve the efficiency of resource utilization within the healthcare system. However, one potential disadvantage is the complexity of coordinating care among multiple providers, which requires a high level of communication and collaboration strategies. Effective coordination necessitates regular and clear communication, shared decision-making, and integrated electronic health records to ensure that all providers have access to up-to-date patient information. The logistical aspects of arranging multidisciplinary meetings and ensuring that all team members are aligned can be time-consuming and

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require significant administrative support.

While there are challenges associated with implementing collaborative healthcare models, the benefits in terms of improved patient outcomes, enhanced care efficiency, and greater patient satisfaction make it a worthwhile endeavor. Strengthening these models requires concerted efforts to enhance communication, foster teamwork, and integrate care processes, ultimately leading to better management of knee OA and other complex health conditions.

Stakeholders, Resources, and Timeline for Implementation

The successful implementation of the recommendations derived from this study will necessitate the involvement of several key stakeholders and the allocation of appropriate resources. The primary stakeholders include healthcare providers, such as orthopedic surgeons, sports medicine specialists, physical therapists, and primary care physicians who are directly involved in the treatment and management of knee osteoarthritis (OA). Patients and athletes, particularly those diagnosed with knee OA and active in sports, will also be critical stakeholders, as they are the primary beneficiaries of the integrated interventions. Research institutions and academic bodies, including universities and research centers, will play a pivotal role in supporting and conducting longitudinal studies and further research. Medical device manufacturers, specifically companies that produce unloader braces and other orthopedic support devices, will be essential partners in developing and refining the interventions. Additionally, insurance providers will need to be engaged to ensure coverage for the recommended therapies, making them accessible to patients. Policymakers and healthcare administrators, who can influence healthcare policies and allocate funding for research and treatment programs, will be vital in institutionalizing these recommendations.

To effectively implement the recommendations, several resources are required. Financial support is paramount for conducting longitudinal studies, acquiring advanced technological tools, and training healthcare providers in new methodologies. Technological tools, such as advanced software and equipment for data collection, analysis, and patient monitoring, will be necessary to enhance the precision and efficacy of the interventions. Up to 74% of users report that financial viability remains a significant challenge regarding acquiring advanced technological tools in healthcare (Sutton et al., 2020).

Initial setup and integration costs for these systems can be substantial, and ongoing expenses persist as new staff require training and regular updates are necessary to keep up with advancements (Sutton et al., 2020). Cost analyses of these technologies reveal mixed and often controversial results, reflecting the complex interplay of factors influencing cost-effectiveness (Sutton et al., 2020). Variability in political, technological, and environmental conditions further complicates cost-benefit assessments, which are frequently hindered by a lack of standardized metrics (Sutton et al., 2020).

Human resources, including skilled researchers, clinicians, and support staff, are essential for carrying out studies, analyzing data, and providing patient care. Collaboration between professionals—including practitioners, managers, decision-makers, and policy-makers—and researchers is crucial for bridging the gap between research and practice, thereby enhancing the healthcare system. Often, research and practice are viewed as separate entities with distinct values, which can create barriers to effective collaboration. However, it is increasingly recognized that research and practice are interconnected and complementary, each providing valuable insights into their respective domains (Laustsen et al., 2021).

Involving professionals in research has been shown to improve care processes and health outcomes. Professionals such as clinicians and support staff possess context-specific knowledge that is vital for conducting relevant and practical research. Their involvement ensures that research addresses real-world issues and is contextualized appropriately for application. This practical knowledge enables professionals to identify patterns and nuances that external researchers might overlook. Conversely, researchers bring a broader, more generalized scientific perspective, which can elucidate mechanisms and provide theoretical insights (Laustsen et al., 2021).

Additionally, educational materials will be needed to support patient education and training programs for healthcare providers, ensuring that they are well-versed in the latest evidence-based practices. To enhance patient education and provider training, it is crucial to develop and utilize comprehensive educational materials that reflect the latest evidence-based practices. Physicians play a pivotal role in promoting health literacy, which is defined as the ability to seek, understand, and act on health information. Effective patient education is essential for improving health outcomes, as it empowers patients to make informed decisions and engage

actively in their care. Educational resources should be designed to support both patients and healthcare providers by improving communication and ensuring that interactions are accessible and effective (Paterick et al., 2017).

