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Dry Needling Versus Exercise in Improving Knee Pain among the Patients with Osteoarthritis

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"Dry Needling Versus Exercise in Improving Knee Pain among the Patients with Osteoarthritis"

Submitted by **Tanjina Afroz Swarna** for the partial fulfillment of the requirements for the degree of Bachelor of Science in Physiotherapy (B.Sc. in PT).

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DECLARATION

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also decline that for any publication or dissemination of information about the study, I would be bound to obtain the written consent of my supervisor.

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Acronyms

BMI	: Body Mass Index
DN	: Dry Needling
EX	: Exercise Therapy
IL-6	: Interleukin-6
MRI	Magnetic Resonance Imaging
NPRS	Numeric Pain Rating Scale
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
OA	Osteoarthritis
RCT	Randomized Controlled Trial
SMD	Standardized Mean Difference
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index

Abstract

Background: Knee osteoarthritis (OA) is a prevalent condition in Bangladesh, contributing to significant pain and functional limitations, particularly in resource-constrained settings.

Objective: This study aimed to compare the efficacy of dry needling (DN) versus exercise therapy (EX) in reducing knee pain and improving function among patients with OA.

Methods: In a randomized controlled trial, 50 participants (25 per group) with clinically diagnosed knee OA were recruited from Saic College of Medical Science and Technology, Dhaka, using purposive sampling. The DN group received biweekly needling targeting quadriceps and hamstring trigger points, while the EX group followed a structured 8-week program of strengthening and flexibility exercises (3 supervised + 2 home sessions/week). Outcomes were assessed at baseline and 8 weeks using the Numeric Pain Rating Scale (NPRS) for pain intensity and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for pain, stiffness, and function. Baseline characteristics (e.g., age, BMI, gender) were comparable between groups ($p > 0.05$).

Results: Both groups showed significant improvements in NPRS and WOMAC scores ($p < 0.001$). The EX group achieved greater reductions in WOMAC Pain (-7.00 ± 1.30), Stiffness (-2.92 ± 0.90), Function (-15.52 ± 3.00), and Total (-25.80 ± 3.50) compared to DN ($p < 0.001$), indicating superior functional outcomes. However, DN demonstrated a greater NPRS reduction (-3.24 ± 0.90 vs. -2.16 ± 0.85, $p = 0.002$), suggesting enhanced pain relief. A moderate correlation between baseline NPRS and WOMAC Total change ($r = 0.45$–0.50) highlighted pain severity as a predictor of functional improvement.

Conclusion: These findings suggest that exercise therapy excels in improving function, while dry needling offers rapid pain relief, providing viable non-pharmacologic options for OA management in Bangladesh. Despite limitations like a modest sample size and short follow-up, this study supports integrating these interventions in low-resource settings, with exercise offering scalability and dry needling targeting acute pain.

CHAPTER-I	INTRODUCTION

1.1 Background:

Knee osteoarthritis (OA) is a prevalent degenerative joint condition marked by the progressive breakdown of articular cartilage, synovial inflammation, and changes in subchondral bone, resulting in pain, stiffness, and reduced function (Loeser et al., 2016, p. 1330). Globally, it affects over 250 million individuals, significantly impairing mobility and quality of life, making it a leading cause of disability (Cross et al., 2014, p. 1325). The condition's pathophysiology stems from mechanical stress and biochemical processes, where inflammatory cytokines such as interleukin-1 (IL-1) and tumor necrosis factor-alpha (TNF-α) trigger cartilage degradation via enzymes like matrix metalloproteinases (MMPs. This leads to cartilage thinning, osteophyte growth, and synovial changes, intensifying symptoms (Loeser et al., 2016, p. 1331).

The development and progression of knee OA are influenced by multiple risk factors. Age significantly increases susceptibility, with prevalence rising after 50 due to accumulated joint wear and diminished cartilage repair capacity (Sharma, 2021, p. 16). Gender plays a role, with women facing higher risk post-menopause due to hormonal shifts and biomechanical differences, such as wider pelvic angles (Boyan et al., 2013, p. 2). Obesity exacerbates the condition by increasing mechanical stress and releasing inflammatory adipokines, with a 5% risk increase per BMI unit (Yusuf et al., 2010, p. 124). Prior joint injuries, such as meniscal or ligament damage, heighten OA risk by 5-7 times within decades (Roos et al., 2011, p. 165). Occupational factors, including repetitive kneeling, accelerate cartilage damage (Palmer, 2012, p. 149). Genetics contribute, with heritability estimated at 40-60% (Reynard & Loughlin, 2013, p. 2), and malalignment or metabolic conditions further compound risk (Neogi, 2013, p. 1146).

Knee OA's global prevalence underscores its public health impact. In developed nations, approximately 16% of adults over 40 are affected (Pereira et al., 2011, p. 1273). In Bangladesh, rates range from 10-20%, driven by obesity, occupational strain, and limited healthcare access (Fransen et al., 2011, p. 876). Rural Bangladeshi women, often engaged in agriculture, face elevated rates due to repetitive knee stress and underdiagnosis (Haque et al., 2016, p. 81). The socioeconomic toll is profound, with reduced productivity and high healthcare costs, particularly in resource-scarce regions (Ahmed et al., 2018, p. 23).

Diagnosing knee OA involves assessing symptoms like chronic pain, stiffness, and swelling, worsened by weight-bearing tasks (Neogi, 2013, p. 1146). Morning stiffness lasting under 30 minutes helps differentiate it from inflammatory conditions (Neogi, 2013, p. 1146). The European League Against Rheumatism (EULAR) criteria prioritize clinical signs and risk factors, such as age and obesity, for diagnosis (Zhang et al., 2010, p. 484). Radiographs reveal joint space narrowing and osteophytes, though symptom severity often misaligns with imaging (Hannan et al., 2000, p. 837). Tools like the Knee Injury and Osteoarthritis Outcome Score (KOOS) quantify patient experience (Roos & Lohmander, 2009, p. 3). In Bangladesh, limited imaging access often delays diagnosis, relying heavily on clinical judgment (Haque et al., 2016, p. 82).

Management strategies for knee OA span pharmacologic, non-pharmacologic, and surgical options. NSAIDs and corticosteroids offer temporary relief but pose risks like gastrointestinal issues (Bannuru et al., 2019, p. 1581). Non-pharmacologic approaches, including exercise and weight loss, are safer and target both symptoms and function (McAlindon et al., 2014, p. 958). Surgery, such as knee arthroplasty, suits advanced cases but is often unfeasible in Bangladesh due to cost and infrastructure barriers (Kamaruzaman et al., 2017, p. 2; Ahmed et al., 2018, p. 24).

