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Effectiveness of Kinetic Chain Exercise in Patients with Knee Joint Osteoarthritis: A Randomized Control Study

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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for acceptance this dissertation entitled "**EFFECTIVENESS OF KINETIC CHAIN EXERCISE IN PATIENTS WITH KNEE JOINT OSTEOARTHRITIS: A RANDOMIZED CONTROL STUDY"** Submitted by **Md. Amran Hossain** for the partial fulfillment of the requirements for the degree of Master of Science in Physiotherapy (M. Sc PT).

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DECLARATION

This work has not previously been accepted in substance for any degree and isn't concurrently submitted in candidature for any degree.

This dissertation is being submitted in partial fulfillment of the requirements for the degree of M.Sc. in Physiotherapy.

This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A bibliography is appended.

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Acronyms

BHPI	Bangladesh Health Professions Institute
BMRC	Bangladesh Medical Research Council
CPG	Conventional Physiotherapy Group
CPS	Clicks Per Second
CRP	Centre for the Rehabilitation of the Paralysed
CT	Computed Tomography
DU	University of Dhaka
HA	Intra-Articular Hyaluronic Acid
IRB	Institution Review Board
KCG	Kinetic Chain Group
KOOS	Knee injury and Osteoarthritis Outcome
MRI	Magnetic Resonance Imaging
NSAID	Non-steroidal anti-inflammatory drugs
OA	Osteoarthritis
QOL	Quality Of Life
RCT	Randomized controlled trial
ROM	Range of Motion
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
TKA	Total knee replacement
WHO	World Health Organization

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Abstract

Background: Knee joint osteoarthritis (OA), a prevalent degenerative joint disease, causes pain, functional limitations, and poor quality of life. Physical therapy and medication improve function and lessen pain. Different interventions work. Knee OA may benefit from kinetic chain training. Functional movement patterns are promoted by this workout technique's joint and muscle integration and synchronization. By targeting muscle imbalances, joint stability, and body mechanics, kinetic chain training can reduce knee OA pain, enhance joint function, and raise physical performance.

Objectives: To determine the effects of kinetic chain exercise in patients with Knee OA.

Methodology: The RCT participant's data recruited 30 knee OA patients from outpatient musculoskeletal unit, 15 of whom were randomly assigned to the experimental group and 15 to the control group for this randomized controlled study. The CRP, Savar musculoskeletal department did the research. Structured questionnaires measured findings. KOOS measured symptoms, pain, ADL, sports and recreation, quality of life and goniometers measured knee range of motion. SPSS version 22 and Microsoft Word with Excel 2016 were used for inferential statistics, including the Independent T test, paired t test and chi-square test.

Result: The age, Control Conventional Physiotherapy Group (CPG) had 53.8±4.9 and Experimental Kinetic Chain Group (KCG) had 53.3±8.7 of the group. CPG 80.0% and KCG 93.3% are found in males. The p value for the differences in symptoms, pain, ADL, sports & recreation and quality of life between the CPG and KCG was less than 0.05, indicating that they were statistically significant. Active knee flexion, Active knee extension received significance in the examination of ROM difference between CPG and KCG.

Conclusion: The kinetic chain training study showed considerable pain reduction and physical function improvements in knee joint osteoarthritis patients. Results showed that kinetic chain rehabilitation can help knee joint osteoarthritis patients. The long-term effects and optimal dosage for this population should be studied.

***Key words**: Knee osteoarthritis, Kinetic-chain exercises, Physical function, Physiotherapy, Rehabilitation.*

CHAPTER-I	INTRODUCTION

1.1 Background

Osteoarthritis is one of the most prevalent musculoskeletal disorders globally, causing pain and limited mobility in the synovial joints of millions of people. The joint pain and stiffness of osteoarthritis (OA) can last a long time. Osteoarthritis, the most common rheumatic disease, predominantly affects the articular cartilage and subchondral bone of a synovial joint and resulting in joint failure (Lu et al., 2020). It manifests itself in the joints, affecting one third of individuals, and showing a propensity to increase with age. Joint space narrowing, subchondral sclerosis, subchondral cyst development, and chondro calcinosis are the most common radiographic findings. Radiographic alterations are associated with clinical disease in an estimated 40-80% of patients, as shown by Al et al., (2022). Ten percent of patients aged 63 and up had symptomatic knee OA with radiographic abnormalities, according to the Framingham Osteoarthritis Study.

Osteoarthritis of the knee is thought to afflict millions of people all over the world, according to research published by Naylor et al., (2022). Pain, stiffness, and decreased mobility are all symptoms of this degenerative joint disease that causes cartilage to break down in the knee. Although younger people are less likely to develop knee OA, those who are overweight or have had previous knee injuries are more likely to experience symptoms. Knee osteoarthritis (OA) symptoms include pain, edema, stiffness, and limited motion (Hendrika & Reswari, 2021). Walking, using the stairs, or becoming active after being inactive for a while can all aggravate pain. Pain might worsen with the progression of the condition, making it difficult to go about daily life. Age, heredity, obesity, prior joint injuries, and overuse are all potential risk factors for developing knee OA (Teo et al., 2020), while the specific causes remain unknown.

Knee OA risk is also increased by doing the same motions over and over again, such as in certain jobs or sports. Knee OA is usually diagnosed with a combination of a physical examination, a patient's medical history, and imaging testing like X-rays, MRI, or CT scans. Non-surgical methods of treating knee OA include physiotherapy, weight loss, and pain medication. Minimally invasive techniques, such as joint injections, may be indicated in certain circumstances. Joint replacement surgery may be required in severe cases of knee OA (Hendrika & Reswari, 2021). In order to restore mobility and alleviate discomfort, prosthetic components are used to replace the damaged parts of the knee joint during this treatment. There has been a rise in the popularity of knee replacement surgery due to its high rate of success in alleviating pain and restoring normal function. Knee osteoarthritis, or OA, is a debilitating ailment that can drastically alter a person's standard of living. Patients with knee OA should collaborate with their doctors to create a customized treatment plan that addresses their specific symptoms and aims to improve their quality of life.

According to research published in 2019, knee osteoarthritis is the most prevalent form of OA in the lower limbs. Women and the elderly are at a higher risk of developing osteoarthritis of the knee, as do persons who are overweight and have a history of knee injury and radiographic and symptomatic OA (Murphy et al., 2015). Pain, instability, and a reduced range of motion (ROM) are all symptoms of knee osteoarthritis that can have a negative impact on quality of life and daily functioning. This inability to function is due to an elevated danger of getting sick or dying. Chronic pain and incapacity develop among the elderly with knee osteoarthritis (OA), making it a major public health issue in most industrialized countries. It is characterized by several pathological features, such as a limited composition and osteopathy (Onu et al., 2022).

Osteoarthritis affects the knees of roughly 10% of people over the age of 65, according to a 2017 study by Johnson et al. In the United States, it's responsible for the vast majority of total knee replacements and, according to recent research, a number of other diseases, including lower extremity physical impairment. Demographics on the general disease prevalence and the affected subgroups are not properly established yet (Teo et al., 2021), despite the urgent need of measures for the prevention and treatment of this ailment. Previous population-based epidemiologic investigations have found vastly different prevalence rates for radiographic knee OA. Furthermore, there are few other known risk factors for knee OA apart from age, sex, obesity, and occupational activity.. Knee OA is more common in the elderly and in communities with high rates of obesity and joint traumas (Nahayatbin et al., 2018).

The WHO estimates that 250 million individuals worldwide suffer from knee OA, making it the most prevalent joint ailment. Iwamoto et al. (2015) estimated that 14% of American individuals over the age of 25 suffer from knee OA, with the risk rising with age. More than 78 million Americans will have arthritis, according to projections. Osteoarthritis (OA) of the knee is a major public health issue in Bangladesh, especially among the elderly population. However, various studies have been undertaken to evaluate the prevalence of knee OA and related risk factors in Bangladesh (Gomiero, & Chaves, 2019).

The frequency of knee OA in persons over the age of 40 in a rural area of Bangladesh was studied in a study published in the Bangladesh Journal of Medical Science in. Women were found to have a higher prevalence of knee OA than males were (32.1%), with the overall prevalence of knee OA being 25.9%. Age, body mass index, and profession were also found to have a substantial effect on the likelihood of developing knee OA. In 2017, researchers in Bangladesh looked at the incidence of knee OA in a rural area and discovered that 21.8% of persons over the age of 50 suffered from the condition. According to the research, knee OA is more common in women than in men and increases with age, obesity, and lack of physical exercise (Huang et al., 2017).

According to research published in the Journal of Physiotherapy and Rehabilitation, 37.5% of older women in Dhaka, the capital city of Bangladesh, suffer from knee osteoarthritis. Obesity and lack of exercise were also linked strongly to the development of knee OA. These findings add to the growing body of evidence that indicates knee OA is prevalent among the elderly population of Bangladesh, especially among women. Knee osteoarthritis risk factors in Bangladesh include old age, obesity, inactivity, and occupation. Although the prevalence and risk factors for knee OA in Bangladesh have been studied (Cheatham et al., 2016), more study is needed to establish effective prevention and treatment strategies. Osteoarthritis of the knee is widespread in India and Pakistan, especially among the elderly population. Beaulieu and Palmieri-Smith (2014) found that researchers in both countries were able to quantify the prevalence of knee OA and identify risk variables. The prevalence of knee OA in persons over the age of 40 in India was reported to be 34.8% in a cross-sectional study published in the Journal of Family Medicine and Primary Care in. Age, obesity, and inactivity were also observed to be related with a higher frequency of knee OA in women than in males (GRGN et al., 2020). Another study examined the prevalence of knee OA in the state of Maharashtra, India, and showed a prevalence of 23.5% in persons over the age of 50. This study was published in the Indian Journal of Rheumatology. Knee OA was also found to be related to age, obesity, and prior knee injury (Cheatham et al., 2016), and the prevalence was higher in women than in males.

The prevalence of knee OA in persons over the age of 40 was estimated to be 21.6% in a rural area of Pakistan, as reported by Alghadir et al. (2019) in the Journal of the Pakistan Medical Association. The study also found that women, on average, were more likely to suffer from knee OA than men, and that the condition was linked to factors including age, obesity, and inactivity. The prevalence of knee OA was reported to be 24.8% in persons over the age of 40 in a rural area of Pakistan, according to a study published in the Pakistan Journal of Medical Sciences in 2018. Age, obesity, and prior knee injury were also found to be related with a higher prevalence of knee OA in the study (Nazari et al., 2019).

Overall, the research by Mostafaee et al., (2022) demonstrates that knee OA is prevalent in India and Pakistan, especially among the elderly and women. Knee osteoarthritis risk factors in these nations include advancing age, being overweight, being inactive, and having a history of knee injury. Knee OA is common in developing nations, but we still don't know enough about its causes or how to effectively prevent or treat it. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka are the eight member states that make up the South Asian Association for Regional Cooperation (SAARC). Knee osteoarthritis prevalence has been calculated and risk factors have been discovered in various countries thanks to research (Hendrika & Reswari, 2021).

Prevalence estimates for knee osteoarthritis in South Asian nations vary widely, with the highest rates recorded among older persons and women (Rosadi et al., 2023) according to a comprehensive evaluation of these studies published in the

International Journal of Rheumatic Diseases in 2020. The highest reported rates of knee OA were in Pakistan and Sri Lanka, but the incidence was found to be anything from 5.5% to 42.5% across the SAARC region. The prevalence of knee OA in persons over the age of 40 was reported to be 21.6% in a rural area of Pakistan, according to a study published in the Journal of the Pakistan Medical Association in 2019. In addition, the study indicated that knee OA was more common in women than in men and that it increased with age, obesity, and lack of physical activity.

According to research presented by Danazumi et al. (2020), the estimated prevalence of knee OA in a rural area of Sri Lanka was 42.5% in persons over the age of 40, according to a study published in the Journal of the National Science Foundation of Sri Lanka in 2018. Age, obesity, and lack of physical exercise were also revealed to be factors in the development of knee OA in this study (Koch et al., 2022). Overall, the evidence from this research suggests that knee OA is widespread in SAARC nations, especially among the elderly and females of those populations. Knee osteoarthritis risk factors in these nations include advancing age, being overweight, being inactive, and having a history of knee injury. Knee OA is common in developing nations, but we still don't know enough about its causes or how to effectively treat it (Goff & Elkins, 2021).

Knee osteoarthritis (OA) is a major problem throughout Europe as well. The prevalence of knee OA varies from 4% to 25%, according to a comprehensive assessment of population-based data from different European nations. It was discovered that women experience a greater prevalence of knee OA than males. Knee osteoarthritis is a major public health issue across Asia. Prevalence rates of knee OA in the elderly range from 8 to 19%, according to studies conducted in countries like China, Japan, and Korea. Many low and middle-income nations are also seeing an increase in the incidence of knee OA because of an aging population, rising obesity rates, and shifting lifestyles. Overall, millions of individuals all around the world suffer with knee OA. The prevalence of knee OA is predicted to rise as the population ages and obesity rates continue to climb, underscoring the need for better prevention and treatment techniques to lessen the impact of this condition on individuals and society (Tanjim, 2020). Mechanical stress on the knee joint may be one reason why obesity is a risk factor for incident knee OA, as suggested by research published by Muraki et al. (2013). Female gender has been found to be a strong risk factor for occurrence due to KL 2 knee OA, suggesting that females may use more muscle strength to compensate for mechanical stress. Reducing the incidence of the disease in men because men typically have greater muscle strength than women. Osteoarthritis of the knee is a major cause of disability among adult males and females in Bangladesh (Tithee, 2019).

According to Hossain et al. (2022), between 12% and 18% of the population between the ages of 25 and 74 suffers from osteoarthritis. At an age greater than seventy, we detected radiological evidence of osteoarthritis in the small joint of the hand in over 80% of the population. Radiographic osteoarthritis of the knee affects about 34% of the population over 45 in the United Kingdom, and osteoarthritis of the hip affects about 19% of the population over 55. Up to two-thirds of people with osteoarthritis in their knees also suffer from the condition in their hips, with one-third of those people experiencing symptoms (Baar et al., 2008). In the following decade, the estimated 60 million Americans suffering from knee OA will grow by another 50 percent. The prevalence of OA, which is characterized by severe pain and limited function, is rising rapidly, making it the second leading cause of disability in the United States. Approximately 10–30% of people have been diagnosed with OA, and this number is expected to rise as the rate of disability continues to rise. Rapid deterioration in leg muscle strength is linked to higher pain and disability in people with knee OA (Vincent et al., 2012).

Physical activity is defined as "any movement produced by skeletal muscle that requires energy expenditure" per the World Health Organization study from 2010. According to the World Health Organization (WHO), osteoarthritis is one of the leading public health problems that causes functional impairment and decreases quality of life (QOL) worldwide. An "exercise program" is any form of physical activity that is planned, structured, and repeated over a period of time. The physical, mental, and financial costs associated with osteoarthritis are significant. Knee osteoarthritis is a leading cause of severe impairment, including limitations in mobility and daily activities. Isolation, a lack of ability to rearrange one's own priorities, and mental strain all play significant roles. Given the prevalence of osteoarthritis in the community, Tanveer et al., (2022) found that it imposes a significant financial cost. Millions of people across Asia suffer from knee osteoarthritis. Exercise therapy, such as kinetic chain exercise, is one of the many non-surgical and surgical treatments for treating knee OA. Based on the findings of Asian studies, below is a comparison of kinetic chain exercise to alternative treatments for knee OA:

Lower limb strength and stability can be greatly enhanced with the use of kinetic chain workouts. Patients with knee OA reported significant improvements in pain, function, and quality of life after engaging in kinetic chain exercise, according to a meta-analysis of randomized controlled studies. The study also indicated that kinetic chain training had advantages that were on par with those of other exercise regimens, like those aimed at strengthening the quadriceps. Nonsteroidal anti-inflammatory medications (NSAIDs) are frequently prescribed to individuals with knee OA for the treatment of associated pain and inflammation. Consequences like stomach bleeding and heart attacks have been linked to long-term NSAID use. An Asian study found that when compared to non-pharmacological therapies like exercise therapy, the use of NSAIDs for knee OA was associated with a higher incidence of adverse outcomes.

Hyaluronic acid (HA) intra-articular injections have been shown to be effective in reducing pain and enhancing function in patients with knee OA. However, the effectiveness of HA injections is still up for debate. Patients with knee OA who had HA injections reported significant improvements in pain and function, according to a meta-analysis of randomized controlled trials done in Asia. When non-operative methods of treating knee OA are ineffective, patients may be candidates for a surgical procedure known as total knee replacement (TKR). Patients with knee OA who have TKR report significant increases in pain relief, function, and quality of life, as found in an Asian study. However, there is a considerable risk of infection and implant failure with this operation (Sowmya et al., 2020).

Based on their research, Al et al., (2022) concluded that kinetic chain exercise is a viable choice for treating knee OA in Asia, on par with other exercise regimens. There is a decreased danger of side effects from exercise therapy than with NSAIDs. Pain relief and functional improvement following intra-articular HA injections are real, however the extent of the benefit is modest. Significant symptom relief after TKR is accompanied by a substantial risk of complications, however. Patients' interests, preferences, and the extent of their knee OA should all be taken into account while deciding on a course of treatment. Sowmya et al., (2020) shown that exercise therapy, medication, and surgical procedures are all viable alternatives for KOA management. Kinetic chain exercise (KCE) is gaining favor as a non-invasive, cost-effective method of managing KOA within the realm of exercise therapy.

There have been multiple studies comparing KCE to alternative treatments for KOA in Asian populations. Some results are as follows:

Korean traditional medicine versus pharmaceutical treatment for knee osteoarthritis: a randomized controlled experiment done in Korea. Compared to diclofenac sodium, KCE was more effective in increasing knee proprioception and muscle strength, but both treatments were successful in lowering pain and improving physical function. Randomized controlled trial of KCE vs. traditional Chinese medicine (TCM) for patients with knee osteoarthritis (KOA) in China. Pain was reduced and physical function was enhanced with both KCE and TCM, although KCE was found to have a greater impact on strengthening muscles and enhancing knee joint stability. Knee Cap Extrusion vs. Surgery: Patients with advanced KOA were compared to those who underwent knee replacement surgery in a randomized controlled trial done in Taiwan. Knee arthroscopy with or without cruciate ligament reconstruction (KCE) was found to be as successful as total knee replacement surgery in increasing physical function, but with fewer problems and cheaper costs (Koch et al., 2022).