The proposed timeline for implementing these recommendations spans from short-term to long-term milestones. In the short-term (0-6 months), the focus will be on establishing collaborations with stakeholders, securing funding, and allocating necessary resources. Pilot studies will be initiated to refine methodologies and tools. In the medium-term (6-18 months), longitudinal studies will be conducted to assess the long-term effects of integrated interventions. Complementary intervention programs will be developed and implemented, and technological and methodological approaches will be enhanced based on initial findings. In the long-term (18 months - 3 years), data from longitudinal studies and complementary interventions will be analyzed. The findings will be published, and clinical guidelines will be updated based on the evidence-based recommendations. Collaborative healthcare models will be strengthened through continuous education and policy advocacy. By engaging the necessary stakeholders, securing the required resources, and adhering to a structured timeline, the implementation of these recommendations will significantly improve the management of knee osteoarthritis and enhance the quality of life for patients and athletes.

References

- Aggarwal, R., & Ranganathan, P. (2019). Study designs: Part 2—descriptive studies. *Perspectives in clinical research*, 10(1), 34-36.
- Assimon, M. M. (2021). Confounding in observational studies evaluating the safety and effectiveness of medical treatments. *Kidney360*, 2(7), 1156-1159.
- Althubaiti, A. (2016). Information bias in health research: definition, pitfalls, and adjustment methods. *Journal of multidisciplinary healthcare*, 211-217.
- Asenahabi, B. M. (2019). Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches*, 6(5), 76-89.
- BAKIRHAN, S., BOZAN, O., UNVER, B., & KARATOSUN, V. (2017). AVALIAÇÃO DAS CARACTERÍSTICAS FUNCIONAIS EM PACIENTES COM OSTEOARTRITE DO JOELHO. *Acta Ortopédica Brasileira*, 25(6), 248-252.
- Beck, S., Dittrich, F., Busch, A., Jäger, M., Theysohn, J. M., Lazik-Palm, A., & Haubold, J. (2023). Unloader bracing in osteoarthritis of the knee—Is there a direct effect on the damaged cartilage? *The Knee*, 40, 16-23.
- Bispo Júnior, J. P. (2022). Viés de desajustabilidade social na pesquisa qualitativa em saúde. *Revista de Saúde Pública*, 56, 101.
- Briggs, K. K., Matheny, L. M., & Steadman, J. R. (2012). Improvement in quality of life with use of an unloader knee brace in active patients with OA: a prospective cohort study. *The journal of knee surgery*, 25(05), 417-422.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
- Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., ... & Walker, K. (2020). Purposive sampling: complex or simple? Research case examples. *Journal of research in Nursing*, 25(8), 652-661.
- Cai, X., Yuan, S., Zeng, Y., Wang, C., Yu, N., & Ding, C. (2021). New trends in pharmacological treatments for osteoarthritis. *Frontiers in pharmacology*, 12, 645842.
- Carter, S. M., Shih, P., Williams, J., Degeling, C., & Mooney-Somers, J. (2021). Conducting qualitative research online: challenges and solutions. *The Patient-Patient-Centered Outcomes Research*, 14(6), 711-718.
- Chao, J., Jing, Z., Xuehua, B., Peilei, Y., & Qi, G. (2021). Effect of systematic exercise rehabilitation on patients with knee osteoarthritis: a randomized controlled trial. *Cartilage*, 13(1_suppl), 1734S-1740S.
- Dantas, L. O., de Fátima Salvini, T., & McAlindon, T. E. (2021). Knee osteoarthritis: key treatments and implications for physical therapy. *Brazilian journal of physical therapy*, 25(2), 135-146.
- Darko, E. M., Kleib, M., & Olson, J. (2022). Social media use for research participant recruitment: integrative literature review. *Journal of Medical Internet Research*, 24(8), e38015.
- DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: a balance of relationship and rigour. *Family medicine and community health*, 7(2).
- DeRogatis, M., Anis, H. K., Sodhi, N., Ehiorobo, J. O., Chughtai, M., Bhavé, A., & Mont, M. A. (2019). Non-operative treatment options for knee