Exercise therapy, a key non-pharmacologic intervention, includes strengthening and aerobic exercises to reduce pain and enhance function (Juhl et al., 2014, p. 624). A Cochrane review reports moderate pain relief (SMD = 0.46) and functional gains (SMD = 0.37), sustained for six months (Fransen et al., 2015, p. 1556). Benefits arise from improved biomechanics and reduced inflammation (Rice et al., 2019, p. 2). In Bangladesh, adherence is challenged by pain and limited physiotherapy access (Ahmed et al., 2018, p. 24).

Dry needling targets myofascial trigger points to alleviate pain and improve movement, showing short-term benefits (SMD = 0.62) within weeks (Dunning et al., 2018, p. 5). It enhances blood flow and modulates pain pathways (Cagnie et al., 2013, p. 349). Though promising, its evidence base is limited, and in Bangladesh, its use is restricted by practitioner scarcity (Ahmed et al., 2018, p. 23).

Dry needling and exercise therapy may complement each other, with the former providing rapid pain relief and the latter offering sustained functional improvement (Fernández-de-las-Peñas et al., 2020, p. 7). Both achieve comparable pain reduction (SMD ≈ 0.50), but exercise excels in quality-of-life gains (Dunning et al., 2018, p. 6). A combined strategy could optimize outcomes, though research is needed (Rice et al., 2019, p. 3).

In Bangladesh, knee OA's burden is amplified by demographic and resource challenges. Exercise therapy and dry needling present accessible management options, yet their comparative efficacy remains underexplored, particularly in this context.

1.2 Rationale:

Osteoarthritis (OA) is a prevalent degenerative joint disease that commonly affects the knee, leading to chronic pain, stiffness, and functional limitations. Globally, it is one of the leading causes of disability in older adults. In the context of Bangladesh and many developing countries, knee OA is becoming increasingly common due to aging populations, sedentary lifestyles, and obesity. Traditional management strategies include pharmacological approaches, physical therapy, exercise, and recently, dry needling as a non-pharmacological intervention. While exercise has long been recognized for its ability to improve joint mobility, muscle strength, and pain management, dry needling is gaining attention for its role in reducing myofascial trigger point pain and improving range of motion.

Although both exercise and dry needling are used in clinical practice to manage knee OA, there is limited comparative evidence on their individual effectiveness, especially in the Bangladeshi population. Most studies tend to focus on either intervention in isolation, without directly comparing their outcomes in terms of pain reduction, function, and quality of life. Additionally, many available studies are conducted in Western settings, and may not reflect the cultural, economic, or healthcare infrastructure differences in South Asia. Therefore, a direct comparison between dry needling and exercise is necessary to determine the more effective treatment option or whether a combined approach might yield better outcomes.

This study is crucial to guide clinicians and physiotherapists in selecting the most effective, evidence-based, and culturally appropriate intervention for managing knee pain in osteoarthritis patients. By comparing dry needling and exercise, the study will provide insight into which intervention offers better pain relief, functional improvement, and patient satisfaction. The findings could also help optimize resource allocation in rehabilitation settings, reduce the burden on healthcare services, and improve the quality of life for individuals suffering from knee OA.

1.3 Research question:

Is dry needling more effective than exercise in reducing knee pain and improving function among patients with osteoarthritis?

1.4 Hypothesis

1.4.1 Null Hypothesis (H_0):

There is no significant difference in pain reduction (NPRS) and functional improvement (WOMAC scores) between dry needling and exercise therapy among patients with knee osteoarthritis.

$$\mu_1 - \mu_2 \neq 0 \text{ or } \mu_1 \neq \mu_2$$

1.4.2 Alternative Hypothesis (H_a):

Dry needling is more effective than exercise therapy in reducing pain (NPRS), while exercise therapy is more effective than dry needling in improving functional outcomes (WOMAC scores) among patients with knee osteoarthritis.

$$\mu_1 - \mu_2 = 0 \text{ or } \mu_1 = \mu_2$$

Key Symbols:

- **H_0**: Null hypothesis
- **H_a**: Alternative hypothesis
- **μ_1**: Mean score of Group 1 (Dry Needling)
- **μ_2**: Mean score of Group 2 (Exercise Therapy)

1.5 Aim of the Study

The aim of this study is to compare the effectiveness of dry needling versus exercise therapy in reducing knee pain and improving functional outcomes among patients with osteoarthritis.

1.6 Objectives

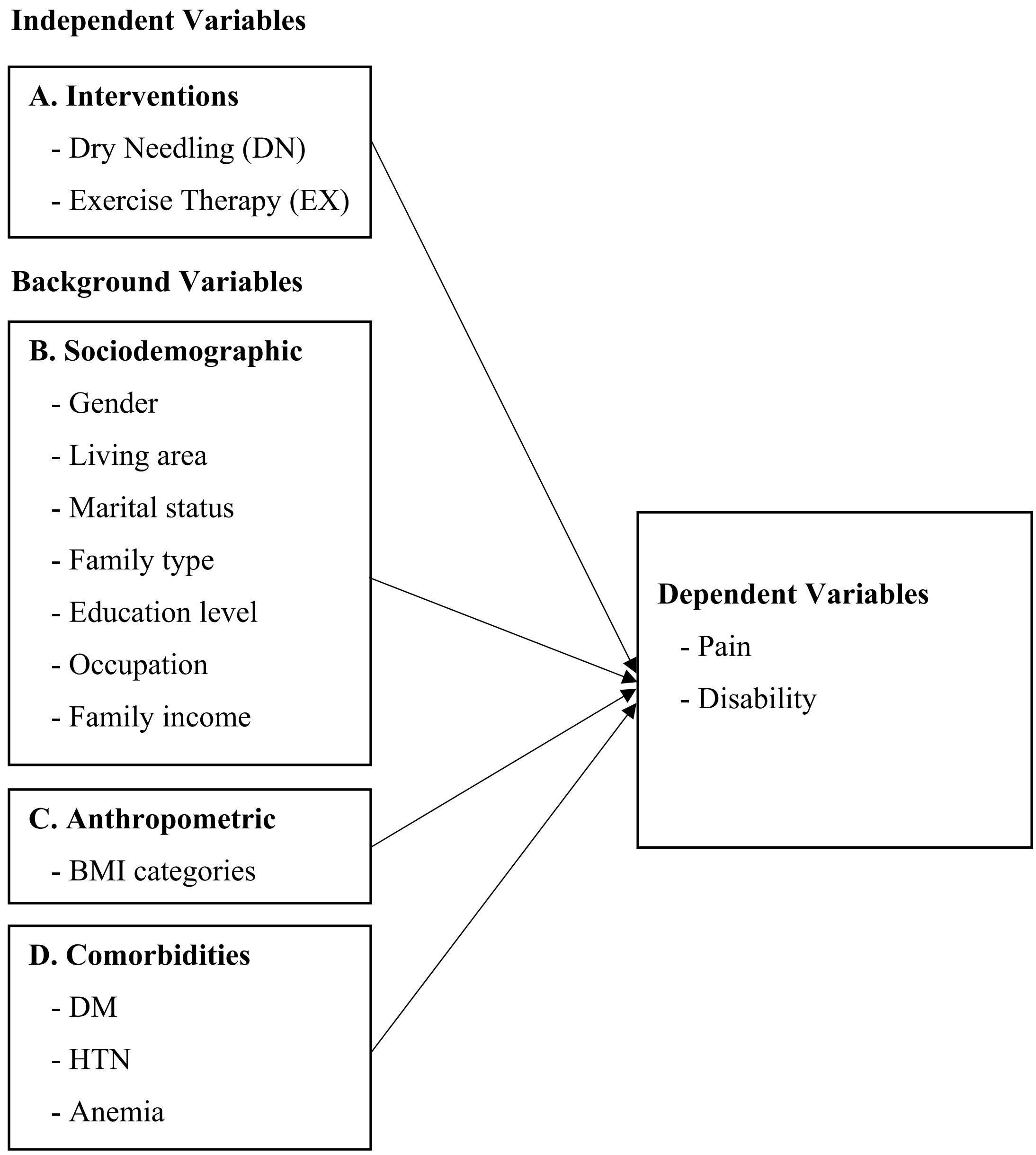
1.6.1 General Objective:

- To compare the effectiveness of dry needling versus exercise in improving knee pain among patients with osteoarthritis.

1.6.2 Specific objectives

- To evaluate the pain levels of the experimental group using the Numeric Pain Rating Scale (NPRS) before and after dry needling..
- To assess the functional disability of the experimental group using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) before and after dry needling.
- To evaluate the pain levels of the control group using the NPRS before and after exercise.
- To assess the functional disability of the control group using the WOMAC before and after exercise.
- To determine the socio-demographic characteristics and pain-related information of the experimental and control groups.
- To compare the outcomes of the experimental and control groups before and after intervention by applying statistical tests.

1.7 Conceptual Framework



1.8 Operational Definition

1.8.1 Osteoarthritis (OA)

For this study, osteoarthritis refers to clinically diagnosed knee osteoarthritis based on American College of Rheumatology (ACR) criteria, including symptoms such as knee joint pain, stiffness, crepitus, and limited range of motion, confirmed by a licensed physician or physiotherapist specializing in musculoskeletal conditions.

1.8.2 Knee Pain

Knee pain is defined as the subjective report of discomfort or aching sensation in the knee joint, measured using the Numeric Pain Rating Scale (NPRS) ranging from 0 (no pain) to 10 (worst possible pain). Pain levels will be assessed at baseline and after the 8-week intervention period to evaluate changes.

1.8.3 Dry Needling

Dry needling in this study refers to a therapeutic technique performed by a certified physiotherapist, involving the insertion of fine, sterile filiform needles into myofascial trigger points around the knee joint, following a standardized protocol of one session per week for 8 weeks.

1.8.4 Exercise

Exercise refers to a structured physiotherapy program tailored for patients with knee osteoarthritis, including strengthening, stretching, and functional mobility exercises, delivered under supervision by a physiotherapist, with a frequency of three 30-minute sessions per week for 8 weeks.

1.8.5 Improvement

Improvement refers to a statistically and clinically significant reduction in knee pain, measured via the Numeric Pain Rating Scale (NPRS), and enhanced functional ability, assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Total score, measured at baseline and after the 8-week intervention period.

1.8.6 Functional Ability

Functional ability refers to the participant's capability to perform daily activities such as walking, sitting, standing, and climbing stairs. It will be assessed using the WOMAC Physical Function subscale at baseline and after the 8-week intervention period.

1.8.7 Intervention Period

The intervention period is defined as the specific time frame during which participants receive either dry needling or exercise therapy. For this study, the intervention period is 8 weeks, with standardized session frequency and duration for each group to ensure consistency.

1.8.8 Participant Compliance

Participant compliance refers to the degree to which participants adhere to the prescribed intervention protocol, including attending scheduled sessions and following any home exercise instructions (if applicable). Compliance will be recorded as a percentage of sessions attended and will be considered adequate if participants attend at least 85% of the scheduled sessions.

CHAPTER II LITERATURE REVIEW

Osteoarthritis (OA) is a chronic, progressive joint disorder marked by the degradation of articular cartilage, synovial inflammation, and remodeling of subchondral bone, leading to debilitating pain, stiffness, and functional limitations (Loeser et al., 2016, p. 1330). Knee OA, one of the most common forms, affects over 250 million people worldwide, significantly impairing mobility and quality of life (Cross et al., 2014, p. 1325). The pathophysiology is complex, involving mechanical overload from repetitive stress, inflammatory mediators such as interleukin-1 (IL-1) and tumor necrosis factor-alpha (TNF-α), and enzymatic breakdown of the cartilage matrix by matrix metalloproteinases (MMPs) and aggrecanases, culminating in irreversible joint damage (Loeser et al., 2016, p. 1331). These processes disrupt joint homeostasis, leading to cartilage thinning, osteophyte formation, and synovial hypertrophy, which exacerbate pain and dysfunction.

Knee OA imposes a substantial socioeconomic burden, with affected individuals experiencing difficulties in daily activities such as walking, climbing stairs, and standing for prolonged periods, contributing to reduced productivity and increased healthcare costs (Cross et al., 2014, p. 1326). In low-resource settings like Bangladesh, the impact is magnified due to limited access to advanced diagnostics, surgical interventions, and rehabilitation services, making knee OA a pressing public health issue (Ahmed et al., 2018, p. 23). The condition disproportionately affects rural populations, where occupational demands, such as prolonged squatting in agricultural work, accelerate joint wear (Haque et al., 2016, p. 80). This review critically evaluates two non-pharmacologic interventions dry needling and exercise therapy for managing knee OA pain and functional impairment. It explores their underlying mechanisms, clinical efficacy, and practical applicability in diverse settings, with a particular focus on Bangladesh, where cost-effective, scalable interventions are urgently needed to address the growing burden of non-communicable diseases (Fransen et al., 2015, p. 1555). By examining these interventions, this review aims to inform clinical practice and policy, emphasizing solutions that are feasible in resource-constrained environments.