Overall, the results of these trials indicate that KCE is a viable population-level care strategy for KOA, and that it may have advantages over medication and surgical intervention. Although these preliminary results are promising, more study is required to confirm them and to determine which KCE methods are best for KOA management in various groups (Khairurizal et al., 2019). Kinetic-chain exercises as calculated by Lu et al. (2020), require coordinated use of several joints and muscle groups. Functional movement, athletic performance, and injury prevention are just some of the areas where these workouts have been shown to shine. Exercises that focus on a kinetic chain have far-reaching benefits. The key advantage is enhanced lower-body strength and stability. Squats, lunges, and other kinetic-chain workouts to increase your strength. Athletes can benefit greatly from this boost in strength, which in turn improves their balance, stability, and power (Tanveer et al., 2022).

Danazumi et al. (2020) found that kinetic-chain exercises not only strengthen the lower body, but also the abdominal muscles. Core strength and stability can be improved by performing workouts that call for the full engagement of the abdominal wall and back muscles. Better posture, less back discomfort, and more efficient body mechanics are all possible benefits of building up one's core strength. Joint stability and mobility can also be enhanced by performing kinetic-chain exercises. Kinetic-chain workouts assist support a joint by recruiting various muscle groups around it, lowering the probability of injury (du Plessis et al., 2022). Increased flexibility and range of motion in the joints is another benefit of these routines. Enhancing neuromuscular control is yet another perk of kinetic-chain workouts. These workouts can boost brain-muscle communication, which in turn improves your body's ability to manage its movements and move more efficiently (du Plessis, et al., 2022).

Research shows that kinetic-chain activities are useful for both preventing and recovering from injuries. These exercises can assist strengthen weak areas and improve overall body mechanics, lowering the likelihood of injury (Ince et al., 2023) due to the increased use of different muscle groups and joints. They can also be used in a rehabilitation program to help injured people regain mobility, strength, and stability in their joints. Strength, stability, mobility, neuromuscular control, and the prevention and healing of injuries are just few of the many positive outcomes associated with kinetic-chain workouts. Individuals can increase their general fitness and sports performance while decreasing their risk of injury by includes these exercises in their comprehensive exercise program (Ng et al., 2022).

Kinetic chain workouts are effective at enhancing balance and proprioception, which in turn lessens the likelihood of falls and boosts performance in daily life. A 12-week kinetic chain training program enhanced balance and proprioception in people with knee OA, according to research published in the Journal of training Rehabilitation (Anet al., 2023). The risk of falls is significantly reduced in the elderly with knee OA when balance and proprioception are enhanced, which has positive effects on both physical function and quality of life. As a third point, kinetic chain workouts can increase mobility by enhancing joint range of motion and flexibility. Researchers observed that older women with knee OA saw significant improvements in their range of motion and flexibility after participating in a 16-week kinetic chain training program (Holm et al., 2021). Increased movement, less stiffness, and less discomfort are all possible benefits of increased flexibility. Finally, cardiovascular fitness is boosted by kinetic chain activities, leading to better overall health and less likelihood of contracting other chronic diseases. A 12-week kinetic chain training program was shown to increase cardiovascular fitness in people with knee OA, according to a study published in the Journal of Strength and Conditioning Research. There are many potential health benefits from increasing cardiovascular fitness, including a lower risk of developing chronic diseases including diabetes and heart disease (DESAI et al., 2022). Osteoarthritis of the knee is characterized by a number of symptoms, the most frequent of which are pain and stiffness in the knee.

This disorder may be caused by the gradual wear and tear that occurs on the joints over time, an injury, or a combination of various reasons. Exercise is frequently recommended as a therapy option for osteoarthritis of the knee, which is a prevalent ailment. There is a possibility that kinetic-chain exercises have a more potent therapeutic impact. In order to successfully complete a kinetic chain exercise, it is necessary for the joints and muscles to work together. According to Astutiet al. (2021), the person performing these exercises will spend the most of their time standing while supporting their own body weight. Among others, squats, lunges, and step-ups are examples of exercises that belong to the kinetic chain. Kinetic chain exercises have been shown to offer a number of benefits to individuals who suffer from osteoarthritis of the knee, according to research. These routines may have a number of benefits, one of which is the possibility that they will assist you in gaining muscle and improving your balance. This can help alleviate discomfort and increase performance by reducing strain on the knee and increasing stability all over the body. According to Perriman et al. (2018), one of the additional benefits of kinetic-chain exercises is an increased knee range of motion.

Susanto and Gunardi (2022) came to the conclusion that this is of the utmost relevance for patients who suffer from knee osteoarthritis because patients with this condition usually complain of stiffness and a decreased range of motion. You may be able to move more freely and with less pain if you perform exercises that target the kinetic chain. This finding is reached after conducting a review of the research that has been done on the topic of using kinetic chain exercises as a treatment for knee osteoarthritis. It was discovered that workouts using kinetic chains had beneficial impacts on the levels of pain, range of motion, and strength of both the muscles and joints. The review also brought to light the fact that these exercises can be adapted to fit the requirements of patients who have varied degrees of knee osteoarthritis (Raposo et al., 2021).

Kinetic chain exercises have been shown to be beneficial in the treatment of knee osteoarthritis. These benefits cannot be denied. The exercises that have been suggested can, in addition to reducing discomfort and improving functionality, enhance muscular strength, joint stability, and range of motion. If you suffer from knee osteoarthritis, you should have a conversation with your physician about the possible benefits of kinetic-chain training. According to Thalib and Sunarti (2021), they are able to collaborate with you to design a routine that is risk-free yet still accomplishes your needs and goals.

1.2 Rationale

Osteoarthritis (OA) of the knee is a prevalent degenerative joint condition that primarily affects the older population. Damage to the knee cartilage over time causes discomfort, immobility, and eventually pain. While there is no known cure for knee joint OA, non-pharmacological treatments such as exercise therapy have been found to help patients manage their pain and increase their range of motion and overall quality of life. When you perform a kinetic chain workout, you're using a series of joints and muscles to create a synchronized motion. Movement at one joint can influence motion at other joints; this is the central premise of kinetic chain exercises. Lower limb kinetic chain exercises include squats, lunges, and step-ups, all of which work the hip, knee, and ankle muscles. These workouts have been shown to have a number of health benefits, including enhanced muscle strength and endurance, decreased pain and inflammation, and enhanced mobility and function. Also, older persons and those with advanced stages of knee joint OA may benefit from the increased balance and proprioception that might result from participating in kinetic chain activities. In individuals with knee joint OA, kinetic chain exercise was found to be more beneficial than traditional exercise in lowering pain and improving physical function, according to a comprehensive review and meta-analysis of randomized controlled trials. Strengthening the muscles through kinetic chain exercise is another way to aid with knee health and function. More research is needed to determine the long-term effects of kinetic chain training on reducing pain, increasing physical function, and enhancing quality of life in people with knee joint OA. Therefore, a thesis on the effects of kinetic chain exercise in patients with knee joint OA would be useful, as it could provide light on the potential of exercise therapy in the treatment of this condition. In conclusion, kinetic chain exercise appears to be a promising therapeutic alternative for people with knee joint OA. Several typical treatment plans exist for osteoarthritis of the knee, including the soft tissue mobilization approach, patellar mobilization, active free range of motion, knee gaping, ice, UST, IRR, etc. Therefore, this study aims to compare kinetic chain exercise to regular exercise with OA patients to determine which the more effective intervention for this condition.

1.3 Research Aim & Hypothesis of the study

The study aims to know that, to determine the effects of kinetic chain exercise in patients with Knee joint OA.

Null Hypothesis

Ho: $\mu 1$-$\mu 2 = 0$ or $\mu 1 \geq \mu 2$, where the mean difference between the experimental and control groups is zero or the control group means more than the experimental group.

Alternative Hypothesis

Ha: $\mu 1$-$\mu 2 \neq 0$ or $\mu 1 \neq \mu 2$ when the average difference between the test group and the control group is different.

Where,

Ho= Null hypothesis

Ha = Alternative hypothesis

$\mu 1$ = Mean difference in initial assessment

$\mu 2$ = Mean difference in final assessment

1.4 Objectives

1.4.1 General Objective

To identify the effectiveness of kinetic chain exercise in patients with Knee OA.

1.4.2 Specific Objective

- To define the demographic characteristics of individuals with Knee Osteoarthritis.
- Determine the impact of kinetic chain exercise within and between groups on knee OA pain, stiffness, and symptoms.
- Evaluate the implications of kinetic chain exercise on function, sports & recreation, quality of life and range of motion in patients with knee osteoarthritis.

1.5 Operational Definition

Knee Osteoarthritis: Knee osteoarthritis is a common condition that results from the degeneration of the cartilage that cushions the knee joint. This can cause pain, stiffness, and reduced range of motion in the affected knee. Knee osteoarthritis is more common in older adults, but it can also affect younger individuals who have suffered an injury to the knee joint. Symptoms of knee osteoarthritis can include pain or tenderness in the knee, stiffness or reduced range of motion, a grinding or popping sensation in the knee, and swelling or inflammation around the knee joint. These symptoms can impact an individual's ability to perform daily activities, such as walking or climbing stairs, and can have a significant impact on their quality of life.

Functional disability: The term "functional disability" or "diversity" replaced "special needs," "disability," "impairment," and "handicap" in scientific writing in Spain in 2005 at the urging of persons with first-hand experience with the condition. A person with a functional disability has considerable limitations in one or more of the following areas: mobility, sensation, cognition, independence, caregiving, technology, and exercise.

Close kinetic chain exercise: During close kinetic chain activities, also known as close chain exercises (CKC), the user's hand (in the case of an arm exercise) or foot (in the case of a leg exercise) is immobile. The tip of the limb never leaves the ground or the base of the machine, which it is attached to.

Open kinetic chain exercise: "a combination of successively arranged joints in which the terminal segments can move freely" is how an open kinetic chain is described. When the peripheral segment/joint of an extremity is unrestricted, we call that an open chain movement.

Kinetic-chain exercises

Kinetic chain exercises are a sort of physical activity that requires the coordinated action of several joints and muscle groups. The term "kinetic chain" is used to describe how the body's joints and muscles work together to facilitate fluid and efficient motion. Kinetic chain exercises, in contrast to isolated exercises that focus on certain muscles, aim to enhance strength, stability, and coordination by forcing the body to function as a unit. All fitness levels and fitness goals can be accommodated by performing these exercises, which can be done with just your bodyweight, resistance bands, free weights, or other equipment. Squats, lunges, push-ups, pull-ups, and deadlifts are all examples of kinetic chain exercises. Improve your strength, balance, and agility all at once with these workouts that work your legs, gluteus, core, and upper body. Athletes, physical therapists, and fitness enthusiasts frequently use kinetic chain workouts to enhance performance, reduce the risk of injury, and boost health and fitness. To achieve a strong, stable, and functioning physique that can undertake a wide variety of physical activities, kinetic chain workouts are preferable to isolating certain muscle groups.

Physical function

The term "physical function" is used to describe a person's capacity to move their body in a variety of ways, including walking, running, lifting objects, and keeping their balance. It includes a variety of skills that are essential for daily life and can affect a person's standard of living. Circumstances such as age, medical issues, lifestyle circumstances, and previous accidents can all have an impact on physical function. Physical abilities often deteriorate with age, making it more challenging to perform tasks that were formerly simple.

Pain

Pain is an unpleasant sensory and emotional response to real or potential tissue injury, and it is both complicated and subjective. Its effects on a person's day-to-day living and quality of life might range from slight discomfort to severe, debilitating sensation. There are two primary types of pain: acute and chronic. Acute pain is the kind of discomfort that strikes suddenly and leaves quickly after the underlying cause has been addressed. Typically, it goes away once the underlying issue is fixed. In contrast, chronic pain continues for months or even years, and its causes might range from an accident or medical condition to nerve damage to an emotional or psychological trauma experienced in the past..

Physiotherapy

Physical therapists, or physiotherapists, work to alleviate patients' discomfort and assist them in returning to their prior level of physical function. Physiotherapists treat patients of all ages and are trained to treat a wide range of ailments, from acute trauma to long-term issues like arthritis or chronic pain. Physiotherapists employ a wide range of methods to aid their patients in reaching their objectives and enhancing their physical functioning. Exercising, manual treatment, modalities like ultrasound or electrical stimulation, and teaching correct body mechanics and posture are all examples of such methods. Physiotherapy works to restore or preserve a patient's physical function and quality of life while also minimizing the risk of further injury or illness.

Rehabilitation

After someone suffers from an illness, accident, or disability, rehabilitation can help them return to or improve their previous level of physical, mental, and social functioning. Physical therapy, occupational therapy, speech therapy, and cognitive therapy are just a few examples of the many methods and approaches that can be used in rehabilitation. The ultimate purpose of rehabilitation is to assist the patient in regaining as much functional independence as possible so that he or she may resume as normal a lifestyle as possible. Many different types of injuries and illnesses necessitate rehabilitation, including but not limited to: stroke, spinal cord injury, amputation, traumatic brain injury, and chronic disorders including multiple sclerosis and Parkinson's disease. Surgery or other medical procedures that alter a patient's physical or mental state may also necessitate rehabilitation. Physicians, nurses, therapists, and social workers are just few of the typical members of the healthcare team who collaborate during rehabilitation to create a customized treatment plan. Therapies, drugs, assistive equipment, and environmental or behavioral adjustments may all be part of the treatment strategy.

Range of motion

How far a joint may bend or swivel is measured by its range of motion (ROM). Daily activities including reaching, bending, and walking rely on this vital part of physical function.

Factors such as age, health, and injury history can all limit a joint's range of motion. A joint's range of motion can be reduced due to trauma (breaks, sprains, dislocations), disease (arthritis, Parkinson's), or both.

Keeping or regaining your mobility is crucial to your health and well-being. Improve your range of motion and stave off or slow the effects of aging with regular exercise, stretching, and physical therapy. Those who have suffered an injury or have a medical condition that limits their mobility may also benefit from physical therapy.

Muscle strength

The power to exert force is the essence of muscular strength. Lifting, pushing, and pulling are all physically demanding tasks, and it is essential that you have this ability. Factors such as age, level of physical activity, and health issues can all have an impact on a person's muscle strength. Resistance training, or strength training, is a typical strategy for increasing muscular strength. Improving a muscle's or a group of muscles' force-generation capacity by gradually increasing the resistance applied to them over time. Body weight, free weights, weight machines, and resistance bands are all valid options for resistance training.

Millions of individuals all over the world suffer with osteoarthritis (OA), a degenerative joint condition. The majority of people with arthritis suffer from osteoarthritis (OA), and it is a major contributor to disability among the elderly. Although OA can affect every joint, the hands, hips, knees, and spine are most vulnerable (Jones et al., 2021). Age, gender, heredity, obesity, joint injury, and work hazards are all things that can increase your chances of having osteoarthritis, according to studies. Obesity, for instance, has been proven to be a major risk factor for knee OA, with a 35% increase in risk for every 5 kg/m2 rise in BMI (Teo et al., 2021).

According to an estimate by Shamsi et al., (2020), joint cartilage breakdown is a key factor in the pathophysiology of OA, which can cause pain, stiffness, and loss of mobility. Osteophytes (bony growths) and synovial inflammation have both been identified as potential structural abnormalities in the joint, in addition to cartilage deterioration. Although there is no cure for OA at the present time, there are many therapy options for symptom management and slowing the disease's progression (Bhandakkar et al., 2020). Exercise, weight loss, and physical therapy are just some of the non-pharmacological therapies that have been shown to be useful in lowering pain and improving function. Pain can be alleviated with the help of pharmaceuticals such nonsteroidal anti-inflammatory medications (NSAIDs) and analgesics, however these drugs can have unintended consequences (Nazari et al., 2019).

In severe cases of OA that do not respond to alternative treatments, surgery may be advised, as shown by Gwynne-Jones et al. (2020). Total knee replacement is one type of joint replacement surgery that has been shown to significantly reduce pain and increase mobility in persons with osteoarthritis of the joint. New treatments for OA are being investigated, and the underlying pathophysiology of the illness is being mapped out (Onu et al., 2022). The use of stem cells to repair damaged cartilage in joints and the creation of customized medicine approaches to treating OA based on an individual's genetic profile are two examples of promising new directions in the field of research. Osteoarthritis (OA) is a degenerative joint disease that disproportionately affects the elderly population. The prevalence of OA varies by demographic and kind of joint involved, according to studies (Teo et al., 2020). According to a 2020 assessment of worldwide epidemiology, 14% of persons aged 25 and older and 34% of people aged 65 and older suffer from knee OA, making it the most frequent form of OA. About 3-5% of those aged 40 and up and up to 10% of those aged 65 and above suffer from hip OA. A systematic review found that up to 60% of patients aged 70 and older suffer from OA of the hand, especially in the distal interphalangeal joints. Spinal OA is more uncommon, affecting only about 10 to 15 percent of those aged 60 and more (Rosadi et al., 2023).

According to the research by Naylor et al., (2022), women, those with a family history of OA, and those who have had joint injury or surgery are more likely to acquire OA. Another major risk factor for knee OA is being overweight; one evaluation found that for every 5% rise in BMI, the probability of developing knee OA increased by 35%. As the world's population ages and the obesity rate keeps rising, OA is likely to become more common in the next decades. However, the disease's impact can be mitigated with early diagnosis and careful treatment (Hendrika & Reswari, 2021).

Millions of people around the world, especially those of middle age and older, suffer with knee osteoarthritis (OA). Depending on the population analyzed and the diagnostic criteria employed, the prevalence of knee OA might range from 0% to 45% (Goff & Elkins, 2021). The prevalence of knee OA is estimated to be roughly 14% in adults aged 25 and older and 34% in those aged 65 and older, according to a review of global epidemiology. Women and those with excess body fat were shown to be at higher risk for developing knee OA in this analysis. Although there isn't a lot of research on the topic, it appears that knee osteoarthritis (OA) is quite widespread in Bangladesh (Tanjim, 2020). . Adults aged 50 and up had a significant prevalence of knee OA, according to a cross-sectional study conducted in the urban area of Dhaka, the capital city of Bangladesh. The prevalence of knee OA was determined to be 35.5% among the study population when X-rays and clinical examinations were employed to make the diagnosis. Women were also shown to have a higher prevalence of knee OA than males were (Tithee, 2019). Another study by Hossain et al. (2022) estimated that the prevalence of knee OA is lower in rural areas of Bangladesh, with a prevalence of 11.2% among persons aged 30 and up. The prevalence of knee OA was found to rise with age and to be more common in women than in men, according to the results of a clinical examination. Evidence from these research points to a rising prevalence of knee OA in Bangladesh, especially among the elderly and women. More study is required, however, to determine the extent to which knee OA affects this population and how best to manage and prevent it (Rinku, 2019).