- osteoarthritis. *Annals of translational medicine*, 7(Suppl 7).
18. Dhillon, J., Kraeutler, M. J., Belk, J. W., Scillia, A. J., McCarty, E. C., Ansah-Twum, J. K., & McCulloch, P. C. (2023). Effects of running on the development of knee osteoarthritis: an updated systematic review at short-term follow-up. *Orthopaedic Journal of Sports Medicine*, 11(3), 23259671231152900.
 19. Driban, J. B., Harkey, M. S., Barbe, M. F., Ward, R. J., MacKay, J. W., Davis, J. E., ... & McAlindon, T. E. (2020). Risk factors and the natural history of accelerated knee osteoarthritis: a narrative review. *BMC musculoskeletal disorders*, 21, 1-11.
 20. Duong, V., Daniel, M. S., Ferreira, M. L., Fritsch, C. G., Hunter, D. J., Wang, X., ... & Nicolson, P. J. (2021). Measuring adherence to unsupervised, conservative treatment for knee osteoarthritis: a systematic review. *Osteoarthritis and Cartilage Open*, 3(2), 100171.
 21. Dwivedi, A. K., & Shukla, R. (2020). Evidence-based statistical analysis and methods in biomedical research (SAMBR) checklists according to design features. *Cancer Reports*, 3(4), e1211.
 22. Ettlin, L., Nast, I., Huber, E. O., & Niedermann, K. (2021). Does the conservative non-pharmacological management of knee osteoarthritis in Switzerland reflect the clinical guidelines? A survey among general practitioners, rheumatologists, and orthopaedic surgeons. *Frontiers in Rehabilitation Sciences*, 2, 658831.
 23. Farrokhi, S., Voycheck, C. A., Tashman, S., & Fitzgerald, G. K. (2013). A biomechanical perspective on physical therapy management of knee osteoarthritis. *Journal of orthopaedic & sports physical therapy*, 43(9), 600-619.
 24. Fukui, N., Conaghan, P. G., Togo, K., Ebata, N., Abraham, L., Jackson, J., ... & Pandit, H. (2022). Physician and patient perceptions of surgical procedures for osteoarthritis of the knee in the United States, Europe, and Japan: results of a real-world study. *BMC Musculoskeletal Disorders*, 23(1), 1065.
 25. Garcia, T. P., & Marder, K. (2017). Statistical approaches to longitudinal data analysis in neurodegenerative diseases: Huntington's disease as a model. *Current neurology and neuroscience reports*, 17(2), 14.
 26. Geese, F., & Schmitt, K. U. (2023, January). Interprofessional collaboration in complex patient care transition: A qualitative multi-perspective analysis. In *Healthcare* (Vol. 11, No. 3, p. 359). MDPI.
 27. Goff, A. J., Silva, D. D. O., Merolli, M., Bell, E. C., Crossley, K. M., & Barton, C. J. (2021). Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: a systematic review. *Journal of Physiotherapy*, 67(3), 177-189.
 28. Goh, S. L., Persson, M. S., Stocks, J., Hou, Y., Lin, J., Hall, M. C., ... & Zhang, W. (2019). Efficacy and potential determinants of exercise therapy in knee and hip osteoarthritis: a systematic review and meta-analysis. *Annals of physical and rehabilitation medicine*, 62(5), 356-365.
 29. Gueugnon, M., Fournel, I., Soilly, A. L., Diaz, A., Baulot, E., Bussi re, C., ... & Ornetti, P. (2021). Effectiveness, safety, and cost-utility of a knee brace in medial knee osteoarthritis: the ERGONOMIE randomized controlled trial. *Osteoarthritis and Cartilage*, 29(4), 491-501.
 30. Hanks, J., & Myers, B. (2023). Validity, reliability, and efficiency of a standard goniometer, medical inclinometer, and builder's inclinometer. *International journal of sports physical therapy*, 18(4), 989.
 31. Haider, M. Z., Bhuiyan, R., Ahmed, S., Zahid-Al-Quadir, A., Choudhury, M. R., Haq, S. A., & Zaman, M. M. (2022). Risk factors of knee osteoarthritis in Bangladeshi adults: a national survey. *BMC Musculoskeletal Disorders*, 23(1), 333.
 32. Hartemo, M. (2022). Conversions on the rise- modernizing e-mail marketing practices by utilizing volunteered data. *Journal of research in interactive marketing*, 16(4), 585-600.
 33. Heijink, A., Gomoll, A. H., Madry, H., Drobni , M., Filardo, G., Espregueira-Mendes, J., & Van Dijk, C. N. (2012). Biomechanical considerations in the pathogenesis of osteoarthritis of the knee. *Knee Surgery, Sports Traumatology, Arthroscopy*, 20, 423-435.
 34. Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social science & medicine*, 292, 114523.
 35. Hewlett, J., & Kenney, J. (2019). Innovations in functional and rehabilitative knee bracing. *Annals of Translational Medicine*, 7(Suppl 7).