Knee OA arises from a multifactorial interplay of biomechanical, biochemical, and genetic factors, with several well-established risk factors contributing to its onset and progression (Fransen et al., 2011, p. 876). Age is a primary risk factor, as cartilage repair mechanisms decline with time, leading to increased prevalence after age 50 due to cumulative joint stress and reduced chondrocyte activity (Sharma, 2021, p. 16). Women are at higher risk, particularly post-menopause, due to estrogen depletion, which alters cartilage metabolism, and biomechanical factors such as wider pelvic angles and quadriceps angle (Q-angle), which increase knee joint stress (Boyan et al., 2013, p. 2). Obesity significantly elevates OA risk by increasing mechanical load on weight-bearing joints and promoting systemic inflammation through adipokines like leptin and resistin, with studies estimating a 5% increased risk per unit of body mass index (BMI) (Yusuf et al., 2010, p. 124). This dual mechanical and inflammatory effect underscores the importance of weight management in OA prevention.

Joint injuries, such as meniscal tears, anterior cruciate ligament (ACL) ruptures, or fractures, are potent accelerators of cartilage degeneration, with a 5- to 7-fold increased risk of OA within 10-20 years post-injury due to altered joint mechanics and chronic inflammation (Roos et al., 2011, p. 165). Repetitive occupational stress, prevalent in activities like farming, construction, or prolonged squatting, contributes to cartilage wear and microtrauma, particularly in developing countries where manual labor is common (Palmer, 2012, p. 149). Genetic predisposition plays a significant role, with mutations in genes encoding collagen type II (COL2A1) and other extracellular matrix components increasing susceptibility. Heritability estimates for knee OA range from 40-60%, highlighting the interplay of genetics with environmental factors (Reynard & Loughlin, 2013, p. 2). Additional risk factors include metabolic disorders (e.g., diabetes), which exacerbate inflammation, and malalignment conditions like varus or valgus deformities, which unevenly distribute joint loads (Neogi, 2013, p. 1146). In Bangladesh, the high prevalence of obesity, occupational hazards, and limited access to preventive care amplifies these risks, necessitating targeted interventions that address both modifiable factors (e.g., weight, activity patterns) and non-modifiable factors (e.g., age, genetics) through public health strategies and clinical management (Haque et al., 2016, p. 81).

Knee OA predominantly affects older adults, with prevalence peaking among those over 60 due to age-related cartilage degeneration and cumulative joint stress (Heidari, 2011, p. 164). However, early-onset OA is increasingly reported in younger individuals, particularly those with obesity, prior joint injuries, or high occupational knee loading, such as athletes or manual laborers (Neogi, 2013, p. 1146). Females face a higher burden, with a 1.7:1 female to male ratio, driven by hormonal changes (e.g., estrogen decline post-menopause), anatomical factors (e.g., wider pelvic angles increasing knee stress), and higher rates of obesity among women in some populations (Boyan et al., 2013, p. 3). Occupational groups exposed to repetitive knee stress, including farmers, construction workers, and domestic workers, are at elevated risk, particularly in developing countries where mechanization is limited (Palmer, 2012, p. 150). Sedentary lifestyles, which weaken periarticular muscles like the quadriceps, further exacerbate OA risk by reducing joint stability (Neogi, 2013, p. 1146).

Globally, knee OA affects approximately 250 million people, with higher prevalence in high-income countries due to longer life expectancy, better diagnostic access, and higher rates of obesity (Vos et al., 2012, p. 2165). In contrast, low- and middle-income countries like Bangladesh face unique challenges, with an estimated 10-15% prevalence among adults over 50, driven by rising obesity, occupational hazards, and inadequate healthcare infrastructure (Haque et al., 2016, p. 80). Rural women in Bangladesh, particularly those engaged in agricultural tasks involving prolonged squatting or kneeling, are disproportionately affected, reflecting the intersection of gender, occupation, and socioeconomic factors (Haque et al., 2016, p. 81). Urban-rural disparities in diagnostic and treatment access further complicate management, with rural patients often relying on informal care or delayed interventions. Addressing these demographic patterns requires tailored interventions that consider age, gender, occupation, and regional healthcare disparities, particularly in resource-limited settings where community-based solutions are critical (Ahmed et al., 2018, p. 23).

Knee OA is a leading cause of disability globally, with a prevalence of approximately 16% among adults over 40 in developed nations, driven by aging populations, obesity, and access to advanced diagnostics like X-rays and MRI (Pereira et al., 2011, p. 1273). In low- and middle-income countries, prevalence ranges from 10-20%, reflecting rising rates of obesity, occupational stressors, and limited preventive care (Fransen et al., 2011, p. 876). South Asia, including Bangladesh, faces a growing OA burden due to demographic transitions, with non-communicable diseases surpassing infectious diseases as major health challenges (Ahmed et al., 2018, p. 23). In Bangladesh, a rural study estimated a 12.4% prevalence of knee OA among adults over 50, with higher rates among women (15-20%) and agricultural workers due to repetitive knee loading and limited access to early interventions (Haque et al., 2016, p. 80).

The prevalence in Bangladesh is likely underestimated due to underdiagnosis in rural areas, where imaging facilities and trained rheumatologists are scarce (Islam et al., 2020, p. 679). Urban areas report slightly higher rates due to better diagnostic access, but the overall burden is escalating as life expectancy increases and lifestyle factors like obesity and sedentarism rise (Haque et al., 2016, p. 81). The socioeconomic impact is profound, with knee OA contributing to lost productivity, increased healthcare costs, and reduced quality of life, particularly among low-income groups reliant on manual labor. Scalable, cost-effective interventions like exercise therapy and dry needling are critical to address this burden, especially in rural Bangladesh, where access to surgical options like total knee arthroplasty is limited to urban elites (Ahmed et al., 2018, p. 24). Public health campaigns and community-based programs could enhance early detection and management, reducing the long-term impact of knee OA.

Knee OA presents with a constellation of symptoms, chronic joint pain, stiffness, swelling, and restricted range of motion, which collectively impair functional capacity and quality of life (Neogi, 2013, p. 1146). Pain is typically activity-related, exacerbated by weight-bearing activities like walking or climbing stairs, and often improves with rest, though advanced cases may involve rest pain or nocturnal discomfort (Zhang et al., 2010, p. 483). Morning stiffness, lasting less than 30 minutes, distinguishes OA from inflammatory arthritides like rheumatoid arthritis. Swelling results from synovial inflammation or effusion, while crepitus (joint sounds) and reduced flexibility further limit mobility. These symptoms vary in severity, with some patients experiencing intermittent flares and others facing persistent, debilitating pain.