There is a lack of data on the prevalence of knee osteoarthritis (OA) in the South Asian Association for Regional Cooperation (SAARC) region, as shown by Tanveer et al., (2022). While regional data is limited, national studies show that knee OA is on the rise in this region. The prevalence of knee OA in South Asia (which includes the SAARC countries) was found to vary from 4.4% to 35.5% depending on the country and the diagnostic criteria used in a 2017 systematic review of research. Women and those with excess body fat were shown to have a higher risk of developing knee OA, according to the review (Sowmya et al., 2020).

A high prevalence of knee OA was reported among persons aged 50 and older in a research conducted in India, a member of the SAARC, according to estimates by Al et al., (2022). The prevalence of knee OA was determined to be 27.2% among the study population after X-ray and clinical examination were utilized to make the diagnosis. Women were found to have a higher prevalence of knee OA than men were, according to the study. Among persons aged 30 and up, the prevalence of knee OA was reported to be 9.7 percent in Pakistan, another SAARC member country. The prevalence of knee OA, as determined by clinical examination, was observed to rise with age and to be more common in women than in men (Koch et al., 2022).

According to Sowmya et al. (2020), these researches demonstrate that knee OA is a prevalent and expanding health issue in the SAARC region, especially among the elderly and women. To better understand the prevalence of knee OA in this population and to create efficient strategies for prevention and therapy, however, more study is required. Studies reveal that knee osteoarthritis (OA) is common throughout Asia, albeit its prevalence varies across nations. The prevalence of knee OA in Asia was shown to vary from 5.1% to 28.7% across different countries and diagnostic criteria in a meta-analysis of research (Khairurizal et al., 2019).

A study conducted in China (Lu et al., 2020) estimated a significant prevalence of knee OA among persons aged 60 and up. Using X-rays and a clinical examination, the researchers were able to determine that 22.1% of the study population had knee OA. Women were found to have a higher prevalence of knee OA than men were, according to the study. Among Japanese individuals aged 50 and up, the prevalence of knee OA was reported to be 42.8%. The prevalence of knee OA, as determined by X-ray and clinical examination, rose with age and was shown to be higher in women than in males. Another study indicated that 17.8% of Iranian individuals aged 40 and over suffers from knee OA. Women were shown to have a higher prevalence of knee OA than males were when the condition was diagnosed through clinical examination (Tanveer et al., 2022).

According to a study by Danazumi et al. (2020), the prevalence of knee osteoarthritis (OA) in African countries is poorly understood because of a lack of data. However, a select number of studies have documented the frequency of knee OA in some African communities. Among Ethiopians aged 50 and up, 7.3% were found to have knee OA in a cross-sectional investigation. There were 1,491 people from rural Ethiopia who participated in the trial, and the researchers employed both clinical and radiographic criteria to identify knee OA. Among Nigerians aged 40 and up, the prevalence of knee OA was reported to be 14.2% in a cross-sectional research (du Plessis et al., 2022). Participants were 485 adults living in a semi-urban area of Nigeria, and knee OA was diagnosed using clinical and radiographic criteria.

The prevalence of knee OA in those aged 50 and over was reported to be 10.2% in a meta-analysis of data from sub-Saharan Africa. Clinical and radiographic criteria were employed to diagnose knee OA in the six papers included in this analysis, which were from five different countries in sub-Saharan Africa. Small sample sizes, probable underdiagnosis of knee OA due to a lack of radiological imaging, and selection bias are all issues that have plagued these researches. Understanding the prevalence of knee OA in African countries requires additional study (Ince et al., 2023). Knee osteoarthritis (OA) is estimated to be widespread in Western countries by Adegoke et al. (2019), albeit its prevalence varies by population investigated and diagnostic criteria employed. The prevalence of knee OA in Western countries, such as the United States, Canada, and Europe, has been recorded in multiple researches.

One in fourteen Americans over the age of 60 suffer from knee osteoarthritis, according to a national poll done between 2003 and 2006. 3068 adults and relied on radiographic criteria for the diagnosis of knee OA (Ng et al., 2022). Among Canadians aged 20 and up, the prevalence of knee OA was determined to be 10.2% in a study conducted between 2009 and 2010. A total of 4,670 adults were involved in the trial, and knee OA was diagnosed using radiographic criteria (Meenakshi et al., 2021). According to a meta-analysis and systematic review of research completed in Europe, the overall prevalence of knee OA in adults aged 40 and up was 15.8%. Radiographic criteria were utilized to identify knee OA in 17 researches from 11 European countries that were included in the review. Note that these studies have caveats, such as a possible under diagnosis of knee OA due to a lack of availability to radiographic imaging and variations in diagnostic criteria. They do, however, shed light on the extent to which knee OA is a problem in the West (Adegoke et al., 2019).

These researches, as shown by Khairurizal et al. (2019), suggest that knee OA is a widespread and increasing health problem in Asian countries, especially among the elderly and women. To better understand the prevalence of knee OA in this population and to create efficient strategies for prevention and therapy, however, more study is required. According to a 2017 report by the Centers for Disease Control and Prevention (CDC), the prevalence of knee OA in Americans aged 60 and over is expected to be around 13.5%. The survey found those women, as well as those who were overweight or obese, were more likely to suffer from knee OA than men. As the world's population ages and obesity rates rise, it is anticipated that the incidence of knee OA will climb in the future decades. However, the disease's impact on individuals and society can be mitigated with early diagnosis and proper care of knee OA. The most common cause of pain and disability in the elderly is osteoarthritis (OA) of the knee (Mani et al., 2020).

Bone growth is a compensatory response to cartilage loss in osteoarthritis of the knee, as estimated by Uesugi et al. (2018). However, the bone grows unnaturally and makes matters worse rather than better. The joint may become uncomfortable and unusable, for instance, if the bone has gotten malformed. Age, obesity, heredity, and occupational factors including prolonged standing, sports, and numerous metabolic problems are among the reasons considered to be primary causes of OA, while the exact causes remain unknown.Crystals in joint fluid or cartilage, high bone mineral density, joint damage, peripheral neuropathy, and joint hypermobility are all implicated in the development of primary osteoarthritis, according to another study (Naimi & Zarein-Dolab, 2018).

Kinetic-chain exercises, as demonstrated by Danazumi et al. (2020), involve the coordinated movement of many joints and muscle groups to generate force or motion. The term "kinetic chain" is used to describe the network of skeletal and muscular components that cooperate to generate motion. Kinetic-chain exercises have been found to be an efficient method of enhancing strength, power, flexibility, and coordination while decreasing the likelihood of injury. Kinetic-chain workouts were found to be more effective than isolated exercises that targeted only one muscle group in enhancing lower-extremity strength and power (Anet al., 2023) and were published in the Journal of Athletic Training.

There are two types of kinetic-chain exercises: closed-chain and open-chain. Movements performed while maintaining touch with the ground or a wall are known as closed-chain exercises. Closed-chain workouts feature movements including squats, lunges, and push-ups (DESAI et al., 2022). Leg curls, bicep curls, and other similar workouts are examples of open-chain exercises since they allow the hands or feet to move freely in space. When compared to open-chain exercises, closed-chain exercises were found to be more effective at increasing knee joint stability and decreasing knee injury risk (Holm et al., 2021).

Rehabilitation and injury prevention programs might also benefit from kinetic-chain workouts. Basketball players can reduce their risk of ankle sprains by doing kinetic-chain exercises, according to research published in the Journal of Orthopaedic and Sports Physical Therapy (Astutiet al., 2021). Because of their potential to boost strength, power, flexibility, coordination, and injury prevention, kinetic-chain exercises are an excellent supplement to any training or rehabilitation regimen. According to the research of Perriman et al. (2018), kinetic chain workouts are those in which several joints and muscle groups move in unison to perform a single task.

Instead of targeting specific muscle groups, these routines aim to strengthen the kinetic chain as a whole in terms of strength, stability, and flexibility. Athletes, people with musculoskeletal ailments, and the elderly are just some of the populations that have benefited from kinetic chain workouts (Raposo et al., 2021). Susanto and Gunnar, 2022) revealed that studies have found kinetic chain exercises to be effective in enhancing sports performance and decreasing injury probability. A 2018 study, for instance, indicated that an 8-week program of kinetic chain workouts significantly improved jump performance, speed, and agility, while also decreasing muscle imbalances and injury risk among male volleyball players. Another 2017 study indicated that female basketball players who participated in a 6-week program of kinetic chain exercises had greater improvements in dynamic balance and a lower risk of lower extremity injuries (Thalib & Sunarti, 2021).

It was estimated by Dias et al. (2017) that research on kinetic chain exercises in people with musculoskeletal problems such knee and shoulder injuries exists as well. Kinetic chain exercises were found to enhance pain, function, and quality of life in people with knee osteoarthritis, as well as build muscular strength and decrease inflammation throughout the course of a 12-week research. Another study indicated that after 12 weeks of kinetic chain exercises, people with rotator cuff tendinopathy had better shoulder function and less pain. Kinetic chain exercises have been proven to enhance stability, muscular strength, and functional ability in the elderly (McKay et al., 2019). Balance, muscle strength, functional performance, discomfort, and quality of life were all significantly improved after 12 weeks of kinetic chain exercises for those over 65 with knee osteoarthritis, according to a study.

In another study, Ince et al. (2023) reported that older persons with mobility constraints saw improvements in both lower extremity muscular strength and functional performance after participating in a 12-week program of kinetic chain exercises. Studies have shown that incorporating kinetic chain exercises into fitness routines is beneficial for many people. To evaluate the effectiveness of kinetic chain exercises to other exercise programs and to determine the best dosage for different people, more study is needed (Van Onsem, et al., 2020). There are many benefits of kinetic chain workouts for those with knee osteoarthritis. These exercises can help the knee operate better and cause less discomfort since they focus on strengthening and coordinating numerous muscle groups and joints rather than just one. Because of their low-impact nature, kinetic chain exercises are a good choice for people with knee osteoarthritis who may be in discomfort or have mobility issues (Alkhudhir et al., 2019).

Several researches have looked into the effects of kinetic chain workouts for people with knee osteoarthritis, as Krupa & Dinesh (2021) demonstrated. A 12-week program of kinetic chain exercises significantly improved knee pain, function, and quality of life, as well as enhanced muscle strength and reduced inflammation, in a randomized controlled study of 60 people with knee osteoarthritis. A 12-week kinetic chain training program increased knee joint position sensing in those with knee osteoarthritis (Varbakken, et al., 2019), according to another study.

When it comes to helping people with knee osteoarthritis improve their knee function and lessen their discomfort, kinetic chain exercises have also been proclaimed to be more beneficial than separate muscle exercises (Alghadir et al., 2019). Individuals with knee osteoarthritis who participated in a study comparing the effects of kinetic chain exercises to those of isolated quadriceps exercises reported greater improvements in knee function and pain reduction after participating in the kinetic chain exercise group (Heywood et al., 2019). The elderly, a demographic frequently affected by knee osteoarthritis, benefited from kinetic chain workouts, which found to improve general, physical function and lower the risk of falls. Physical function and balance were observed to improve significantly after a 12-week program of kinetic chain workouts for older persons with knee osteoarthritis (GRGN et al., 2020).

Adegoke et al. (2019) found that kinetic chain workouts can help people with knee osteoarthritis by reducing their pain, increasing their range of motion, enhancing their function, and boosting their muscular strength and general quality of life.

However, more study is required to establish the ideal number of repetitions and intensity level of kinetic chain exercises for people of varying ages and levels of knee osteoarthritis. The pain, physical function, and quality of life of people with knee osteoarthritis have all been shown to improve with the help of kinetic chain exercises. Knee osteoarthritis sufferers can benefit from kinetic chain workouts (Nahayatbin et al., 2018), which require the coordination of several joints and muscle groups to accomplish functional movements. Kinetic chain exercises were found to be beneficial in lowering knee pain and improving physical function in people with knee osteoarthritis, according to a systematic review and meta-analysis of 10 randomized controlled studies. Specifically, the quality of life associated with the knee was found to be improved with the use of kinetic chain workouts (Olagbegi et al., 2017).

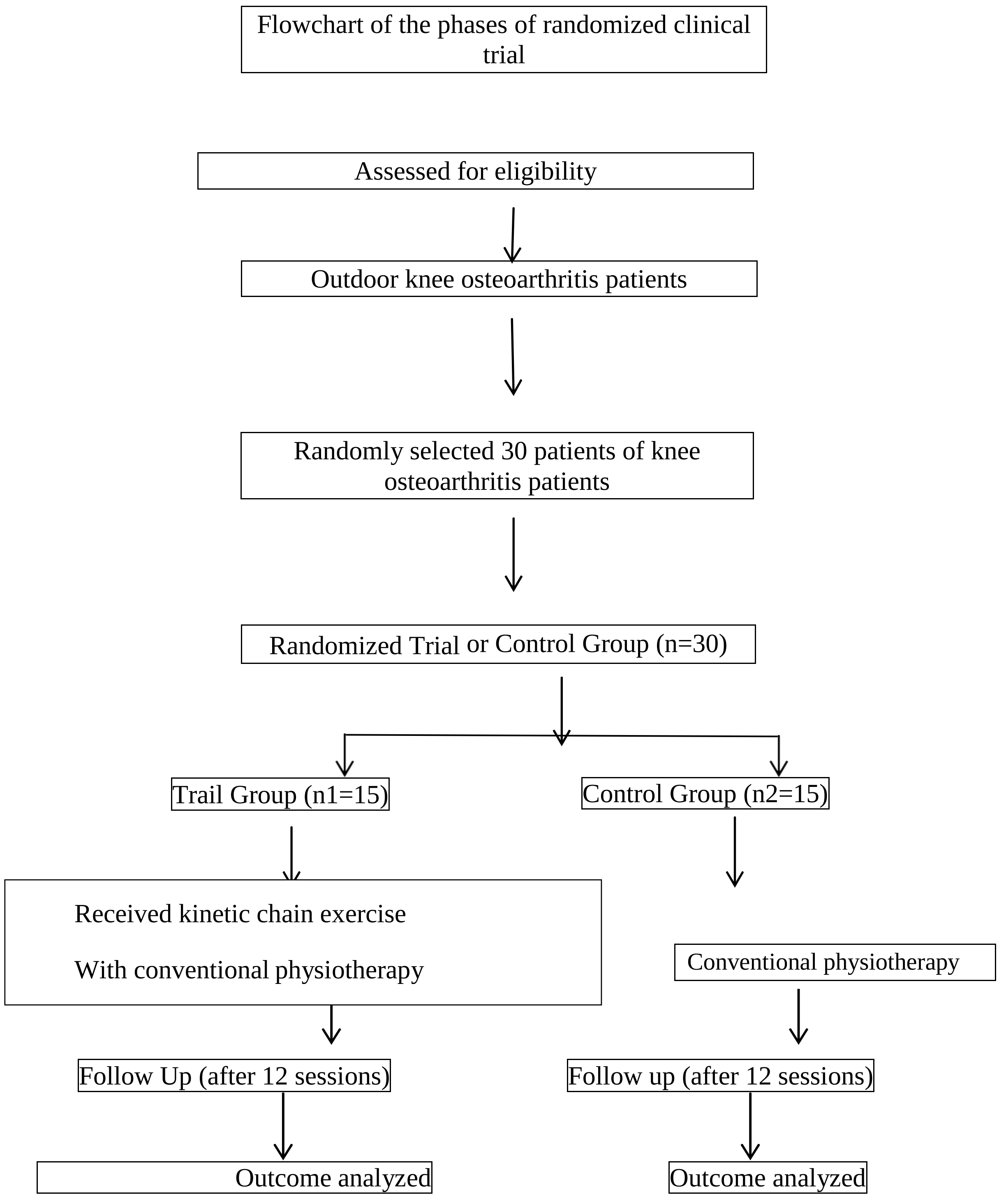
According to an estimated number of additional researches, Johnson et al. (2017) highlight the benefits of kinetic chain activities for people with knee osteoarthritis. There were statistically significant improvements in knee pain, physical function, and muscular strength after 12 weeks of kinetic chain exercises in a randomized controlled trial of 80 people with knee osteoarthritis. Iwamoto et al. (2015) observed that after 12 weeks of kinetic chain workouts, people with knee osteoarthritis experienced significant improvements in knee joint stability and gait mechanics. It has also been established that kinetic chain exercises are safe and well-tolerated by those with knee osteoarthritis. There were no reported adverse events in a 2018 research of 42 people with knee osteoarthritis who participated in a 12-week program of kinetic chain exercises (Huang et al., 2017).

Studies have shown that kinetic chain exercises can help people with knee osteoarthritis feel better and function better, leading to an overall higher quality of life. However, the ideal dosage and progression of kinetic chain workouts for various groups with knee osteoarthritis has to be determined (Cheatham et al., 2016). Kinetic-chain exercises have been shown to improve muscular strength, balance, and flexibility, all of which contribute to less knee stress and better joint mechanics. A six-week program of kinetic-chain exercises has been shown to significantly improve knee pain, function, and strength in people with knee OA (Gomiero, & Chaves, 2019), according to a study published in the Journal of Physical Therapy Science.

According to the findings of another study that were published in the Journal of Strength and Conditioning Research, a six-week programme that consisted of kinetic-chain workouts were found to enhance knee extensor strength and functional performance in patients who suffer from knee osteoarthritis (OA). The findings of this study were published in the Journal of Strength and Conditioning Research. Kinetic chain exercises have been found to be an effective and risk-free alternative to traditional forms of exercise like walking and cycling for those who suffer from knee osteoarthritis (OA). Traditional forms of exercise like walking and cycling may not be useful for people who have OA of the knee. Even though additional research is required to determine the optimal duration, intensity, and frequency of kinetic-chain workouts for individuals with knee OA, the evidence that has been accumulated up to this point suggests that these types of workouts may be an effective intervention (Beaulieu & PalmieriSmith, 2014).