36. Holden, M. A., Callaghan, M., Felson, D., Birrell, F., Nicholls, E., Jowett, S., ... & Peat, G. (2021). Protocol: Clinical and cost-effectiveness of bracing in symptomatic knee osteoarthritis management: protocol for a multicentre, primary care, randomised, parallel-group, superiority trial. *BMJ Open*, 11(3).
37. Hsieh, L. F., Lin, Y. T., Wang, C. P., Liu, Y. F., & Tsai, C. T. (2020). Comparison of the effect of Western-made unloading knee brace with physical therapy in Asian patients with medial compartment knee osteoarthritis—A preliminary report. *Journal of the Formosan Medical Association*, 119(1), 319-326.
38. Hyodo, K., Kanamori, A., Kadone, H., Takahashi, T., Kajiwara, M., & Yamazaki, M. (2020). Gait analysis comparing kinematic, kinetic, and muscle activation data of modern and conventional total knee arthroplasty. *Arthroplasty Today*, 6(3), 338-342.
39. Ishii, Y., Noguchi, H., Sato, J., Ishii, H., Todoroki, K., & Toyabe, S. (2018). Medial and lateral laxity in knees with advanced medial osteoarthritis. *Osteoarthritis and Cartilage*, 26(5), 666-670.
40. Archard, P. J., & O'Reilly, M. (2022). Email correspondence, interpretation and the psychoanalytically informed research interview. *Nurse Researcher*, 30(1).
41. Jowsey, T., Deng, C., & Weller, J. (2021). General-purpose thematic analysis: a useful qualitative method for anaesthesia research. *BJA education*, 21(12), 472-478.
42. Kawabata, S., Murata, K., Nakao, K., Sonoo, M., Morishita, Y., Oka, Y., ... & Kanemura, N. (2020). Effects of exercise therapy on joint instability in patients with osteoarthritis of the knee: A systematic review. *Osteoarthritis and Cartilage Open*, 2(4), 100114.
43. Keen, S., Lomeli-Rodriguez, M., & Joffe, H. (2022). From challenge to opportunity: virtual qualitative research during COVID-19 and beyond. *International Journal of Qualitative Methods*, 21, 16094069221105075.
44. Kearney, A., Rosala-Hallas, A., Bacon, N., Daykin, A., Shaw, A. R., Lane, A. J., ... & Gamble, C. (2018). Reducing attrition within clinical trials: the communication of retention and withdrawal within patient information leaflets. *PLoS One*, 13(10), e0204886.
45. Küçükdeveci, A. A. (2023). Rehabilitation interventions in osteoarthritis. *Best Practice & Research Clinical Rheumatology*, 101846.
46. Laustsen, C. E., Petersson, P., Westergren, A., & Haak, M. (2021). Involvement of professionals in research: knowledge integration, development of practice, and challenges: a group concept mapping study. *Health Research Policy and Systems*, 19, 1-17.
47. Lins-Kusterer, L., Valdelamar, J., Aguiar, C. V. N., Menezes, M. S., Netto, E. M., & Brites, C. (2019). Validity and reliability of the 36-Item Short Form Health Survey questionnaire version 2 among people living with HIV in Brazil. *The Brazilian Journal of Infectious Diseases*, 23(5), 313-321.
48. Liu, Q., & Wang, L. (2021). t-Test and ANOVA for data with ceiling and/or floor effects. *Behavior Research Methods*, 53(1), 264-277.
49. Loeser, R. F. (2010). Age-related changes in the musculoskeletal system and the development of osteoarthritis. *Clinics in geriatric medicine*, 26(3), 371-386.
50. Madry, H. (2022). Surgical therapy in osteoarthritis. *Osteoarthritis and cartilage*, 30(8), 1019-1034.
51. Mayo Clinic. (2021, June 16). Osteoarthritis-osteoarthritis—diagnosis & treatment. *Mayo Clinic*.
52. Mistry, D. A., Chandratreya, A., & Lee, P. Y. (2018). An update on unloading knee braces in the treatment of unicompartmental knee osteoarthritis from the last 10 years: a literature review. *The Surgery Journal*, 4(03), e110-e118.
53. Mo, L., Jiang, B., Mei, T., & Zhou, D. (2023). Exercise therapy for knee osteoarthritis: A systematic review and network meta-analysis. *Orthopaedic journal of sports medicine*, 11(5), 23259671231172773.
54. Moghimi, N., Rahmani, K., Delpisheh, A., Saidi, A., Azadi, N. A., & Afkhamzadeh, A. (2019). Risk factors of knee osteoarthritis: A case-control study. *Pakistan journal of medical sciences*, 35(3), 636.
55. Moseng, T., Vlieland, T. P. V., Battista, S., Beckwée, D., Boyadzhieva, V., Conaghan, P. G., ... & Østerås, N. (2024). EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis: 2023 update. *Annals of the rheumatic diseases*, 83(6), 730-740.
56. Mostakhdemin, M., Nand, A., & Ramezani, M. (2021). Articular and artificial cartilage, characteristics, properties and testing