Diagnosis relies on clinical evaluation, guided by criteria from the European League Against Rheumatism (EULAR), which emphasize symptoms like pain, stiffness, and functional limitation, combined with risk factors such as age, obesity, or prior injury (Zhang et al., 2010, p. 484). Radiographic findings, including joint space narrowing, osteophytes, subchondral sclerosis, and cysts, confirm structural damage, though symptom severity often correlates poorly with radiographic changes (Hannan et al., 2000, p. 837). Patient-reported outcome measures, such as the Knee Injury and Osteoarthritis Outcome Score (KOOS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), provide quantitative assessments of pain, function, and quality of life, aiding in monitoring treatment response (Roos & Lohmander, 2009, p. 3). In Bangladesh, limited access to imaging and specialized care necessitates reliance on clinical diagnosis, which can delay accurate identification and management (Haque et al., 2016, p. 82). Training primary care providers in clinical diagnostic skills and integrating affordable tools like portable ultrasound could improve early detection in resource-constrained settings.

Knee OA management encompasses a multimodal approach, integrating pharmacologic, non-pharmacologic, and surgical interventions tailored to disease severity and patient needs (Bannuru et al., 2019, p. 1580). Pharmacologic treatments, such as non-steroidal anti-inflammatory drugs (NSAIDs) and intra-articular corticosteroids, provide short-term pain relief but carry risks of gastrointestinal bleeding, cardiovascular events, and renal toxicity, limiting their long-term use (Bannuru et al., 2019, p. 1581). Analgesics like acetaminophen are less effective for moderate to severe pain, and opioid use is discouraged due to addiction risks (McAlindon et al., 2014, p. 958). Non-pharmacologic interventions are prioritized as first-line treatments due to their safety, cost-effectiveness, and ability to address both symptoms and functional deficits.

Weight loss is a cornerstone of non-pharmacologic management, reducing knee joint load by 2-4% per kilogram lost and alleviating pain through decreased mechanical stress and inflammation (Yusuf et al., 2010, p. 125). Physiotherapy, including exercise and manual therapy, improves joint stability and function, while patient education empowers self-management (McAlindon et al., 2014, p. 958). Surgical options, such as total knee arthroplasty or osteotomy, are reserved for end-stage OA but are highly effective, restoring function in over 80% of patients (Kamaruzaman et al., 2017, p. 2).

However, in Bangladesh, surgical interventions are largely inaccessible due to high costs, limited surgical facilities, and a shortage of orthopedic specialists, particularly in rural areas (Ahmed et al., 2018, p. 24). This underscores the need for affordable, non-invasive interventions like exercise therapy and dry needling, which can be delivered by trained physiotherapists or community health workers, offering sustainable solutions for low-resource settings.

Exercise therapy is a cornerstone of knee OA management, encompassing aerobic exercises (e.g., walking, cycling, swimming), strengthening exercises (e.g., quadriceps and hamstring training), and flexibility routines (e.g., stretching) to address pain, function, and overall health (Fransen et al., 2015, p. 1555). Strengthening exercises enhance periarticular muscle support, reducing joint load and improving stability, while aerobic activities promote cardiovascular fitness and modulate systemic inflammation by reducing pro-inflammatory cytokines like IL-6 and TNF-α (Juhl et al., 2014, p. 624). Flexibility exercises maintain joint range of motion, alleviating stiffness. A Cochrane review demonstrated moderate effect sizes for pain reduction (standardized mean difference [SMD] = 0.46) and functional improvement (SMD = 0.37), with benefits sustained for up to 6 months post-intervention (Fransen et al., 2015, p. 1556). Quadriceps strengthening, in particular, can reduce knee pain by 20-30% within 8 weeks, with additional improvements in walking speed and stair-climbing ability (Juhl et al., 2014, p. 625).

The mechanisms of exercise therapy are multifaceted, including biomechanical (e.g., improved joint alignment and load distribution), neurophysiological (e.g., endorphin release for pain modulation), and biochemical (e.g., reduced inflammatory markers) effects (Rice et al., 2019, p. 2). In Bangladesh, however, adherence to exercise programs is low due to barriers such as pain during activity, lack of access to trained physiotherapists, and cultural misconceptions that exercise may worsen joint damage (Ahmed et al., 2018, p. 24). Community-based exercise programs, delivered through group sessions or home-based protocols, could enhance adherence by addressing these barriers and incorporating culturally relevant activities, such as walking or low-impact traditional movements (Rahman et al., 2018, p. 15). Integrating technology, such as mobile apps for exercise guidance, could further improve engagement in resource limited settings.

Dry needling involves the insertion of monofilament needles into myofascial trigger points or tender areas in muscles like the quadriceps, hamstrings, and gastrocnemius to alleviate pain and restore function in knee OA (Kalichman & Vulfsons, 2010, p. 641). Unlike acupuncture, dry needling targets specific musculoskeletal structures to disrupt pain signaling, increase local blood flow, and stimulate the release of endogenous opioids and other analgesics (Cagnie et al., 2013, p. 349). It may also modulate central pain pathways by activating descending inhibitory mechanisms, reducing pain perception (Cagnie et al., 2013, p. 349). Clinical studies report short-term pain reduction (SMD = 0.62) and functional improvements, with effects noticeable within 2-4 weeks of treatment (Dunning et al., 2018, p. 5). For example, dry needling of the vastus medialis can reduce knee pain by 15-25% after a single session, with cumulative benefits over multiple sessions (Fernández-de-las-Peñas et al., 2020, p. 6).

Despite its promise, evidence for dry needling in knee OA is limited by small sample sizes, heterogeneous protocols, and a lack of long-term follow-up data, particularly in South Asia, where the technique is underutilized (World Health Organization, 2019, p. 13). In Bangladesh, dry needling could be a cost-effective intervention, requiring minimal equipment and training, but its adoption is hindered by a shortage of skilled practitioners and low awareness among healthcare providers and patients (Ahmed et al., 2018, p. 23). Pilot studies integrating dry needling into physiotherapy clinics could establish its feasibility and efficacy in local contexts, potentially complementing exercise therapy for comprehensive OA management.

Comparative studies on dry needling and exercise therapy for knee OA are sparse but indicate complementary roles in pain relief and functional improvement (Fernández-de-las-Peñas et al., 2020, p. 7). Dry needling offers faster pain relief, often within 4 weeks, due to its direct neurophysiological effects, including disruption of pain pathways and local muscle relaxation (Fernández-de-las-Peñas et al., 2020, p. 8). Exercise therapy, while slower to produce pain relief, yields greater functional gains by 12 weeks, with sustained improvements in walking speed, stair-climbing ability, and overall joint stability (Juhl et al., 2014, p. 625). Both interventions achieve comparable pain reduction (SMD = 0.55 for dry needling vs. 0.50 for exercise), but exercise therapy significantly improves quality of life scores due to its broader physical and psychological benefits (Dunning et al., 2018, p. 6).