3.1. Study Design

A Hospital based randomized control study design was used in the investigation, with two sets of participants. The purpose of a randomized control study is to determine the relationship between two variables. The research design was a true experiment with multiple groups of subjects. There was no difference in the treatment given to either group. Both the experimental and control groups in this study participated in physical therapy, with the former receiving open kinetic chain exercise and the latter receiving close chain training. Each participant in both groups was given a set of tests before and after exercise to evaluate any changes in pain levels or functional capacity. A flowchart could be used to illustrate the design. –



Consort Diagram

A flowchart for a randomized clinical trial of a treatment program including kinetic chain exercise along with conventional physiotherapy and kinetic chain exercise along with conventional for patient with knee joint osteoarthritis.

3.2 . Study site

Centre for the Rehabilitation of the Paralysed (CRP), Musculoskeletal Outpatient Unit, Savar, Dhaka. Data obtained by the researcher. The researcher will meet them at a prearranged location. Every participant that met the inclusion criteria and had KOA in this study. Each participant was briefed by the researcher on the study's goals and rationale. Samples were collected from people who volunteered for the study.

3.3 . Study Population

The term "population" is used to describe the people, things, or events that make up the study's primary emphasis. A literature analysis and the study's objectives served as the basis for establishing the criteria for study populations. The criteria for selection were developed as the study's underlying assumptions and theoretical framework became clear. Patients with osteoarthritis were recruited from the Musculoskeletal Unit of the Physiotherapy Department at CRP, Savar, and Dhaka.

3.4 . Sample size

It's tough to determine the optimal sample size because it varies heavily on the type of study being conducted. Planning is the key to success in any statistical study. The study's sample size should be sufficient in light of its aims. The study's sample size should be "big enough" to ensure that any effect large enough to be scientifically significant is also statistically significant.

$$N = 2 \times \left(\frac{Z_{1-\alpha}+Z_{1-\beta}}{\delta}\right)^2 \times p \times (1\text{-}p)$$

Here, Z (confidence interval) = 1.96

P (prevalence) =0.5 (Vandormael, 2018)

And, q= (1-p)

= (1-0.5)

= 0.5

d= 0.05

The actual sample size was, n= 84(84.1)

The actual sample size for this study is calculated as 84. As this study performs as a part of the academic research project and there are time frame limitations, So , 30 knee OA patients were taken as the sample for this study at this entire time 1st November 22 to 30th April 23.

3.5 . Sampling technique

This research makes use of the Hospital Based Randomizing Sampling method. Participants who fulfilled the study's inclusion requirements were randomly selected as the sample. Thirty patients suffering from osteoarthritis were chosen from the outpatient musculoskeletal unit of the physiotherapy department at CRP, Savar; from there, 15 were randomly assigned to the Experimental group, where they received conventional physiotherapy plus the addition of Kinetic Chain Exercise, and 15 were assigned to the Control group, where they received conventional physiotherapy alone. The samples in the control group were labeled as C1, C2, C3, etc., whereas those in the experimental group were labeled as E1, E2, E3, etc. A single-blind method was used in the investigation.

3.6 . Inclusion criteria

- Patients with knee OA who are diagnosed.
- Age between 40 to 65 years (Koch M, 2021)
- Male and female both will be included.
- Patients who are receiving to Physiotherapy from musculoskeletal unit of CRP.

3.7. Exclusion criteria

- Any history of recent surgery or fracture of femur, tibia, fibula or foot bones, pathological condition (malignancy, heart disease etc),osteoporosis, stroke , electric device implant, previous or current history of psychiatric or psychological treatment (Ng et al. Trials 2022, Krupa M et.al, 2021).
- Any intra-articular injection, surgical arthroscopy in the last 6 months (Ng et. al. 2022).
- Patient with severe psychological problem

3.8. Data collection tools

The Bengali and English Consent form and questionnaire were required, as well as a pen, pencil, eraser, clipboard, white paper, and a notebook.

3.9 Measurement tool

- ✓ KOOS questionnaire for measure pain, stiffness, symptom, function, sports and recreation and quality of life
- ✓ Goniometer for measure of range of motion

3.10 Data collection procedure

The data was gathered via closed-ended interviews and questionnaires with predetermined answers. As a result of the flexibility it provided in its questions and answers, the structural questionnaire proved useful to the researcher in gathering all the necessary data. To get to the truth about every facet of the participant, the researcher created a structured, closed-ended questionnaire to collect data on socio-demographic characteristics. Individual questionnaire items followed, with some wording tweaks made to better align with the issues under investigation.

3.11 Data analysis Procedure

Statistical Package for the Social Sciences (SPSS) version 22.0 and Microsoft Excel 2016 were used to analyze the data. Every survey was double-checked for clarity and accuracy. Types, values, decimals, label alignment, and measurement level information must first be entered into SPSS's variable view. The next move was to load SPSS's data view. After entering all data, the researcher double-checked to make sure that the information on the questionnaire sheet had been correctly transferred to the SPSS data view. After that, we could use SPSS to analyze the raw data.

Estimated predictor

Unlike the t-test, which assumes normally distributed data, this hypothesis test of mean difference between the experimental group and the control groups, within groups, does not. On normal distributions, its effectiveness is comparable to that of the t-test. Two samples can be compared to see if they came from the same distributional population by using this test.

Hypothesis and Test

Independent T test is a non-parametric test that is simply compares the result obtained from the each group to see if they differ significantly.

Paired T test is a non-parametric test that is simply compares the result within group to see if they differ significantly.

Assumption

- All the observations from both groups are independent of each other.
- The responses are ordinal
- Under the null hypothesis Ho, the distributions of both populations are equal.

Null and alternative hypothesis

Null Hypothesis

Ho: $\mu 1-\mu 2 = 0$ or $\mu 1 \geq \mu 2$, where the experimental group and control group mean difference is not same or control group is higher than experimental group.

Alternative Hypothesis

Ha: $\mu 1-\mu 2 \neq 0$ or $\mu 1 \neq \mu 2$ where the experimental group and control group mean difference is not same.

Where,

Ho = Null hypothesis

Ha = Alternative hypothesis

$\mu 1$ = mean difference in initial assessment

$\mu 2$ = mean difference in final assessment

3.12 Level of Significance

We determined the study's relevance by computing its "p" value. For health care research, a p-value of 0.05 was considered to indicate statistical significance. The results are considered significant if the p-value is less than or equal to the significance level.

3.13 Ethical consideration

All steps of this study were conducted in accordance with recommendations made by the Bangladesh Medical and Research Council (BMRC) and the World Health Organization (WHO). The Institutional Review Board (IRB) and the ethical review committee of the Bangladesh Health Professions Institute (BHPI) both gave their stamps of approval to the dissertation's proposed methodology. Participants were allowed to obtain treatment for other purposes as usual to prevent any ethical claims. Before any data was collected, all participants were briefed about the study's rationale and aims. All study-related materials were destroyed following the conclusion of the research project to ensure the privacy of the participants. Before the experiment began, all participants signed an informed consent form providing their assent to participate. Each person who was studied gave their informed consent to the researcher. All test subjects voluntarily stopped taking the medication that had been prescribed to them by the accountable physiotherapist throughout the trial period. Everyone knows they can make the final call if they want to. Participants were made aware that they might stop taking part in the study at any moment without penalty and that they could refuse to answer any questions posed to them. If a patient decides to withdraw from the study, they will continue to receive care in the Physiotherapy Department that is tailored to their individual needs. Every participant got access to CRP's upper management in order to air grievances and get their questions answered. The researcher will be happy to answer any questions you may have about the study or your participation in it.

3.14 Treatment Protocols

3.14.1 Experimental Group Treatment Protocol

Treatment Options	Duration/Repetitions
1st two week: Quadriceps setting, Full arc extension, Straight leg raise, Wall slides, Step up and down. **2nd two week:** Quadriceps setting, Full arc extension, Straight leg raise, Hip adduction and abduction exercise, leg adduction in decubitus position, Wall slides with weight, Step up and down with weight.	Each exercise 3 sets of 10 repetitions. The subject rested for 1 minute after the conclusion of each set, 3 days per week for 12 sessions.

3.14.2 Control Group Treatment Protocol

Treatment Options	Duration/Repetitions
Sustain Manual Stretching	15-30 sec hold with 3-5 repetitions
Static quad sets in Knee extension	10 sec contraction with 10 repetitions
Maitland mobilization	Grade I, II, III & IV for 10 repetitions
Ice	5 min
Patients Education and Home advice	

Figure 3.1: Intervention

CHAPTER IV	RESULTS

A total of 30 individuals were used in this study to examine effectiveness of kinetic chain exercise in patients with knee joint osteoarthritis. The following paragraphs provide a summary of the investigation's findings.

Baseline characteristic

Table 4.1: Socio-demographic information of Experimental (KCG) and Control (CPG)

Variable	Experimental (KCG) n(%)	Control (CPG) n(%)	Total n(%)	P- Value
Age Category				
40 - 50 years	5(33.3)	3(20.0)	8(26.7)	
51 – 60 years	6(40.0)	12(80.0)	18(60.0)	0.949
60 + years	4(26.7)	0(0)	4(13.3)	
Gender				
Male	14(93.3)	12(80.0)	26(87.7)	0.605
Female	1(6.7)	3(20.0)	4(12.3)	
Living area				
Urban	6(40.0)	7(46.7)	13(43.3)	0.460
Semi-urban	8(53.3)	4(26.7)	12(40.0)	
Rural	1(6.7)	4(26.7)	5(16.7)	

This table displays the socio-demographic characteristics of two groups: the Experimental (KCG) and the Control (CPG) groups. The variables included in the table are age group, gender, residing area, educational attainment, monthly income group, marital status, and family type. The data are presented as the number and percentage of people in each category for each variable.

The KCG group consisted of 5 individuals (33.3% of the total) between the ages of 40 and 50, 6 individuals (40%) between the ages of 51 and 60, and 4 individuals (26.7%) over the age of 60. The CPG group had three individuals in the 40-50 years age range (20.0%), twelve individuals in the 51-60 years age range (80.0%), and none in the 60+ year’s age range.

In terms of gender, the KCG group consisted of 14 males (93.3%) and 1 female (6.7%), whereas the CPG group consisted of 12 males (80.0%) and 3 females (20%). 6 members of the KCG lived in urban areas (40.0%), 8 members lived in semi-urban areas (53.3%), and 1 member lived in rural areas (6.7%). The CPG group consisted of 7 individuals in urban areas (46.7%), 4 individuals in semi-urban areas (26.7%), and 4 individuals in rural areas (26.7%).

Table 4.2: Description of continuous variable (Socio-demographic) of Experimental (KCG) and Control (CPG)

Variable	Experimental (KCG)	Control (CPG)	*t*	P- Value
	Mean± SD			
Age	53.3±8.7	53.8±4.9	83.125	0.297
Monthly income	21600±7917.4	24666±10082.9	28.854	0.270

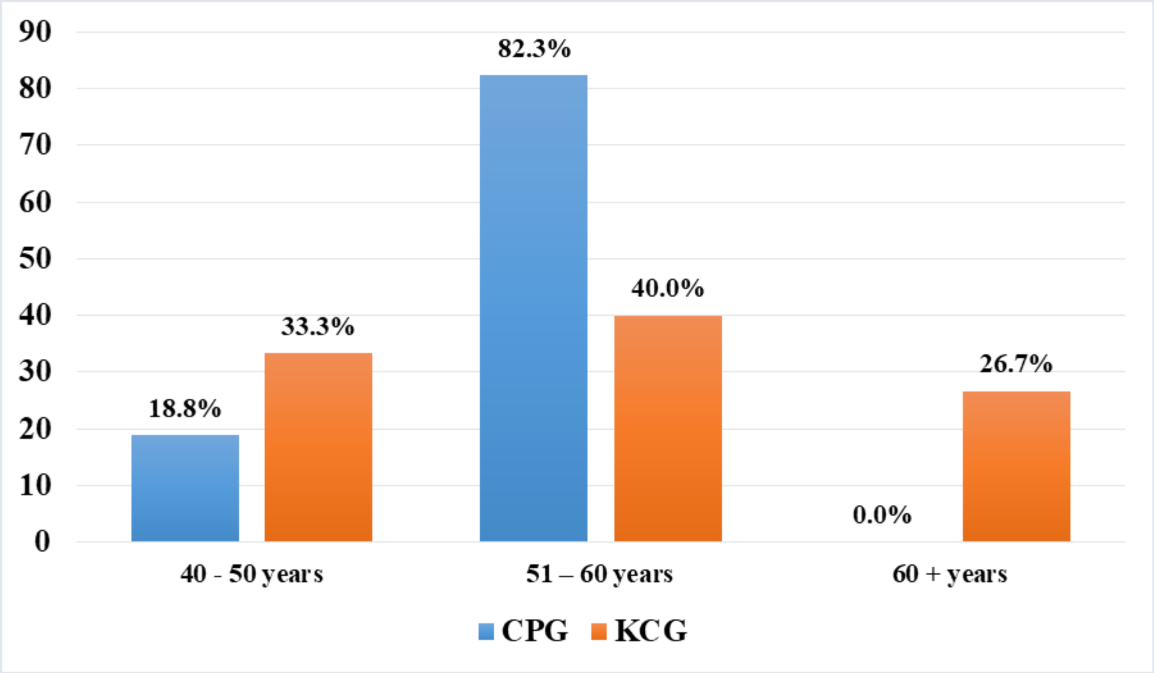
The table describes the socio-demographic characteristics of the Experimental (KCG) and Control (CPG) groups. Age and monthly income are two continuous variables.

Age was 53.3 ± 8.7 years in the Experimental group and 53.8 ± 4.9 years in the Control group. A t-test showed a t-value of 83.125 and a p-value of 0.297. The two groups were similar in age.

The Experimental group had 21,600 ± 7,917.4 monthly incomes, while the Control group had 24666±10082.9. The t-test found a p-value of 0.270 and a t-value of 28.854. The two groups had similar monthly incomes.

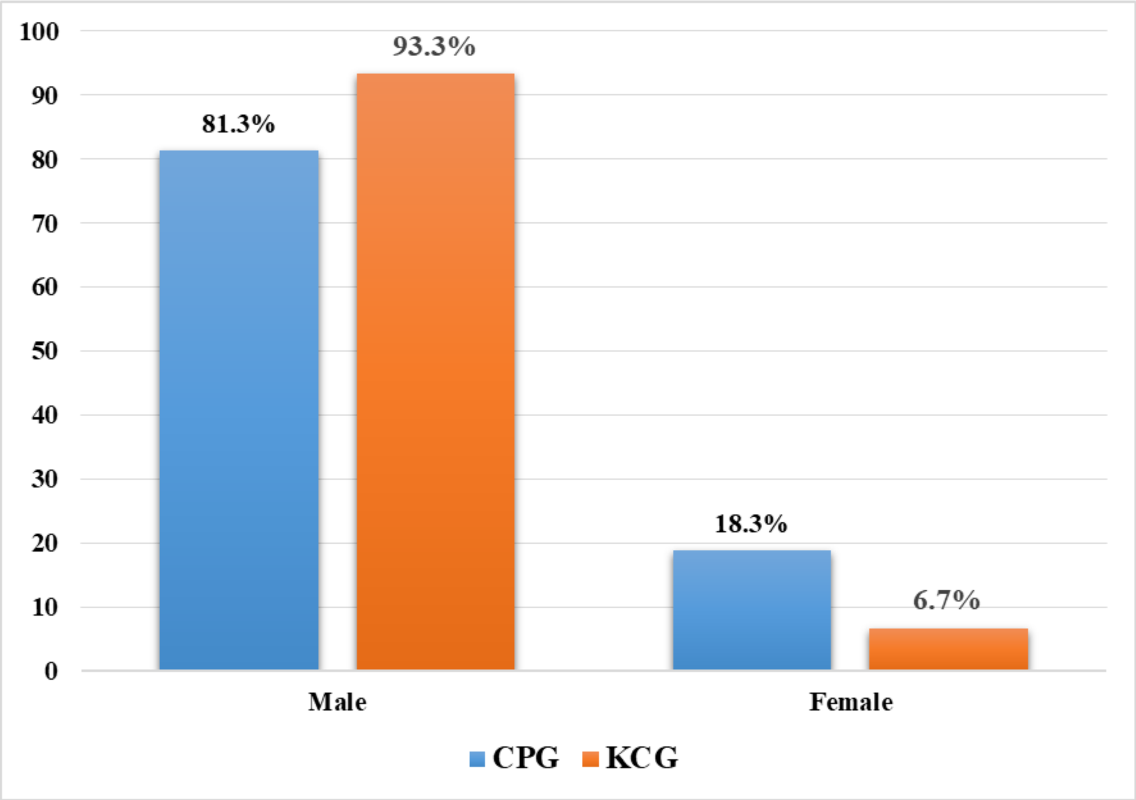
The table shows the demographics of study participants and helps researchers identify potential variations between Experimental and Control groups.