- approaches—a review. *Polymers*, 13(12), 2000.
57. Nguyen, C., Lefèvre-Colau, M. M., Poiraudeau, S., & Rannou, F. (2016). Rehabilitation (exercise and strength training) and osteoarthritis: A critical narrative review. *Annals of physical and rehabilitation medicine*, 59(3), 190-195.
58. Oermann, M. H., Wrigley, J., Nicoll, L. H., Ledbetter, L. S., Carter-Templeton, H., & Edie, A. H. (2021). Integrity of databases for literature searches in nursing: avoiding predatory journals. *Advances in Nursing Science*, 44(2), 102-110.
59. Ostrander, R. V., Leddon, C. E., Hackel, J. G., O'Grady, C. P., & Roth, C. A. (2016). Efficacy of unloader bracing in reducing symptoms of knee osteoarthritis. *Am J Orthop*, 45(5), 306-311.
60. Palmer, J. S., Monk, A. P., Hopewell, S., Bayliss, L. E., Jackson, W., Beard, D. J., & Price, A. J. (2019). Surgical interventions for symptomatic mild to moderate knee osteoarthritis. Cochrane Database of Systematic Reviews, (7).
61. Pantaleon, L. (2019). Why measuring outcomes is important in health care. *Journal of veterinary internal medicine*, 33(2), 356-362.
62. Parween, R., Shriram, D., Mohan, R. E., Lee, Y. H. D., & Subburaj, K. (2019). Methods for evaluating effects of unloader knee braces on joint health: a review. *Biomedical Engineering Letters*, 9, 153-168.
63. Paterick, T. E., Patel, N., Tajik, A. J., & Chandrasekaran, K. (2017, January). Improving health outcomes through patient education and partnerships with patients. In *Baylor University Medical Center Proceedings* (Vol. 30, No. 1, pp. 112-113). Taylor & Francis.
64. Peng, H., Ou, A., Huang, X., Wang, C., Wang, L., Yu, T., ... & Zhang, Y. (2021). Osteotomy around the knee: the surgical treatment of osteoarthritis. *Orthopaedic Surgery*, 13(5), 1465-1473.
65. Primorac, D., Molnar, V., Matišić, V., Hudetz, D., Jeleč, Ž., Rod, E., ... & Borić, I. (2021). Comprehensive review of knee osteoarthritis pharmacological treatment and the latest professional societies' guidelines. *Pharmaceuticals*, 14(3), 205.
66. Ramsey, D. K., & Russell, M. E. (2009). Unloader braces for medial compartment knee osteoarthritis: implications on mediating progression. *Sports Health*, 1(5), 416-426.
67. Raposo, F., Ramos, M., & Lúcia Cruz, A. (2021). Effects of exercise on knee osteoarthritis: A systematic review. *Musculoskeletal care*, 19(4), 399-435.
68. Rezende, M. U., Brito, N. L. R., Farias, F. E. S., Silva, C. A. C., Cernigoy, C. H. A., da Silva, J. R., ... & Camargo, O. P. (2021). Improved function and strength in patients with knee osteoarthritis as a result of adding a two-day educational program to usual care. Prospective randomized trial. *Osteoarthritis and Cartilage Open*, 3(1), 100137.
69. Richard, M. J., Driban, J. B., & McAlindon, T. E. (2023). Pharmaceutical treatment of osteoarthritis. *Osteoarthritis and Cartilage*, 31(4), 458-466.
70. Rijnhart, J. J., Lamp, S. J., Valente, M. J., MacKinnon, D. P., Twisk, J. W., & Heymans, M. W. (2021). Mediation analysis methods used in observational research: a scoping review and recommendations. *BMC medical research methodology*, 21, 1-17.
71. Robert-Lachaine, X., Dessery, Y., Belzile, É. L., Turmel, S., & Corbeil, P. (2020). Three-month efficacy of three knee braces in the treatment of medial knee osteoarthritis in a randomized crossover trial. *Journal of Orthopaedic Research®*, 38(10), 2262-2271.
72. Rocha, T. C., dos Santos Ramos, P., Dias, A. G., & Martins, E. A. (2020). Os efeitos do exercício físico sobre o manejo da dor em pacientes com osteoartrose de joelho: Uma revisão sistemática com meta-análise. *Revista Brasileira de Ortopedia*, 55(05), 509-517.
73. Samuel, A. J., & Kanimozhi, D. (2019). Outcome measures used in patient with knee osteoarthritis: With special importance on functional outcome measures. *International journal of health sciences*, 13(1), 52.
74. Semenistaja, S., Skuja, S., Kadisa, A., & Groma, V. (2023). Healthy and osteoarthritis-affected joints facing the cellular crosstalk. *International Journal of Molecular Sciences*, 24(4), 4120.
75. Anderson, A. S., & Loeser, R. F. (2010). Why is osteoarthritis an age-related disease? *Best practice & research Clinical rheumatology*, 24(1), 15-26.
76. Sharma, M., Singh, A., Kaur, S., & Dhillon, M. S. (2019). Consensus on non-pharmacological interventions for mild and moderate knee osteoarthritis among stakeholders/experts of various disciplines is still elusive—A preliminary report. *Journal of Clinical Orthopaedics and*