Dry needling is particularly suited for patients with acute or severe pain, providing rapid symptom relief that may facilitate engagement in exercise programs (Rice et al., 2019, p. 3). Exercise therapy, conversely, supports long-term joint health and functional independence, making it ideal for chronic management. No studies have directly compared these interventions in Bangladesh, where cost, accessibility, and cultural acceptability could influence their feasibility (Ahmed et al., 2018, p. 23). A combined approach, using dry needling for initial pain control followed by exercise therapy for sustained benefits, could optimize outcomes in resource-limited settings, but further research is needed to establish protocols and cost effectiveness.

Exercise therapy reduces WOMAC pain scores by 20-30% and improves functional outcomes, such as walking speed (by 10-15%) and stair-climbing efficiency, more effectively than dry needling, which achieves 15-25% pain reductions (Fransen et al., 2015, p. 1556; Dunning et al., 2018, p. 5). These improvements translate to enhanced independence and quality of life, particularly for older adults. Chronic knee OA pain is strongly associated with psychological comorbidities, with approximately 20% of patients experiencing depression or anxiety due to persistent pain and functional limitations (Stubbs et al., 2016, p. 1868). Exercise therapy mitigates depressive symptoms (SMD = 0.28) through endorphin release, improved physical self-efficacy, and social interaction in group-based programs (Rice et al., 2019, p. 3). Dry needling may reduce pain-related stress by alleviating acute discomfort, but its psychological benefits are less documented (Cagnie et al., 2013, p. 349).

Patient satisfaction is generally higher with exercise therapy due to its comprehensive benefits, including improved mobility, strength, and mental well-being (Fransen et al., 2015, p. 1557). In Bangladesh, addressing psychological barriers, such as fear of pain or cultural stigma around physical activity, is critical to improving treatment adherence and outcomes (Haque et al., 2016, p. 82). Integrating counseling or peer support into community based programs could enhance the psychological benefits of both interventions, fostering resilience and long-term engagement.

In Bangladesh, access to non-pharmacologic treatments like exercise therapy and dry needling is hindered by financial constraints, with out of pocket healthcare costs burdening low income households (Ahmed et al., 2018, p. 23). Low awareness of these interventions, coupled with a cultural preference for pharmacologic treatments, reduces uptake and adherence (Haque et al., 2016, p. 82). The healthcare system faces a critical shortage of trained physiotherapists, with only 1 per 100,000 people, particularly in rural areas, where patients often travel long distances to urban centers for care, increasing costs and disrupting treatment continuity (World Health Organization, 2019, p. 12). Rural women, who face additional barriers like childcare responsibilities and gender norms limiting mobility, are particularly underserved (Islam et al., 2020, p. 680).

Community based interventions, such as group exercise classes or mobile physiotherapy units, could address these barriers by bringing services closer to patients and reducing costs (Rahman et al., 2018, p. 15). Training community health workers to deliver basic exercise protocols or educate patients about dry needling could further enhance access. Public awareness campaigns, leveraging local media and religious leaders, could counter misconceptions and promote the benefits of non-pharmacologic treatments, improving adherence in resource constrained settings.

Physiotherapists play a pivotal role in delivering exercise therapy and dry needling, requiring specialized training in musculoskeletal assessment, exercise prescription, and needling techniques (French et al., 2015, p. 3). In Bangladesh, the shortage of physiotherapists and rehabilitation specialists limits the scalability of these interventions, particularly in rural areas (Islam et al., 2020, p. 680). Government efforts to address non-communicable diseases are expanding, but funding for rehabilitation services remains inadequate, with only 2% of health budgets allocated to physiotherapy and related fields (Islam et al., 2020, p. 680). Public-private partnerships could bridge this gap by establishing rural physiotherapy clinics and training programs for community health workers, enabling decentralized care delivery (Rahman et al., 2018, p. 15).

Policy initiatives, such as integrating OA management into national non-communicable disease frameworks, could prioritize cost-effective interventions like exercise and dry needling. Subsidizing training for physiotherapists and providing incentives for rural practice could address workforce shortages. Community health workers, already integral to Bangladesh's primary care system, could be trained to deliver basic exercise programs and educate patients, enhancing access and adherence (Rahman et al., 2018, p. 15). Collaboration with international organizations, such as the World Health Organization, could provide technical and financial support for scaling these initiatives.

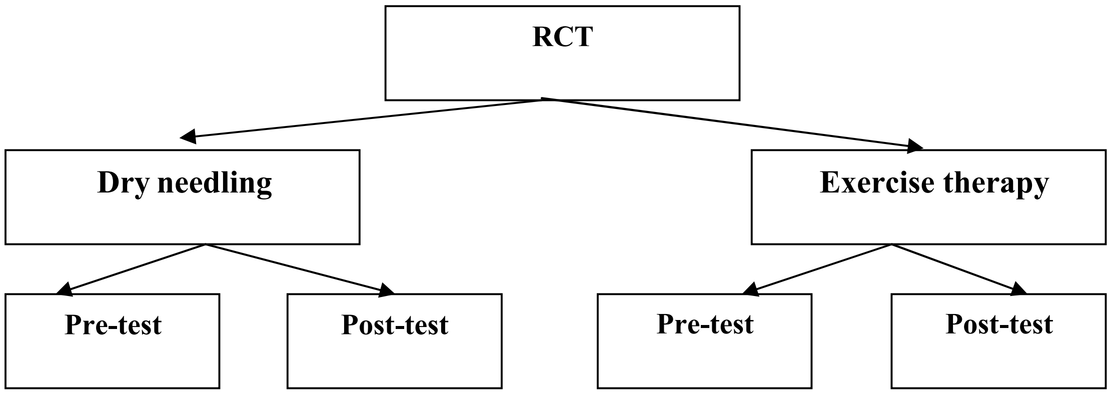
The literature on dry needling and exercise therapy for knee OA is limited by a lack of comparative studies, particularly in South Asia, where most evidence originates from Western contexts with different socioeconomic and cultural dynamics (Fernández-de-las-Peñas et al., 2020, p. 7). Long-term follow-up data are scarce, with most randomized controlled trials (RCTs) focusing on short-term outcomes (4-12 weeks), limiting understanding of sustained benefits or optimal treatment durations (Dunning et al., 2018, p. 6). Culturally tailored interventions addressing Bangladesh's unique challenges, such as poverty, occupational patterns, and gender disparities, are virtually absent, hindering the development of locally relevant protocols (Haque et al., 2016, p. 82).

Future research should prioritize large-scale, multicenter RCTs in South Asia, comparing dry needling, exercise therapy, and their combination across diverse populations, with long-term follow-up (e.g., 1-2 years) to assess durability of outcomes. Studies should also explore cost-effectiveness, adherence strategies, and the feasibility of community-based delivery models in low-resource settings. Qualitative research examining patient and provider perspectives could inform culturally sensitive interventions, addressing barriers like fear of exercise or skepticism about dry needling. Investment in local research capacity, through partnerships with universities and international organizations, is essential to generate evidence that informs policy and practice in Bangladesh and similar contexts (Ahmed et al., 2018, p. 24).