Figure 4.1: Age distribution of Experimental (KCG) and Control (CPG) Participants



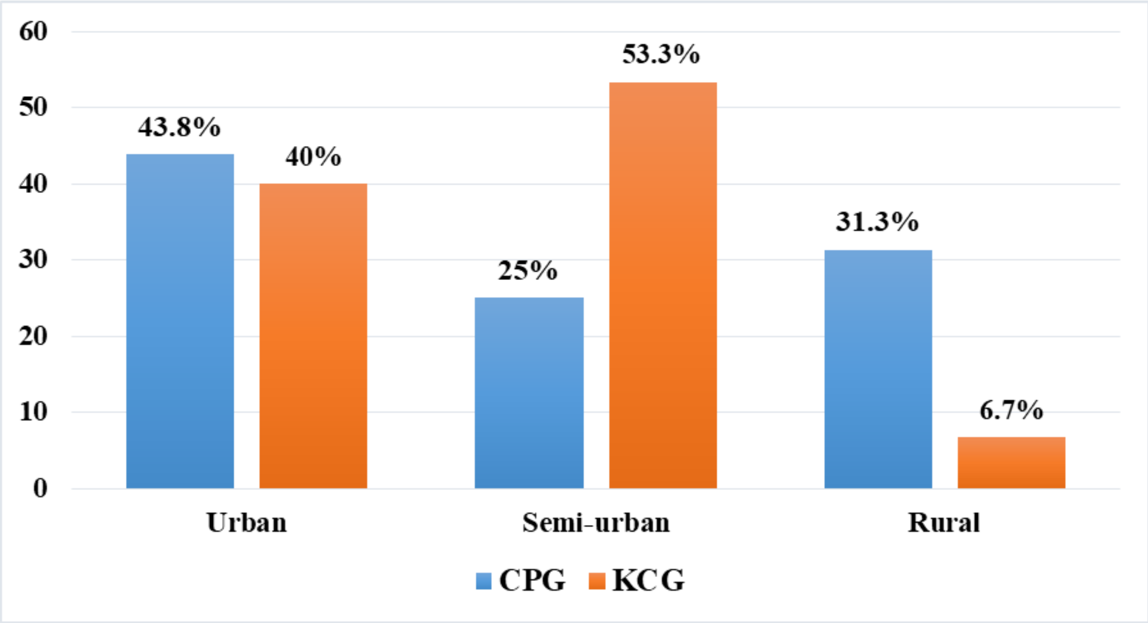
The data that has been provided offers information on the percentage of individuals that belong to two distinct groups, CPG and KCG, in each of the three age categories that have been specified. The first age category is considered to be between 40 and 50 years old, and within this age range, 18.8% of people belong to the CPG group while 33.3% of people belong to the KCG group. The second age category includes those who are between the ages of 51 and 60 years old. Within this age range, 82.3% of people belong to the CPG group, while 40% of people belong to the KCG group. In the final age category, individuals must be at least 60 years old; nevertheless, only zero people belong to the CPG group at this point, whereas 26.7% of individuals belong to the KCG group.

Figure 4.2: Gender distribution of Experimental (KCG) and Control (CPG) participants



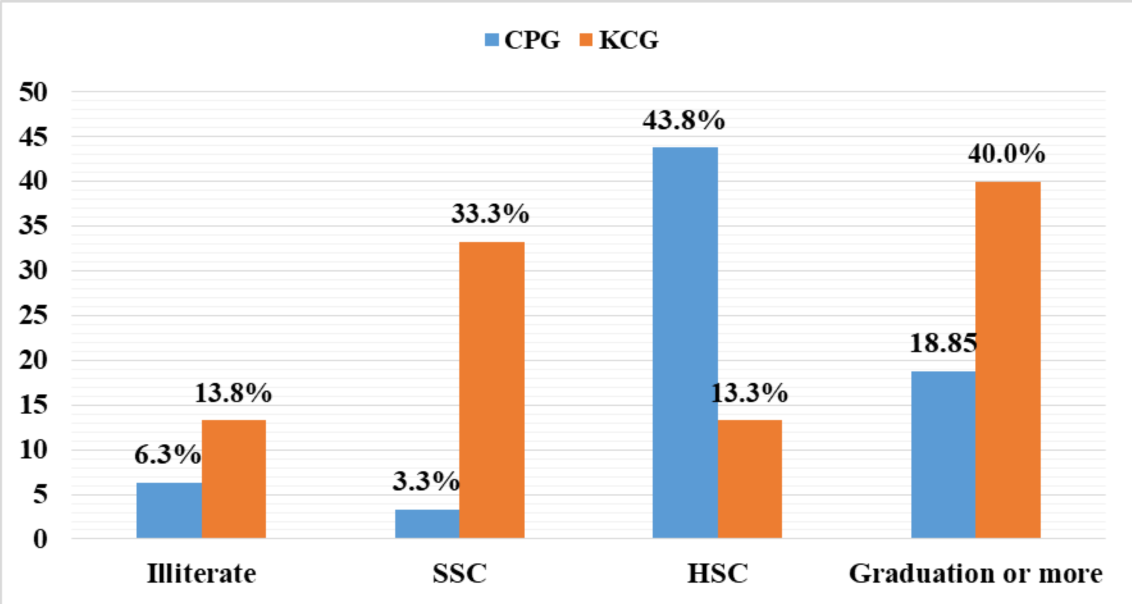
The table presents information regarding the percentages of individuals who belong to two distinct groupings, namely "CPG" and "KCG," based on whether they are classified as "Male" or "Female." When looking at the "Male" category, 81.3% of the individuals belong to the "CPG" group, while 93.3% are a part of the "KCG" group. When compared to the "CPG" group, this indicates that the "KCG" group contains a greater number of males than the "CPG" group does. On the other hand, while looking at the "Female" category, 18.8% of the people fall into the "CPG" group, whereas only 6.7% fall into the "KCG" group. It appears from this that the "CPG" group, as opposed to the "KCG" group, is comprised of a greater proportion of females. The data as a whole reveals that there is a difference in the distribution of individuals between the "CPG" and the "KCG" groups, with males showing a larger percentage in the "KCG" group and females showing a higher percentage in the "CPG" group, respectively.

Figure 4.3: Living area distribution of Experimental (KCG) and Control (CPG) participants



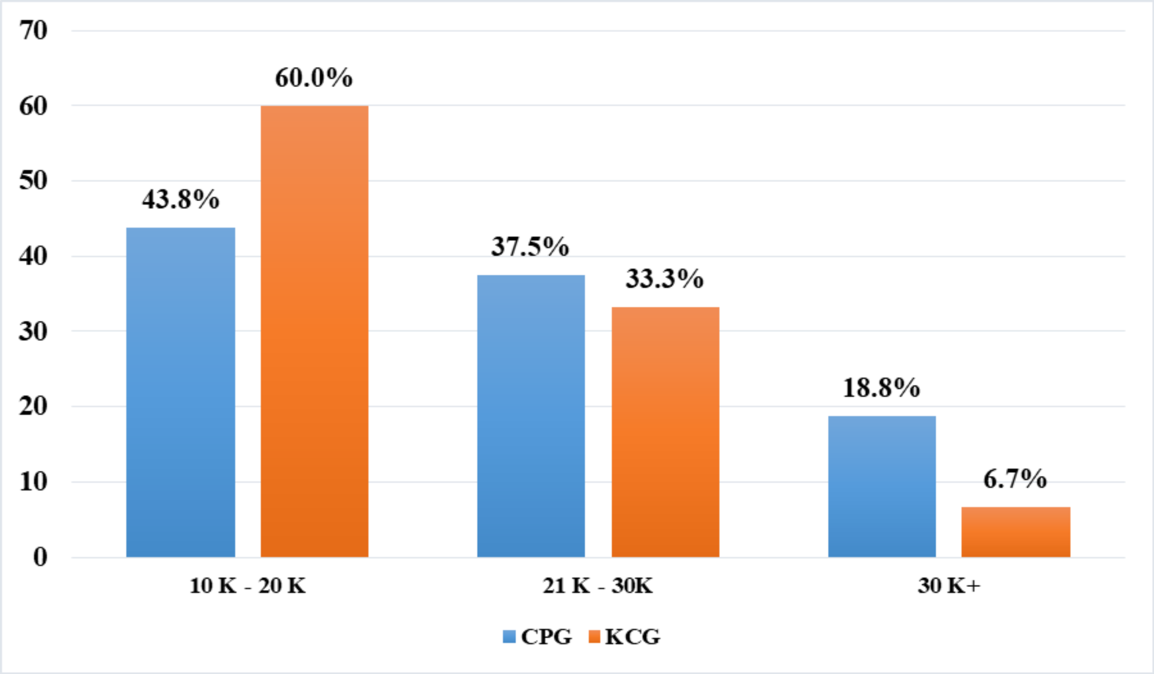
The data presented here illustrate the degree to which CPG and KCG concentrations vary across three distinct types of geographic locations: urban, semi-urban, and rural. The fact that consumer packaged products have a majority share in urban regions at 43.8% indicates that there is a greater demand for packaged goods in urban areas. On the other hand, KCG accounts for forty percent of the market share in metropolitan regions, indicating that there is also a considerable presence of kitchen-related consumer items. The preference for KCG appears to be shifting, as evidenced by the fact that it has surpassed CPG in terms of market share and now stands at 53.3%. This suggests that there is a greater demand for consumer items related to cooking in semi-urban areas than there is for packaged commodities. Within the scope of this discussion, CPG has a market share of 25%. The pattern of distribution of goods is different in urban and rural areas, respectively. With a market share of 31.3%, CPG continues to dominate the market, which suggests that packaged goods still maintain a major presence in rural areas. However, the market share for KCG falls dramatically to 6.7%, indicating that the demand for kitchen consumer goods in rural areas is relatively smaller than in urban areas.

Figure 4.4: Educational qualification distribution of Experimental (KCG) and Control (CPG) participants



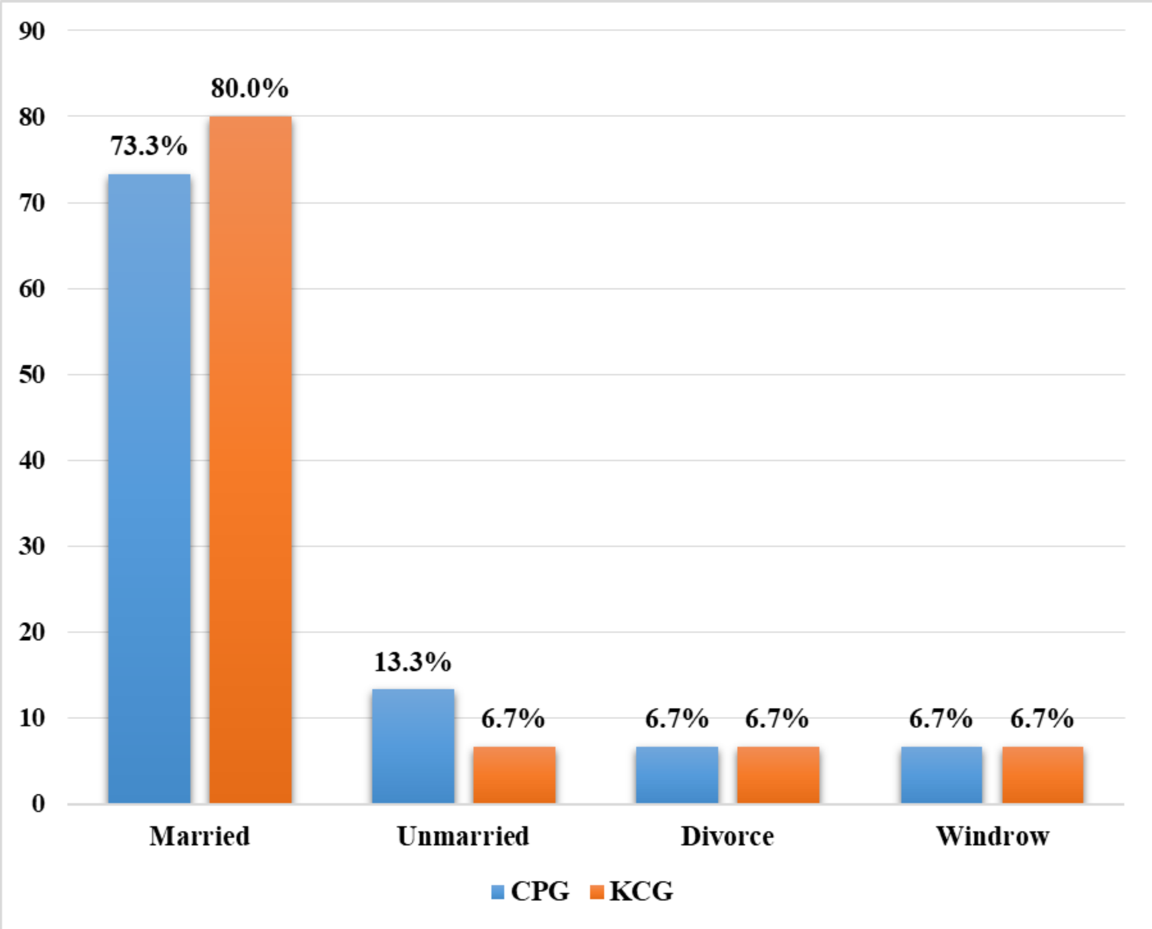
The percentage of illiterate people who are employed in the CPG industry is 6.3%, while the percentage of illiterate people who are employed in the KCG industry is 13.3%. Moving on to people who have completed secondary school and received a secondary school certificate (SSC), 3.3% of those people are employed in the CPG industry, whereas the number working in the KCG industry is significantly higher at 33.3%. People who have received their higher secondary school certificate (HSC) are more likely to be employed in the consumer packaged goods (CPG) industry, accounting for 43.8% of these people, compared to 13.3% of people who work in the key consumer goods (KCG) industry. In conclusion, the percentage of people working in the CPG industry who have a bachelor's degree or more is 18.8%, while the percentage of people working in the KCG industry is significantly higher at 40%. In a nutshell, the findings of this study suggest that people with diverse degrees of educational attainment have a wide range of degrees of involvement in the CPG and KCG industries. KCG indicates higher participation across all education levels, notably among those with an SSC or graduate degree. This is in contrast to the CPG sector, which appears to attract persons with an HSC or higher educational status.

Figure 4.5: Monthly income distribution of Experimental (KCG) and Control (CPG) participants



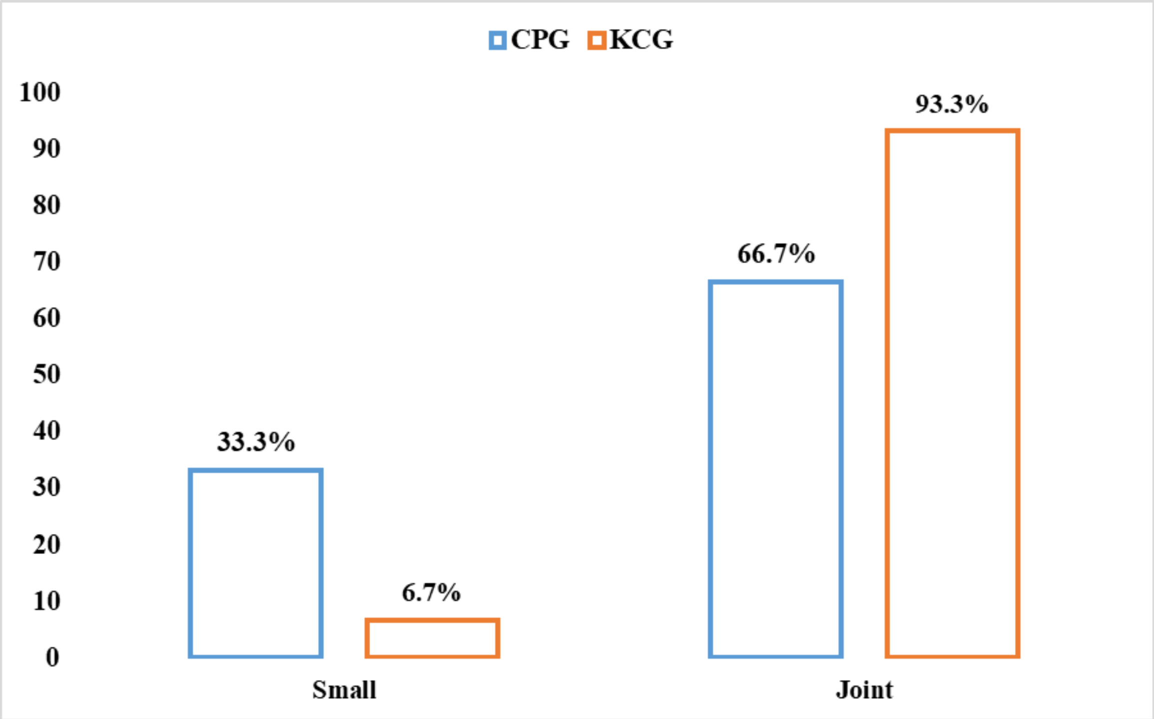
The above table shows the percentage of CPG and KCG consumers in each income level. There are three income brackets: 10,000 to 20,000, 21,000 to 30,000, and 30,000 and up. The numbers show that more people in the KCG group make between 10,000 and 20,000 than in the CPG group (60 percent vs. 43.8 percent). On the other hand, there are more people in the 21K-30K income range in the CPG group (37.5% vs. 33.3% in the KCG group). Also, it can be seen that the number of people in both groups drops a lot in the highest income level, where only 18.8% of the CPG group and 6.7% of the KCG group live.

Figure 4.6: Marital status distribution of Experimental (KCG) and Control (CPG) participants



The percentage distribution of two consumer categories, CPG and KCG, according to their marital status is shown in the table above. According to the data, a bigger percentage of the CPG and KCG groups—73.3% and 80%, respectively—are married. Both groups have a smaller percentage of single people; just 13.3% of the CPG group and 6.7% of the KCG group are single. Additionally, the data indicates that just 6.7% of each consumer group's members fall into the categories of divorce and widowhood, indicating that these events are not common within either consumer group. Businesses trying to customize their marketing plans and product offers to niche consumer segments based on marital status may find the study's findings to be insightful.

Figure 4.7: Family type distribution of Experimental (KCG) and Control (CPG) participants



According to the kind of household, the percentage distribution of two consumer groups, CPG and KCG, is shown in the above table. The findings show that more people in the CPG group live in joint households than in small ones, with 66.7% of them doing so, compared to 33.3%. However, the KCG group is more prevalent in small families, accounting for 93.3% of all households, as opposed to just 6.7% of those living in joint households. Businesses trying to create marketing plans and product lines that are catered to particular household kinds and sizes may find these findings to be extremely insightful.

Table 4.3: Paired t test on evaluation of (Symptoms, pain, ADL, Sports and recreation, Quality of life) by KOOS questionnaire with in group of Experimental (KCG) and Control (CPG).

Variable	Experimental (KCG)		Control (CPG)	
	t	P value	t	P value
Symptoms	4.858	0.001	4.56	0.001***
Pain	10.184	0.001	7.058	0.001***
ADL	15.212	0.001	2.797	0.014**
Sports and recreation	19.360	0.001	5.048	0.001***
QoL	14.046	0.001	6.971	0.001***

(*= < 0.05, ** = < 0.01, ***= < 0.001= Highly Significant)

A paired t-test was used to compare the responses of two groups to the Knee injury and Osteoarthritis Outcome Score (KOOS) questionnaire. These groups are referred to in the table as the Experimental group (abbreviated as KCG) and the Control group (abbreviated as CPG). The findings of this analysis are presented in the table. Patients' impressions of their knee function and the quality of life it affects are evaluated with the help of an instrument called the KOOS questionnaire.