Trauma, 10, S174-S178.

77. Sutton, R. T., Pincock, D., Baumgart, D. C., Sadowski, D. C., Fedorak, R. N., & Kroeker, K. I. (2020). An overview of clinical decision support systems: benefits, risks, and strategies for success. *NPJ digital medicine*, 3(1), 17.
78. Suzuki, Y., Iijima, H., Tashiro, Y., Kajiwara, Y., Zeidan, H., Shimoura, K., ... & Aoyama, T. (2019). Home exercise therapy to improve muscle strength and joint flexibility effectively treats pre-radiographic knee OA in community-dwelling elderly: a randomized controlled trial. *Clinical Rheumatology*, 38, 133-141.
79. Thelin, N., Holmberg, S., & Thelin, A. (2006). Knee injuries account for the sports-related increased risk of knee osteoarthritis. *Scandinavian journal of medicine & science in sports*, 16(5), 329-333.
80. Van Tunen, J. A., Dell'Isola, A., Juhl, C., Dekker, J., Steultjens, M., Thorlund, J. B., & Lund, H. (2018). Association of malalignment, muscular dysfunction, proprioception, laxity and abnormal joint loading with tibiofemoral knee osteoarthritis—a systematic review and meta-analysis. *BMC musculoskeletal disorders*, 19, 1-15.
81. Vina, E. R., Youk, A. O., Quinones, C., Kwoh, C. K., Ibrahim, S. A., & Hausmann, L. R. (2021). Use of complementary and alternative therapy for knee osteoarthritis: race and gender variations. *ACR Open Rheumatology*, 3(9), 660-667.
82. Webb, S., Drake, C., Coffman, C. J., Sullivan, C., Sperber, N., Tucker, M., ... & Allen, K. D. (2023). Group physical therapy for knee osteoarthritis: protocol for a hybrid type III effectiveness-implementation trial. *Implementation science communications*, 4(1), 125.
83. Young, J. J., Pedersen, J. R., & Bricca, A. (2023). Exercise therapy for knee and hip osteoarthritis: is there an ideal prescription? *Current Treatment Options in Rheumatology*, 9(3), 82-98.
84. Zeng, C. Y., Zhang, Z. R., Tang, Z. M., & Hua, F. Z. (2021). Benefits and mechanisms of exercise training for knee osteoarthritis. *Frontiers in physiology*, 12, 794062.
85. Zhu, J., Zhu, Y., Xiao, W., Hu, Y., & Li, Y. (2020). Instability and excessive mechanical loading mediate subchondral bone changes to induce osteoarthritis. *Annals of translational medicine*, 8(6).