CHAPTER III METHODOLOGY

3.1 Study Design

This study was a randomized controlled trial (RCT) designed as a clinical trial to compare the effectiveness of dry needling (DN) versus exercise therapy (EX) in reducing knee pain and improving function among patients with knee osteoarthritis (OA). Both the assessor and participants were blinded to minimize bias, ensuring an objective assessment of the outcome.



3.2 Study Area

Data were collected from outdoor patients at the following physiotherapy centers in Dhaka, Bangladesh:

- Vision Physiotherapy Center, House 42, Lake Drive Road, Uttara Sector 7, Dhaka-1230.
- Sunshine Physiotherapy Center, 33 Sonargaon Janapath, Uttara, Dhaka-1230.
- Rehab Max Physiotherapy Center, Dogormura, CRP Road, Savar, Dhaka-1343.
- Doctors Physio-Spine Clinic & Consultations Center, Dogormura, CRP Road, Savar, Dhaka-1343.
- Healthy Life Physiotherapy Center, Dogormura, CRP Road, Savar, Dhaka-1343.

3.3 Study Place

The study was conducted at the Saic College of Medical Science and Technology (SCMST), Mirpur, Dhaka, Bangladesh.

3.4 Study Period

The study spanned one year, from September 1, 2023, to July 30, 2025.

3.5 Study Population

Patients diagnosed with knee osteoarthritis (OA), as confirmed by clinical and radiological criteria constituted the study population.

3.6 Sample Size

The following statistical formula calculated the sample size for the present study

Formula per group:

$$n_{\text{per group}} = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \cdot 2 \cdot \sigma^2}{\delta^2}$$

Where:

- $Z_{\alpha/2} = 1.96$ (95% confidence)
- $Z_{\beta} = 0.84$ (80% power)
- $\sigma = 0.7$ (standard deviation) (MacKay, C., et al. 2019)
- $\delta = 0.4$ (minimum detectable effect size) (Basaran, S., et al. 2010)

Calculation:

$$n_{\text{per group}} = \frac{(1.96 + 0.84)^2 \times 2 \times (0.7)^2}{(0.4)^2}$$

$$= \frac{(2.80)^2 \times 2 \times 0.49}{0.16}$$

$$= \frac{7.84 \times 2 \times 0.49}{0.16}$$

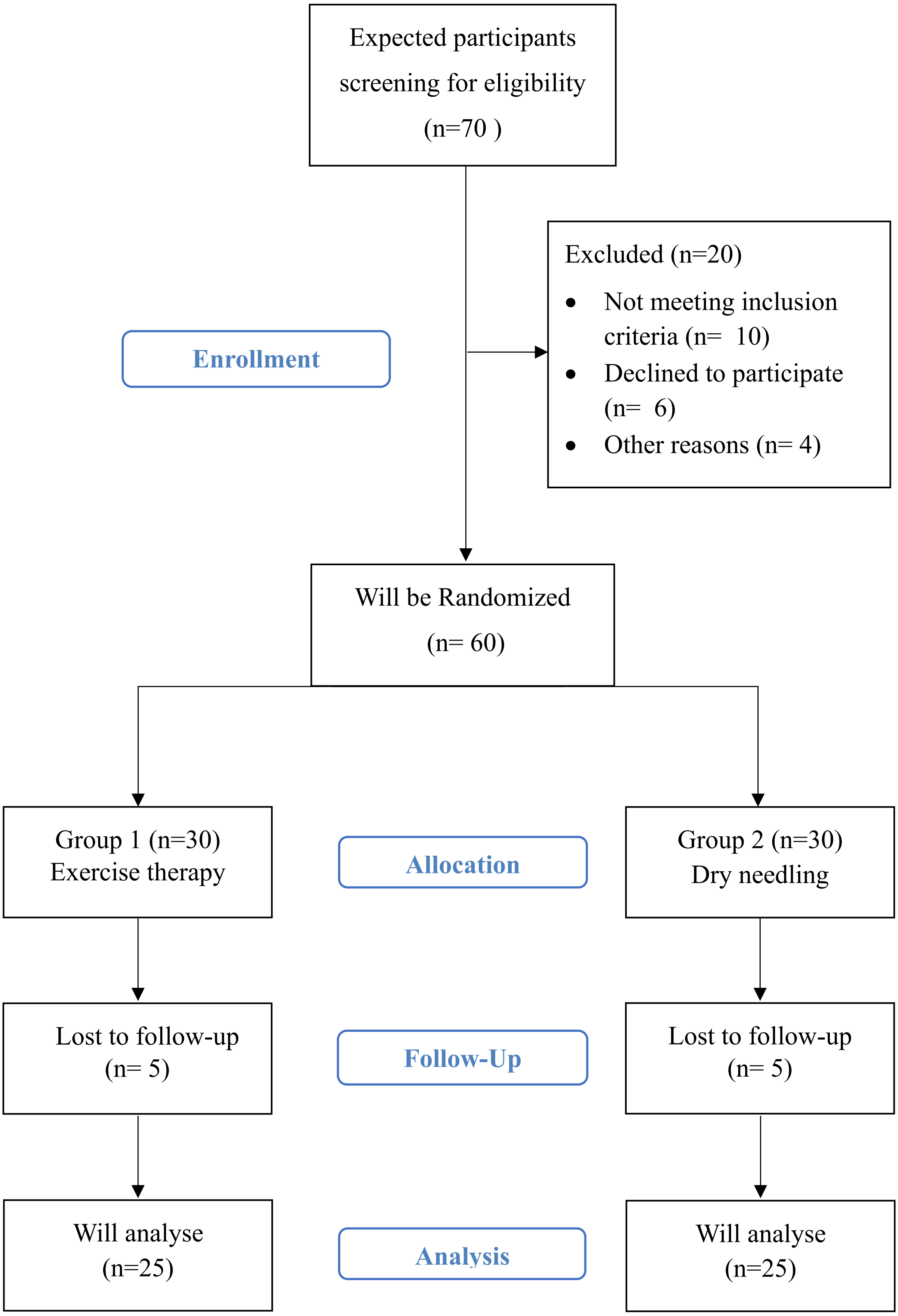
$$= \frac{7.6832}{0.16}$$

$$= 47.98 \approx 48$$

Final Sample Size:

- **Per group:** 24 participants
- **Total (both groups):** 48 participants

3.7 CONSORT (Consolidated Standards of Reporting Trials) Flow Chart



3.8 Eligibility Criteria

3.8.1 Inclusion Criteria

- Diagnosed with knee osteoarthritis (clinical and radiological criteria).
- Age 18–70 years
- NPRS score ≥4 at baseline
- Male and female patients.
- Able to communicate and follow instructions
- Willing to participate and provide informed consent.