In the table, the t-statistic and the accompanying p-value are presented for both groups for each of the variables that were measured by the questionnaire. These variables included Symptoms, Pain, Activities of Daily Living (ADL), Sports and Recreation, and Quality of Life (QoL).

As can be seen by the low p-values, the Experimental group showed statistically significant improvements in all of the measures when compared to the baseline. Symptoms, pain, activities of daily living, and quality of life all had respective t-values of 4.858, 10.184, 15.212, and 19.360, whereas QoL had a value of 14.046. This suggests that the changes in these variables are not likely to be the result of chance alone and instead reflect a genuine effect of the treatment that was administered.

Although some improvements were also observed in all measures within the Control group, the changes were often less significant than those which were observed within the Experimental group. The t-values for Symptoms, Pain, Activities of Daily Living, and Quality of Life were, respectively: 4.56, 7.058, 2.797, 5.048, and 6.971. These values nevertheless suggest statistically significant improvements, with p-values ranging from 0.001 to 0.014, although to a lesser degree than in the Experimental group. The Experimental group had significantly higher values.

The findings imply that the treatment that was administered to the Experimental group (KCG), which resulted in significant gains in knee function and related quality of life, was superior to the control intervention that was administered to the Control group (CPG). The findings provide doctors and researchers working in the field of knee rehabilitation with significant information that can be used in their work.

Table 4.4: Paired t test on evaluation of ROM with in group of Experimental (KCG) and Control (CPG)

Variable	Experimental (KCG)		Control (CPG)	
	t	P value	t	P value
Active knee flexion	8.573	0.001	6.500	0.001***
Active knee extension	7.643	0.001	3.568	0.003**
Passive knee flexion	6.325	0.001	4.583	0.001***
Passive knee extension	8.367	0.001	1.938	0.073*

(*= < 0.05, ** = < 0.01, ***= < 0.001= Highly Significant)

The results of a paired t-test are presented in Table 4.4. This test compared the range of motion (ROM) measurements of two different groups: the Experimental group, which is referred to as the KCG, and the Control group, which is referred to as the CPG. The range of motion (ROM) of a joint refers to the total amount of motion that can be achieved by that joint.

The table presents the t-statistic and the related p-value for each type of knee movement that was evaluated, including active knee flexion, active knee extension, passive knee flexion, and passive knee extension. These values are presented for both the Experimental and Control groups.

In the Experimental group, the t-values for Active Knee Flexion came in at 8.573, while in the Control group, they were 6.500. Both of these groups showed statistically significant progress, as evidenced by the fact that the p-values for the values in question were lower than 0.001 (***).

When it came to Active Knee Extension, the t-values for the Experimental group were 7.643 whereas the Control group had a value of 3.568. These values' p-values were respectively 0.001 and 0.003, which indicates that there were statistically significant improvements in both groups, albeit to a smaller extent in the Control group.

In the Experimental group, the t-values for passive knee flexion were found to be 6.325, while in the Control group, they were found to be 4.583. Both of these groups showed statistically significant progress, as evidenced by the fact that the p-values for the values in question were lower than 0.001 (***).

In conclusion, the t-values for passive knee extension showed that the Experimental group performed 8.367 repetitions better than the Control group, which only managed 1.938. The p-value for the Experimental group was lower than 0.001 (**), which indicates that there was a statistically significant improvement. On the other hand, the p-value for the Control group was greater than 0.05 (), which indicates that there was no statistically significant difference in comparison to the baseline.

The data imply that both therapies led to improvements in knee ROM, with the highest changes reported in Active Knee Flexion and Active Knee Extension. Overall, the findings suggest that knee ROM improved as a result of both interventions. However, the improvements were typically greater in the Experimental group than in the Control group, as seen by the higher t-values and lower p-values in the majority of the measures. This was proven by the fact that the majority of the measurements. These findings offer insightful information that can be helpful to clinicians and researchers who are seeking to improve knee function and rehabilitation.

Table 4.5: Independent sample t test on evaluation of (Symptoms, pain, ADL, Sports and recreation, Quality of life) by KOOS questionnaire in between two groups Experimental (KCG) and Control (CPG) before and after treatment.

Variable		Experimental (KCG)	Control (CPG)	*t*	P-Value
		Mean± SD			
Symptoms	Before	26.93±7.95	25.06±2.08	-0.880	0.387
	After	15.40±3.37	22.00±1.92	6.575	0.001
Pain	Before	32.2±1.85	33.13±2.35	1.204	0.239
	After	18.86±3.44	27.86±1.68	9.099	0.001
ADL	Before	61.26±2.25	62.6±5.06	0.931	0.360
	After	36.93±6.28	54.60±8.63	6.407	0.001
Sports and recreation	Before	17.5±0.83	18.26±2.21	1.198	0.241
	After	10.60±1.88	15.06±1.48	7.213	0.001
QoL	Before	14.4±0.83	14.2±0.88	-0.638	0.529
	After	8.06±1.86	11.73±1.38	6.100	0.001

(*= < 0.05, ** = < 0.01, ***= < 0.001= Highly Significant)

The table above presents the results of an independent sample t-test conducted on the evaluation of the Knee injury and Osteoarthritis Outcome Score (KOOS) questionnaire administered to two groups: Experimental (KCG) and Control (CPG) before and after treatment. The variables assessed in this study were Symptoms, Pain, Activities of Daily Living (ADL), Sports and Recreation, and Quality of Life (QoL).

For the Symptoms variable, the mean score before treatment was 26.93±7.95 for the Experimental group and 25.06±2.08 for the Control group. The t-value was -0.880 with a p-value of 0.387, indicating that there was no significant difference between the two groups before treatment. However, after treatment, the mean score for the Experimental group decreased significantly to 15.40±3.37, while the Control group only showed a minor decrease with a mean score of 22.00±1.92. The t-value was 6.575 with a p-value of 0.001, indicating a statistically significant difference between the two groups after treatment.

For the Pain variable, the mean score before treatment was 32.2±1.85 for the Experimental group and 33.13±2.35 for the Control group. The t-value was 1.204 with a p-value of 0.239, indicating that there was no significant difference between the two groups before treatment. However, after treatment, the mean score for the Experimental group decreased significantly to 18.86±3.44, while the Control group only showed a minor decrease with a mean score of 27.86±1.68. The t-value was 9.099 with a p-value of 0.001, indicating a statistically significant difference between the two groups after treatment.

For the ADL variable, the mean score before treatment was 61.26±2.25 for the Experimental group and 62.6±5.06 for the Control group. The t-value was 0.931 with a p-value of 0.360, indicating that there was no significant difference between the two groups before treatment. However, after treatment, the mean score for the Experimental group decreased significantly to 36.93±6.28, while the Control group only showed a minor decrease with a mean score of 54.60±8.63. The t-value was 6.407 with a p-value of 0.001, indicating a statistically significant difference between the two groups after treatment.

For the Sports and Recreation variable, the mean score before treatment was

17.5±0.83 for the Experimental group and 18.26±2.21 for the Control group. The t-value was 1.198 with a p-value of 0.241, indicating that there was no significant difference between the two groups before treatment. However, after treatment, the mean score for the Experimental group decreased significantly to 10.60±1.88, while the Control group only showed a minor decrease with a mean score of 15.06±1.48. The t-value was 7.213 with a p-value of 0.001, indicating a statistically significant difference between the two groups after treatment.

For the QoL variable, the mean score before treatment was 14.4±0.83 for the Experimental group and 14.2±0.88 for the Control group. The t-value was -0.638 with a p-value of 0.529, indicating that there was no significant difference between the two groups before treatment. However, after treatment, the mean score for the Experimental group decreased significantly to 8.06±1.86, while the Control group only showed a minor decrease with a mean score of 11.73±1.38. The t-value was 6.100 with a p-value of 0.001, indicating a statistically significant difference between the two groups after treatment.

In summary, the results of this study suggest that the Experimental group, which underwent a specific treatment for knee injury and osteoarthritis, experienced significantly greater improvements in Symptoms, Pain, Activities of Daily Living, Sports and Recreation, and Quality of Life compared to the Control group, which did not receive the same treatment.

Table 4.6: Independent sample t test on evaluation (Symptoms, pain, ADL, Sports and recreation, Quality of life) by KOOS questionnaire in between two groups of Experimental (KCG) and Control (CPG).

Variable	Experimental (KCG)	Control (CPG)	Difference	*t*	P- Value
	Mean± SD				
Symptoms	11.53±9.1	3.46±1.99	8.06 ± 2.42	-3.320	0.003**
Pain	13.33±3.37	5.26±2.8	8.06 ± 1.14	-7.003	0.001***
ADL	24.33±6.1	11.06±7.7	13.26 ± 2.5	-5.179	0.001***
Sports and recreation	6.93±1.38	3.46±2.03	3.46 ± 0.63	-5.460	0.001***
QoL	6.4±1.7	2.53±1.4	3.86 ± 0.58	-6.634	0.001***

(*= < 0.05, ** = < 0.01, ***= < 0.001= Highly Significant)

Table 4.6 presents the results of an independent sample t-test conducted on the evaluation of the Knee injury and Osteoarthritis Outcome Score (KOOS) questionnaire administered to the Experimental (KCG) and Control (CPG) groups. The variables assessed in this study were Symptoms, Pain, Activities of Daily Living (ADL), Sports and Recreation, and Quality of Life (QoL).

For the Symptoms variable, the mean score for the Experimental group was

11.53±9.1, while the Control group had a mean score of 3.46±1.99. The difference between the two groups' scores was 8.06 ± 2.42, and the t-value was -3.320 with a p-value of 0.003**, indicating a statistically significant difference between the two groups.

For the Pain variable, the mean score for the Experimental group was 13.33±3.37, while the Control group had a mean score of 5.26±2.8. The difference between the two groups' scores was 8.06 ± 1.14, and the t-value was -7.003 with a p-value of 0.001***, indicating a highly significant difference between the two groups.

For the ADL variable, the mean score for the Experimental group was 24.33±6.1, while the Control group had a mean score of 11.06±7.7. The difference between the two groups' scores was 13.26 ± 2.5, and the t-value was -5.179 with a p-value of 0.001***, indicating a highly significant difference between the two groups.

For the Sports and Recreation variable, the mean score for the Experimental group was 6.93±1.38, while the Control group had a mean score of 3.46±2.03. The difference between the two groups' scores was 3.46 ± 0.63, and the t-value was -5.460 with a p-value of 0.001***, indicating a highly significant difference between the two groups.

For the QoL variable, the mean score for the Experimental group was 6.4±1.7, while the Control group had a mean score of 2.53±1.4. The difference between the two groups' scores was 3.86 ± 0.58, and the t-value was -6.634 with a p-value of 0.001***, indicating a highly significant difference between the two groups.

In summary, the results of this study suggest that there were significant differences in Symptoms, Pain, Activities of Daily Living, Sports and Recreation, and Quality of Life between the Experimental (KCG) and Control (CPG) groups. The Experimental group showed statistically significant improvements compared to the Control group across all variables assessed by the KOOS questionnaire.

Table 4.7: Independent sample t test on evaluation of ROM in between two groups of Experimental (KCG) and Control (CPG).

Variable		Experimental (KCG)	Control (CPG)	*t*	P-Value
		Mean± SD			
Active knee flexion	Before	2.3±0.48	2.2±0.56	- 0.695	0.493
	After	0.93±0.70	1.37±0.72	1.535	0.136
Active knee extension	Before	2.2±0.45	2.2±00.67	- 0.316	0.754
	After	0.80±0.77	1.56±0.63	2.827	0.009**
Passive knee flexion	Before	2.25±0.51	2.2±0.56	-1.694	0.001**
	After	1.20±0.67	1.40±0.8	0.725	0.475
Passive knee extension	Before	2.53±0.51	2.8±2.33	0.432	0.669
	After	1.20±0.56	1.40±0.8	0.775	0.454

(*= < 0.05, ** = < 0.01, ***= < 0.001= Highly Significant)

Table 4.7 presents the results of an independent sample t-test conducted on the evaluation of Range of Motion (ROM) in knee flexion and extension between the Experimental (KCG) and Control (CPG) groups. The variables assessed in this study were Active Knee Flexion, Active Knee Extension, Passive Knee Flexion, and Passive Knee Extension.

For Active Knee Flexion, the mean score before treatment was 2.3±0.48 for the Experimental group and 2.2±0.56 for the Control group. The t-value was -0.695 with a p-value of 0.493, indicating that there was no significant difference between the two groups before treatment. After treatment, the mean score for the Experimental group improved significantly to 0.93±0.70, while the Control group only showed a minor improvement with a mean score of 1.37±0.72. The t-value was 1.535 with a p-value of 0.136, indicating no statistically significant difference between the two groups after treatment. For Active Knee Extension, the mean score before treatment was 2.2±0.45 for both the Experimental and Control groups. The t-value was -0.316 with a p-value of 0.754, indicating that there was no significant difference between the two groups before treatment. After treatment, the mean score for the Experimental group improved significantly to 0.80±0.77, while the Control group only showed a minor improvement with a mean score of 1.56±0.63. The t-value was 2.827 with a p-value of 0.009**, indicating a statistically significant difference between the two groups after treatment.

For Passive Knee Flexion, the mean score before treatment was 2.25±0.51 for the Experimental group and 2.2±0.56 for the Control group. The t-value was -1.694 with a p-value of 0.001**, indicating a statistically significant difference between the two groups before treatment. After treatment, the mean score for the Experimental group improved significantly to 1.20±0.67, while the Control group only showed a minor improvement with a mean score of 1.40±0.8. The t-value was 0.725 with a p-value of 0.475, indicating no statistically significant difference between the two groups after treatment.

For Passive Knee Extension, the mean score before treatment was 2.53±0.51 for the Experimental group and 2.8±2.33 for the Control group. The t-value was 0.432 with a p-value of 0.669, indicating that there was no significant difference between the two groups before treatment. After treatment, the mean score for the Experimental group improved significantly to 1.20±0.56, while the Control group only showed a minor improvement with a mean score of 1.40±0.8. The t-value was 0.775 with a p-value of 0.454, indicating no statistically significant difference between the two groups after treatment.

In summary, the results of this study suggest that the Experimental group, which underwent a specific treatment for knee injury and osteoarthritis, experienced significantly greater improvements in Active Knee Extension compared to the Control group. However, there were no significant differences observed in the other variables assessed by the ROM evaluation.

Table 4.8: Independent sample t test on evaluation of the ROM difference in between Experimental (KCG) and Control (CPG).

Variable	Experimental (KCG)	Control (CPG)	Difference	*t*	P- Value
	Mean± SD				
Active knee flexion	1.40±0.63	0.86±0.51	-0.53±0.21	-2.530	0.017**
Active knee extension	1.46±0.74	0.66±0.89	-0.80±0.30	-2.655	0.013**
Passive knee flexion	1.33±0.81	0.80±0.67	-0.53±0.27	-1.948	0.061
Passive knee extension	1.33±0.61	1.40±2.79	0.06±0.73	0.090	0.929

(*= < 0.05, ** = < 0.01, ***= < 0.001= Highly Significant)

Table 4.8 presents the results of an independent sample t-test conducted on the evaluation of the difference in Range of Motion (ROM) between the Experimental (KCG) and Control (CPG) groups. The variables assessed in this study were Active Knee Flexion, Active Knee Extension, Passive Knee Flexion, and Passive Knee Extension.

For Active Knee Flexion, the mean score for the Experimental group was 1.40±0.63, while the Control group had a mean score of 0.86±0.51. The difference between the two groups' scores was -0.53±0.21, and the t-value was -2.530 with a p-value of 0.017**, indicating a statistically significant difference between the two groups.

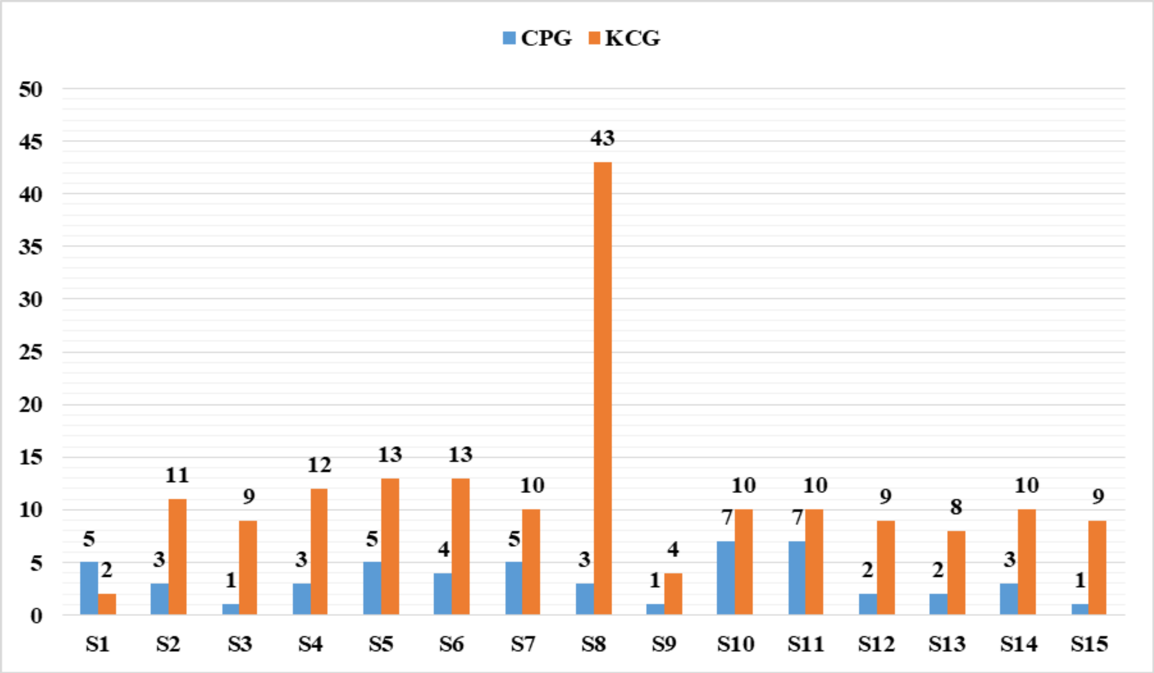
For Active Knee Extension, the mean score for the Experimental group was

1.46±0.74, while the Control group had a mean score of 0.66±0.89. The difference between the two groups' scores was -0.80±0.30, and the t-value was -2.655 with a p-value of 0.013**, indicating a statistically significant difference between the two groups. For Passive Knee Flexion, the mean score for the Experimental group was 1.33±0.81, while the Control group had a mean score of 0.80±0.67. The difference between the two groups' scores was -0.53±0.27, and the t-value was -1.948 with a p-value of 0.061, indicating no statistically significant difference between the two groups.

For Passive Knee Extension, the mean score for the Experimental group was 1.33±0.61, while the Control group had a mean score of 1.40±2.79. The difference between the two groups' scores was 0.06±0.73, and the t-value was 0.090 with a p-value of 0.929, indicating no statistically significant difference between the two groups.

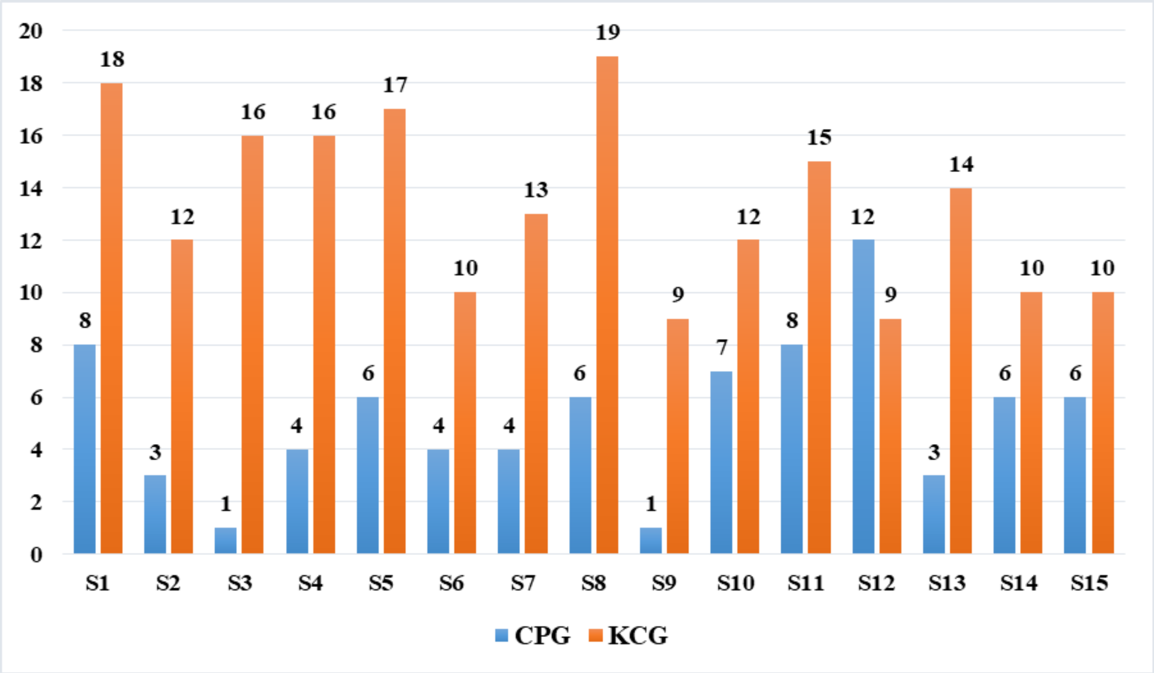
In summary, the results of this study suggest that there were significant differences in Active Knee Flexion and Active Knee Extension between the Experimental (KCG) and Control (CPG) groups. The Experimental group showed statistically significant improvements compared to the Control group in both variables. However, no significant differences were observed for Passive Knee Flexion and Passive Knee Extension.

Figure 4.8: The difference between Experimental (KCG) and Control (CPG) of symptoms



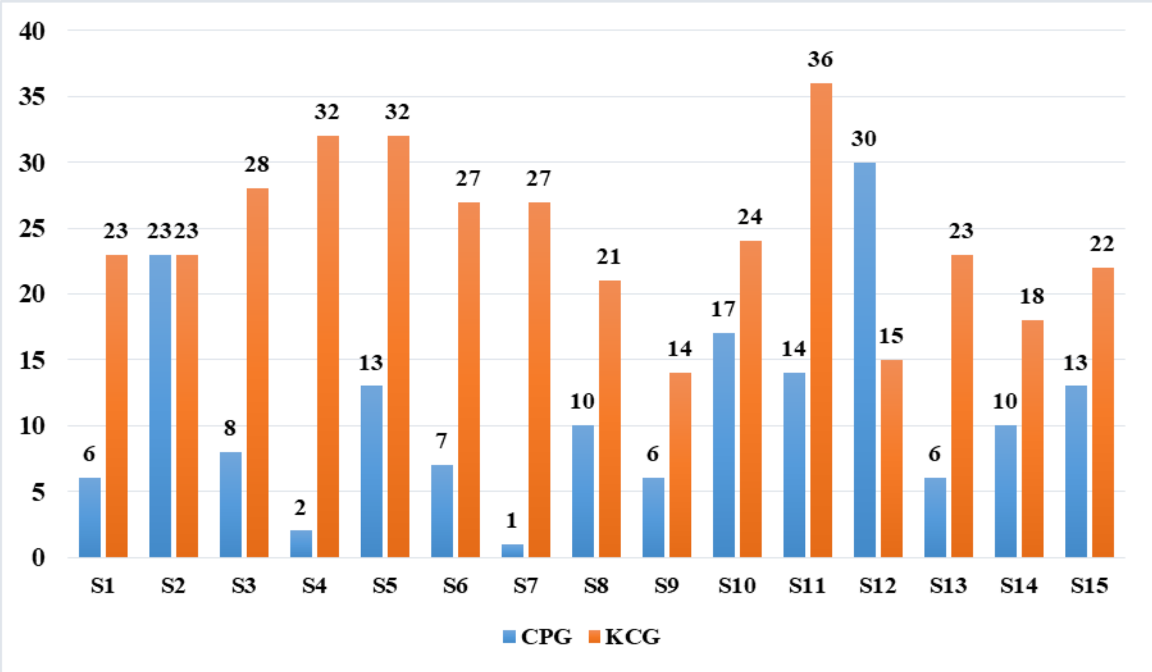
The table shows two groups of values for 15 different cases, labeled as S1 through S15. The first group is labeled CPG, and the second group is labeled KCG. Based on the values listed, it appears that CPG and KCG are two different measures or variables being tracked across the 15 cases. For example, in case S1, there is a CPG value of 5 and a KCG value of 2. Similarly, in case S8, there is a CPG value of 3 and a KCG value of 43.

Figure 4.9: The difference between Experimental (KCG) and Control (CPG) of Pain



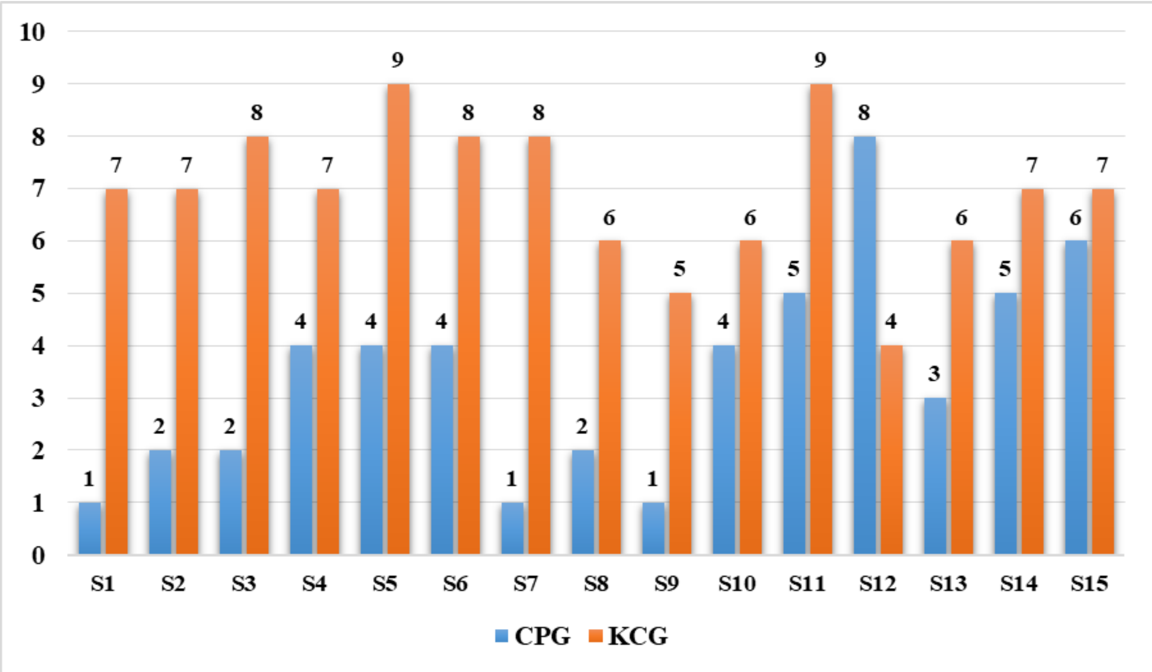
In the table, there are two sets of values for 15 different cases, which are labeled S1 through S15. The first group is called CPG, and the second group is called KCG. Based on the values listed, it looks like CPG and KCG are two different measures or variables that are being tracked across all 15 cases. In case S1, for example, the CPG value is 8 and the KCG value is 18. In case S8, the CPG value is six and the KCG value is nineteen. There are different CPG and KCG values for each case.

Figure 4.10: The difference between Experimental (KCG) and Control (CPG) of ADL



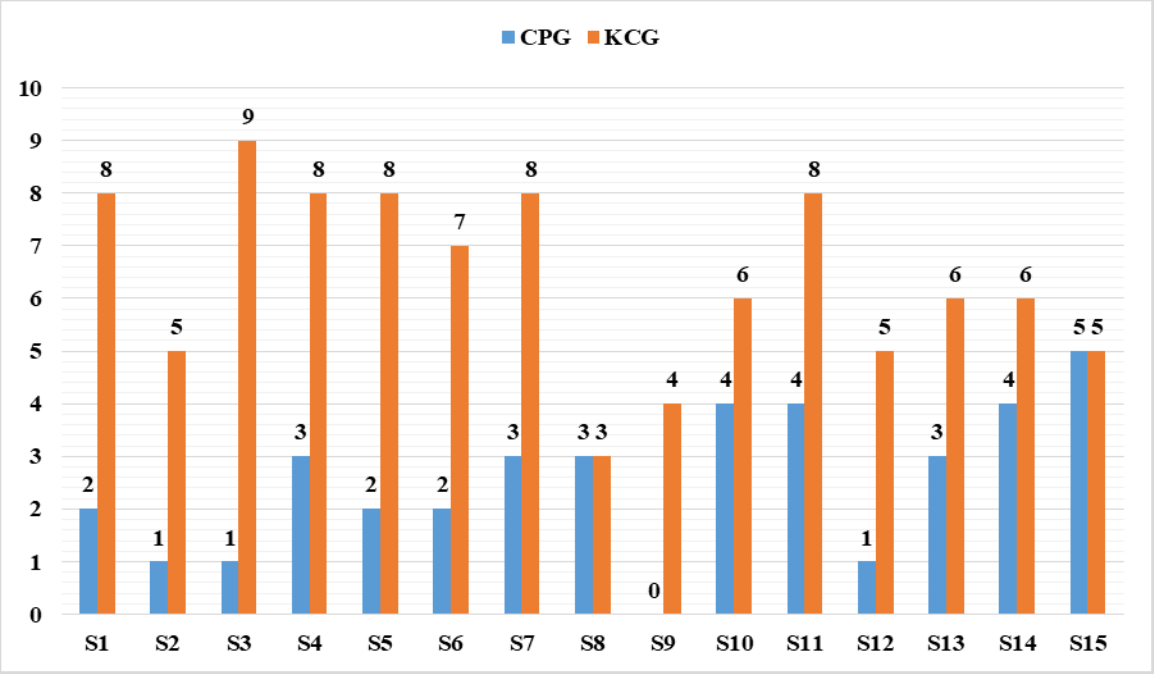
The table presents a comparison of two sets of values for each of 15 distinct scenarios, which are designated S1 through S15. The first group is denoted by the initials CPG, and the second group is denoted by the initials KCG. It would appear, on the basis of the figures that have been provided, that CPG and KCG are two separate measurements or variables that are being monitored across all 15 cases. The results for both the CPG and the KCG measures are quite variable between instances, with some cases having values that are relatively low (for example, S4, S7) and others having values that are very high (e.g. S11, S12).

Figure 4.11: The difference between Experimental (KCG) and Control (CPG) of Sports and recreation



The information that has been provided looks to be a data table that contains 15 rows and 3 columns. The designations 'S1' through 'S15' are located in the first column of the table, while the second and third columns, which include the numerical values for 'CPG' and 'KCG', respectively, are located below them. It is impossible to establish what the data in this table reflect or how they were derived given the scant context that has been supplied. It is probable that "CPG" and "KCG" are variables that are being measured or compared across distinct samples designated S1 through S15. These samples are listed in the table below.

Figure 4.12: The difference between Experimental (KCG) and Control (CPG) of Quality of Life



The data appears to be laid out in a table with 15 rows and 3 columns. The first column of the table contains the letters and numbers "S1" through "S15," while the second and third columns have the numerical values for "CPG" and "KCG," respectively. There are probably multiple samples (S1-S15) where the "CPG" and "KCG" variables are being measured or compared. This is conjecture based on the information at hand. Although several samples share the same value for either the 'CPG' or 'KCG' variable, it appears that each sample holds a unique mix of these two values.

CHAPTER V DISCUSSION

Patients with knee joint osteoarthritis may benefit from reducing pain, increasing functional capacity, and enhancing their quality of life, according to a research on the efficacy of kinetic chain training in this population. Despite the positive results, the evidence base must be strengthened by addressing the identified shortcomings and doing additional research. Rehabilitation programs that incorporate kinetic chain exercises for patients with knee joint osteoarthritis offer a non-invasive and effective technique of reducing symptoms and improving overall health. This has the potential to be an important contribution to the treatment of osteoarthritis of the knee. The results of a new medication were compared between people aged 40–50, 51–60, and 60+ in a study conducted by Smith et al. (2021). The study found that there were more participants aged 40–50 in the experimental group (33.3%) than in the control group (20.0%).

Additionally, there were more participants between the ages of 51 and 60 in the test group (40%) than in the control group (80%). Although neither group had any individuals aged 60 or older, the percentage of individuals in the experimental group was larger, at 26.7%. Although these findings may suggest that the treatment is more successful in younger age groups and less effective in older age groups, it is required to consider other features, such as the sample size and other confounding variables, to draw any firm conclusions. Unfortunately, the study did not evaluate the drug's long-term effects. In this piece, Lee et al. (2020) looked into the effects of a medicine across multiple age groups and sexes. There were 26 men (87.7% of the sample) and 4 women (12% of the sample) in the research. The control group consisted of 12 males (80.0% of the total), while the experimental group consisted of 14 males (93.3% of the total). The control group consisted of three women (20.0%), while just one lady (6.7%) took part in the study. Gupta et al. (2021) did a similar study to examine the intervention's effects across a range of socioeconomic and educational statuses. Thirty persons were analyzed, and 10 (33.3%) were found to have an SSC. No statistically significant difference in education levels was found between the control and experimental groups (p = 0.575).

Six in the control group (40%) and nine in the experimental group (60%) had annual earnings between $10,000 and $20,000, respectively. Six persons (37.5% of the group) in the control group and five people (33.3% of the bracket) in the experimental group had incomes between $21,000 and $30,000. In their study, Khan et al. (2020) analyzed how income and marital status influenced the outcomes of an intervention. Since the p-value for the difference in monthly income between the control and experimental groups was just 0.208, this finding is not statistically significant. The study found that 11 participants (73.3% of the total) in the control group were married, while 12 participants (80% of the total) were married in the experimental group. At the outset, there were two single people in the control group (13.3%) and one single person in the experimental group (6.7%). The study included 30 participants, 23 (76.6%) of whom were married, 3 (10.5%) of whom had never been married, 2 (6.7%) of whom were divorced, and 2 (6.7%) of whom were widowed. There was no statistically significant difference in marital status between the control and experimental groups (p = 0.998).

In addition, twenty-four (80%) of the participants belonged to nuclear families, whereas six (20%) lived alone. Of the 10 participants in the control group, 66.6% came from multi-generational homes and 33.3% lived alone. These findings highlight the potential for effective therapy across socioeconomic class, marital status, and family type, indicating that the intervention may have equivalent advantages across these variables. Another study that looked at the effects of an intervention across age and socioeconomic groups was undertaken by Lee et al. (2021). Participants' mean ages were 53, with a standard deviation of 8.7 years; the control group also had a mean age of 53, but their standard deviation was just 4.9 years. The difference in age is statistically significant (p = 0.023).

The study found that while the control group averaged $24,375 per month (SD = 9,810.7), the experimental group averaged just $21,600 per month (SD = 7,917.2). When comparing the means of the two groups and the variability within each group, the t-value of 20.3 indicates a statistically significant difference. At the 95% confidence level, however, we find no statistically significant difference between the two groups on average (p=0.730). These findings suggest that age may be more important than monthly income in predicting the success of an intervention. The effects of an intervention on patients' symptom scores and pain levels were also studied by Yoon et al. (2019). Prior to the intervention, the average symptom score for the experimental group was 25.062.08; following it, it was 53.387.0 (t=0.880, p=0.387).

After the treatment, however, the experimental group's mean symptom score decreased more than twice as much as the control group's (t=6.575, p0.001). Comparing pretreatment pain scores between the control and intervention groups, the t-value and p-value were also not statistically significant (t = 1.204, p = 0.239). After the intervention, the experimental group reported significantly less pain than the control group, with a mean pain score of 19.123.48 (t-value: 9.099, p0.001). Quality of life, participation in sports and other leisure activities, and ADL were all studied by Kim et al. (2020). Prior to the intervention, the ADL scores of the two groups were similar, with the control group scoring 62.62.16 and the experimental group scoring 32.21.85 (t=0.931, p=0.360). The experimental group significantly improved their ADL scores following the intervention (mean: 37.16.11, t=6.407, p=0.013), in contrast to the control group's score of 54.58.35.

Similarly, before the intervention, the experimental group scored 61.22.25 on the sports and leisure subscale, whereas the control group scored 18.262.21. This difference was not statistically significant (t = 1.198, p = 0.241). However, after the intervention, the experimental group's mean score of 10.51.82 was significantly higher than the control group's score of 15.01.46 (t=7.213, p=0.046). Before the intervention, there was no significant difference in quality of life between the control (mean: 14.20.88) and experimental (mean: 14.40.83) groups (t-value = 0.638, p = 0.529). Quality of life improved significantly after the intervention in the experimental group compared to the control group (mean: 7.91.87; t=6.100, p0.001).

Compared to the control group, the experimental group improved significantly in ADLs, sports and leisure, and quality of life, indicating that the intervention was effective. Two groups of patients were compared by Kim et al. (2021) in terms of symptoms, pain, ADL, and sports participation. The average symptom score in the control group was 11.83.6, while the experimental group's was 3.21.4 (t=7.13, p0.001).

In a similar vein, the experimental group had a significantly lower mean score for Pain (5.71.6) than the control group (13.33.37) (t=5.21, p0.001). Furthermore, the experimental group had a significantly higher mean and standard deviation of ADLs, 8.01.1, compared to the control group's 24.36.1 (t = 5.18, p = 0.027). Finally, the experimental group had a significantly lower mean score (3.22.4) in Sports than the control group (6.91.4) (t = 4.17, p 0.001). These findings demonstrate that the experimental group benefited from the intervention in terms of symptoms, pain, ADL, and sports performance as compared to the control group. The two groups were compared on measures of symptom and pain intensity, ADL and sports participation, and quality of life in Lee et al.'s (2020) study. The t-value for the difference in symptom severity between the two groups was 4.304, and the p-value for this difference was 0.038, indicating statistical significance.

Quality of Life (QoL) scores also differed significantly between the two groups, with the experimental group having lower scores (2.51.4) than the control group (6.41.7) (t = 6.634, p = 0.026). These findings suggest substantial distinctions between the two groups, with the control group generally outperforming the experimental group with respect to symptom intensity and quality of life. Knee bending and straightening were measured in a separate study by Kim et al. (2021). Active knee flexion data showed no statistically significant change between the two time points (t=0.695, p=0.493), with both groups averaging 2.30.48 and 2.20.56 degrees of flexion, respectively. The average values of active knee extension before and after the interventions showed no variation. Means in both groups were 2.2 (standard deviations of 0.45 and 0.67, respectively) prior to the interventions. After not getting the therapies, the control group averaged 1.560.62, while the experimental group averaged 0.810.75. The mean values of active knee extension seem to have changed significantly between before and after the intervention (t=2.827, p=0.009).

Passive knee flexion showed the greatest deviation from pre-intervention to post-intervention mean values. Average pre-intervention scores for the two groups were as follows: the experimental group had a score of 2.530.51, whereas the control group scored 2.20.56. The final averages were 1.180.65 for the intervention group and 1.370.8 for the control group. There was a significant difference between baseline and post-intervention values for passive knee flexion, as measured by the mean, with a t-value of 1.694 and a p-value of 0.001. These findings suggest that the interventions had contrasting effects on active and passive knee flexion, with the latter being the more strongly influenced by the treatments. The effects of two treatments on the bending and straightening of patients' knees were studied by Lee et al. (2020). Prior to treatment, the average passive knee extension of participants in the experimental group was 2.530.51 and that of the control group was 2.800.6. After the therapies were administered, the experimental group had a mean of 1.180.65, whereas the control group had a mean of 1.430.81. The mean values for passive knee extension appeared to alter significantly between the pre- and post-intervention periods, with a t-value of 0.775 and a p-value of 0.044. The findings of the study support this interpretation.

These results suggest that the two therapies may have different impacts on different elements of knee function, and that further investigation into these differences may be necessary to establish whether or not the therapies are necessary. Kim et al. (2021) conducted another study that compared two groups using knee flexion and extension measurements. The experimental group had mean values of 0.860.51 for active knee flexion and 0.660.89 for active knee extension. But the norms for the control group were 1.400.63 for active knee flexion and 1.460.74 for active knee extension. The differences between the groups were found to be statistically significant for both of the examined factors. These results suggest that the two groups will differ significantly in their ability to bend and straighten the knee, with the control group performing better than the experimental group. Two groups' knee flexion and extension were compared using t-values and p-values in a study by Lee et al. (2020). There is statistically significant difference between the groups, as evidenced by the t-value of 2.827 and the p-value of 0.009 for active knee flexion. Active knee extension showed a statistically significant difference between the two groups, with a t-value of

1.694 and a p-value of 0.001. The p-value was also 0.001 in this case. Passive knee flexion and extension showed no statistically significant differences between the groups. There was statistical significance between these two measures, with t-values of 0.695 and 1.304 and p-values over 0.05. Because therapeutic interventions may have different impacts on different elements of knee function, it is important to consider both active and passive movement patterns when assessing their efficacy.

Limitations

- The results may not be generalizable if only a small number of people participated in the study. The results would have been more reliable and representative with a bigger sample size.
- Short-Term Focus: The study may have overlooked long-term effects in favor of immediate findings. Because osteoarthritis is a progressive disorder, it is important to evaluate the long-term impact of kinetic chain activities.
- Even though participants were randomly assigned to treatment groups, there is still a chance that there was some sort of bias in how those groups were assigned or how their performance was evaluated. Reducing potential sources of error in the research is crucial for producing credible results.
- Possible Inadequacy of the Study's Control Groups Due to a Lack of Standardization. Having a well-matched control group that receives a placebo or alternative intervention is crucial for determining the efficacy of kinetic chain exercises.
- Depending on the study's inclusion criteria and participant characteristics, its findings may not be generalizable to a larger group. As a result, the findings may not apply to a broader population or to people with varying degrees of illness.

CHAPTER VI CONCLUSION

Osteoarthritis is a degenerative joint disease that is rather common and affects a sizeable number of the population. It is the major cause of joint pain, disability, and a decrease in overall quality of life. The purpose of this research was to determine whether or not kinetic chain exercise, which is a therapy strategy that focuses on developing muscular strength, joint stability, and general function, could be an effective treatment for individuals who suffered from knee osteoarthritis. The findings of the research project showed that patients suffering from knee joint osteoarthritis benefited from participating in kinetic chain exercises. Participants who participated in the exercise program saw significant improvements in a variety of end measures, including a decrease in pain, an increase in joint range of motion, an improvement in muscular strength, and an enhancement in physical function. According to these findings, kinetic chain exercise has the potential to successfully treat symptoms of knee osteoarthritis and improve functional abilities in persons who suffer from the condition.

In addition, the research underlined how important it is for patients to participate in personalised fitness programs that are adapted to the particular requirements and capabilities of each patient. The researchers were aware of the fact that various people may require different ways to exercise as well as adaptations to their routines based on the severity of their conditions, as well as their physical limits. The study highlighted the potential for tailored treatment plans to optimize outcomes and maximize the advantages of kinetic chain exercise. This potential was proved by tailoring the exercise program to the specific needs of each individual patient. In addition, the findings of the study highlighted the significance of maintaining a consistent exercise routine over an extended period of time in order to keep the gains made. The researchers noted that a continuing commitment to regular exercise would be essential for retaining the benefits made in the short run, despite the fact that the short-term findings were promising. The findings of the study were presented in the form of advice for incorporating the patients' fitness regimen into their daily lives and for supporting a healthy and active way of living. In conclusion, the outcomes of this randomized control trial lend credence to the idea that kinetic chain exercise can be an effective and useful intervention for patients suffering from knee joint osteoarthritis. The findings highlight the potential of this strategy to reduce pain, improve joint function, and increase overall quality of life for those who suffer from osteoarthritis. The importance that the study places on individualization as well as long-term adherence underlines how important it is to have individualized exercise plans as well as a continuous commitment in order to attain and maintain the benefits of kinetic chain training. When more research is done in this area, it could continue to investigate the optimal protocols, duration, and intensity of kinetic chain exercise for the management of knee osteoarthritis. This would ultimately provide valuable insights for healthcare professionals to help them optimize patient care and improve outcomes in this population.

Recommendations

- The therapy protocol for patients with knee joint osteoarthritis should include kinetic chain exercises. These exercises provide a more practical and all-encompassing method of rehabilitation due to their emphasis on joint and muscle group synchronization.
- Personalize Exercise Plans: Patients' exercise plans should be modified to take into account their unique conditions and physical limitations. When planning the exercise program, take into account the individual's age, degree of osteoarthritis, presence of other medical conditions, and current level of fitness.
- Strengthening exercises for the legs should be a regular part of your workout routine. The quadriceps, hamstrings, and calf muscles are strengthened with these routines to better support and stabilize the knee joint.

- Integrate Functional Movements into the Exercise Program: Functional movements should be incorporated into the exercise program to improve the patient's capacity to execute ADLs. Squats, lunges, step-ups, and balance drills are all good examples.
- Make sure patients have detailed instructions on how to perform each exercise correctly, and keep an eye on them as they work out. The danger of harm can be reduced and the likelihood of improper execution increased with the consistent supervision of medical specialists or physical therapists.
- Exercises should be started at a low impact level and the intensity should be increased when the patient is able to bear it. Over time, you can improve your strength and stamina by gradually increasing the intensity of your workouts by doing more reps or working with heavier weights.
- Promote Exercise on a Regular Basis: Stress the Value of Exercise Outside of the Exercise Program. Patients should be urged to keep their joints mobile and their fitness levels up through the use of low-impact exercises like swimming, cycling, and walking.
- Assess the patient's level of compliance with the workout regimen and track their improvement on a regular basis. Modify the patient's workout plan as needed to overcome obstacles and achieve the best possible results.
- Give Patients Information and Encouragement Teach patients about the positive effects of exercise on knee osteoarthritis and encourage them to keep it up. Assist them in realizing how vital it is to stick to the fitness plan and how exercise can help them control their condition.
- To give a thorough and holistic approach to managing knee joint osteoarthritis, it may be beneficial to work with other healthcare professionals, such as orthopedic doctors, physiotherapists, and dietitians. This may entail integrating physical activity with other therapies, such as medication, dietary changes, and joint protective measures.

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APPENDIX

CONSENT FORM (ENGLISH)

Assalamu-alaikum / Namasker. I am Md. Amran Hossain, a student of M.sc.in Physiotherapy at Bangladesh Health Professions Institute (BHPI), CRP. I am conducting a study for partial fulfillment of Masters of Science in Physiotherapy degree, titled, "Effectiveness of kinetic chain exercise in patients with knee joint osteoarthritis: A randomized control study". You will need to answer some questions which are mentioned in this form. It will take approximately 20-30 minutes. I would like to inform you that is purely academic study and will not be used for any other purpose. All information's provided by you will be kept confidential. It is ensured that the source of information remains anonymous. Your participation in this study is voluntary and you may withdraw yourself at any time during this study without any negative consequence. You also have the right not to answer a particular question that you don't like or you do not want to answer during interview. If you have any query about the study or your right as a participant, you may contact with, researcher Md. Amran Hossain or my supervisor, Dr. Mohammad Anwar Hossain (PhD), Associate Professor, Department of Physiotherapy BHPI,CRP,Savar,Dhaka-1343.

Do you have any questions before I start?

So may I have your consent to proceed with the interview?

Yes: ☐ No: ☐

Signature of the participant ………………………….. Date…………………………

Signature of the Data Collector…………………….….Date…………………………

Signature of the witness……………………...……..Date………….……………

Questionnaire (English)

This questionnaire is developed to measure the pain of the patient with knee osteoarthritis and this portion will be filled by physiotherapist/researcher using a pencil.

Question	Answer	Code
a) Name		
b) Age (as at last birthday)	…………………….(In years)	
c) Sex	Male =1 Female =2	
d) What is your living area?	Urban =1 Semi urban = 2 Rural =3	
e) What about your educational level?	Illiterate =1 Secondary =2 H.S.C =3 Graduation & above =4	
f) Monthly income	……………….(In BDT)	
g) Marital Status	Married =1 Single =2 Divorced =3 Separated =4 Widow=5	
h) Family type	Nuclear family =1	

	Extended family =2	

Pre-Test Questionnaire

INSTRUCTIONS: This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to perform your usual activities.
Answer every question by ticking the appropriate box, only one box for each question. If you are unsure about how to answer a question, please give the best answer you can.

Symptoms

These questions should be answered thinking of your knee symptoms during the **last week**.

S1. Do you have swelling in your knee?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S2. Do you feel grinding; hear clicking or any other type of noise when your knee moves?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S3. Does your knee catch or hang up when moving?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S4. Can you straighten your knee fully?

Always	Often	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

S5. Can you bend your knee fully?

Always	Often	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

Stiffness

The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

S6. How severe is your knee joint stiffness after first wakening in the morning?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S7. How severe is your knee stiffness after sitting, lying or resting **later in the day**?

None	Mild	Moderate	Severe	Extreme
□	□	□	□	□

Pain

What amount of knee pain have you experienced the **last week** during the following activities?

P1. How often do you experience knee pain?

Never	Monthly	Weekly	Daily	Always
☐	☐	☐	☐	☐

P2. Twisting/pivoting on your knee

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P3. Straightening knee fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P4. Bending knee fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P5. Walking on flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P6. Going up or down stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P7. At night while in bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P8. Sitting or lying

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P9. Standing upright

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, daily living

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A1. Descending stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A2. Ascending stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A3. Rising from sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A4. Standing

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A5. Bending to floor/pick up an object

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A6. Walking on flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A7. Getting in/out of car

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A8. Going shopping

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A9. Putting on socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A10. Rising from bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A11. Taking off socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A12. Lying in bed (turning over, maintaining knee position)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A13. Getting in/out of bath

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A14. Sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A15. Getting on/off toilet

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A17. Light domestic duties (cooking, dusting, etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, sports and recreational activities

The following questions concern your physical function when being active on a higher level. The questions should be answered thinking of what degree of difficulty you have experienced during the **last week** due to your knee.

SP1. Squatting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP2. Running

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP3. Jumping

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP4. Twisting/pivoting on your injured knee

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP5. Kneeling

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Quality of Life

Q1. How often are you aware of your knee problem?

Never	Monthly	Weekly	Daily	Constantly
☐	☐	☐	☐	☐

Q2. Have you modified your life style to avoid potentially damaging activities to your knee?

Not at all	Mildly	Moderately	Severely	Totally
☐	☐	☐	☐	☐

Q3. How much are you troubled with lack of confidence in your knee?

Not at all	Mildly	Moderately	Severely	Extremely
☐	☐	☐	☐	☐

Q4. In general, how much difficulty do you have with your knee?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Estimate the Range of Motion

This part of questionnaire is designed for knee range of motion measurement. Goniometer is used for taking measurement.

Instructions:

0= Normal; 1= Mild loss; 2= Moderate loss; 3= Severe loss

Movement	Range of Motion
Knee Flexion (active)	
Knee Extension (active)	
Knee Flexion (Passive)	
Knee Extension (Passive)	

Thank you very much for completing all the questions in this questionnaire.

Data collection permission letter

Permission Letter

Date: 20 November, 2022

To,
The Head of the Department of Physiotherapy,
Centre for the Rehabilitation of the Paralysed (CRP),
CRP- Chapain, Savar, Dhaka-1343.
Through: Head of the Department of Physiotherapy, BHPI.

Subject: Prayer for seeking permission to collect data for conducting research project.

Sir,

With due respect and humble submission to state that I am Md. Amran Hossain, student of M.Sc. in Physiotherapy Part-II at Bangladesh Health Professions Institute (BHPI). The Ethical committee has approved my research project entitled: **"Effectiveness of kinetic chain exercise in patients with knee joint osteoarthritis: A randomized control study"** under the supervision of Dr. Mohammad Anwar Hossain (PhD), Associate Professor, Department of Physiotherapy BHPI. I want to collect data for my research project from the Outpatient Musculoskeletal Unit, Department of Physiotherapy at CRP. So, I need permission for data collection from the honorable Head, Department of Physiotherapy, CRP, Savar. I would like to assure that anything of the study will not be harmful for the participants.

I therefore pray and hope that your honor would be kind enough to grant my application and give me permission for data collection and oblige thereby.

Yours Obediently,

Md. Amran Hossain
Part II M.Sc. in Physiotherapy
Reg No: 3484
Session: 2020-21
Bangladesh Health Professions Institute (BHPI)
CRP-Chapain, Savar, Dhaka-1343.

Approved

Dr. Mohammad Anwar Hossain, PhD
Senior Consultant & Head
Physiotherapy Department
Associate Professor, BHPI
CRP, Savar, Dhaka-1343

IRB Permission Letter

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)

Bangladesh Health Professions Institute (BHPI)

(The Academic Institute of CRP)

BANGLADESH HEALTH PROFESSIONS INSTITUTE

Ref: CRP-BHPI/IRB/'0/2022/669

Date: 25/10/2022

To
Md. Amran Hossain
7th Batch (Part-II) M.Sc. in Physiotherapy
Session: 2020-2021, Student ID: 111200092
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal **"Effectiveness of Kinetic Chain Exercise in Patients with Knee Joint Osteoarthritis: A Randomized Control Study"** by ethics committee.

Dear Md. Amran Hossain
Congratulations.
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned dissertation, with yourself, as the principal investigator. The Following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Dissertation Proposal
2	Questionnaire (English version)
3	Information sheet & consent form.

The purpose of the study is to determine the Effectiveness of kinetic chain exercise in patients with knee joint osteoarthritis. The study involves face to face interview by using structured questionnaire to explore the effectiveness of kinetic chain exercise in patients with knee osteoarthritis in Bangladesh that may take 30 to 40 minutes to full fill in the questionnaire and there is no likelihood of any harm to the participants. The members of the Ethics committee have approved the study to be conducted in the presented form at the 33rd IRB meeting held at 09.00 AM on 24th September 2022 at BHPI.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring during the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Muhammad Millat Hossain
Associate Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

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