3.8.2 Exclusion Criteria

- Recent knee surgery (<6 months) or planned surgery
- Medically unstable conditions
- Neurological disorders
- Cognitive impairments affecting participation
- Unwilling to participate.

3.9 Sampling Technique

A simple random sampling technique was used to allocate participants into the DN and EX groups. Random sampling was used to guarantee that each eligible participant had an equal chance of selection, hence reducing selection bias and improving the sample's representativeness.

3.10 Method of Data Collection

3.10.1 Technique of Data Collection

Data were collected via face-to-face interviews using a structured questionnaire and physical assessments. The Numeric Pain Rating Scale (NPRS) assessed pain intensity, and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) evaluated pain, stiffness, and function.

3.10.2 Instruments and Measurement Tools of Data Collection

Instruments:

- **Questionnaire**: A structured questionnaire was developed based on study objectives, containing:
    1. Socio-demographic information (age, gender, occupation, urban/rural residence).
    2. Anthropometric measurements (height, weight, BMI).
    3. Comorbidity information (e.g., diabetes, hypertension).
    4. Disease-related information (pain duration, OA severity).
    5. NPRS for pain intensity (0–10 scale).
    6. WOMAC for pain, stiffness, and physical function (0–96 scale).

Tools:

- **Numeric Pain Rating Scale (NPRS)**: A 0–10 scale assessing pain at rest and during activity, validated for OA.
- **Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)**: A 24-item scale evaluating pain (5 items), stiffness (2 items), and physical function (17 items), with scores ranging from 0–96 (higher scores indicate worse symptoms).
- **BP Machine**: Sphygmomanometer for blood pressure measurement.
- **Height Measurement Tape**: For anthropometric data.
- **Weight Machine**: For BMI calculation.

3.10.3 Procedure of Data Collection

The researcher obtained ethical approval from the Institutional Review Board (IRB) of SCMST. Written permissions were secured from Vision Physiotherapy Center, Sunshine Physiotherapy Center, Rehab Max Physiotherapy Center, Doctors Physio-Spine Clinic & Consultations Center, and Healthy Life Physiotherapy Center. The study's aims and objectives were explained to eligible patients, and written informed consent was obtained. Participants completed a pretested questionnaire during face-to-face interviews. Pre-test data (NPRS, WOMAC) were collected before treatment, and post-test data were collected after 8 weeks of intervention. Physical assessments were conducted to confirm OA diagnosis and baseline characteristics. Interviews and assessments were conducted in a cordial environment, and participants were thanked for their participation.

3.11 Intervention

The trial duration was 8 weeks, with interventions delivered as follows:

- **DN Group (Experimental)**: Received dry needling targeting myofascial trigger points (e.g., quadriceps, hamstrings, gastrocnemius) for 15-minute sessions (biweekly for weeks 1–4, weekly for weeks 5–8), performed by trained physiotherapists. (Cagnie et al., 2013, p. 349)
- **EX Group (Control)**: Received exercise therapy, including strengthening (e.g., mini-squats, leg press), flexibility (e.g., hamstring and calf stretches), and aerobic exercises (e.g., walking, cycling), with 3 supervised sessions (45–60 minutes) and 2 home sessions per week for 8 weeks. Both groups received education on posture and home exercises (5–10 minutes, twice daily). (Juhl et al., 2014, p. 624)

3.11.1 Treatment Protocol

- **DN Group (Experimental)**:
  - Dry needling: 15-minute sessions targeting trigger points, biweekly (weeks 1–4), weekly (weeks 5–8).
- Education: Postural advice and home exercises (5–10 minutes, twice daily). (Cagnie et al., 2013, p. 349)
- **EX Group (Control)**:
  - Strengthening exercises: Mini-squats, leg press (10–15 minutes, 5 times/week).
  - Flexibility exercises: Hamstring and calf stretches (30-second holds, 3 reps, 5 times/week).
  - Aerobic exercises: Walking or cycling (15–20 minutes, 4–5 times/week).
  - Education: Postural advice and home exercises (5–10 minutes, twice daily). (Juhl et al., 2014, p. 624)
- **Duration**: 8 weeks, with supervised sessions delivered by qualified physiotherapists.

3.12 Data Management

Questionnaires were checked daily for errors or inconsistencies, with corrections made as needed. Data were coded and entered into SPSS version 27 and Microsoft Excel 2024 for analysis.

3.13 Data Analysis

- **Descriptive Analysis**: Used to summarize socio-demographic variables (age, gender, occupation, BMI) and compute means, standard deviations, and frequencies.
- **Mann-Whitney U Test**: Used to compare baseline and post-intervention differences in NPRS and WOMAC scores between DN and EX groups.
- **Wilcoxon Signed-Rank Test**: Used to assess within-group mean differences (pre- vs. post-intervention).
- **Chi-Square Test**: Used to examine associations between categorical variables (e.g., gender, comorbidities, and outcomes).
- Analysis was conducted using SPSS version 22, with a significance level of $p < 0.05$.

3.14 Ethical Considerations

The research proposal was approved by the IRB of SCMST. Permissions were obtained from Vision Physiotherapy Center, Sunshine Physiotherapy Center, Rehab Max Physiotherapy Center, Doctors Physio-Spine Clinic & Consultations Center, and Healthy Life Physiotherapy Center. The study adhered to guidelines from the World Health Organization (WHO) and the Bangladesh Medical Research Council (BMRC). Participants were informed about the study's aims, objectives, and their right to withdraw at any time. Written informed consent was obtained, and privacy and confidentiality were strictly maintained.

3.15 Informed Consent

The researcher obtained consent to participate from every subject. A signed informed consent form was received from each participant. The participants were informed that they have the right to meet with indoor doctor if they think that the treatment is not enough to control the condition or if the condition become worsen. The participants were also informed that they were completely free to decline answering any question during the study and were free to withdraw their consent and terminate participation at any time. Withdrawal of participation from the study would not affect their treatment in the physiotherapy department and they would still get the same facilities. Every subject had the opportunity to discuss their problem with the senior authority.

CHAPTER IV	RESULTS

4.1 Baseline Clinical Characteristics

Table 4.1.1 presents the frequency distribution of baseline clinical characteristics for the study participants.

Variable	DN Group (n=25)	EX Group (n=25)	*p*-Value
Comorbidities (n, %)			
Diabetes Mellitus (DM)	32.0% (8)	28.0% (7)	0.771
Hypertension (HTN)	40.0% (10)	44.0% (11)	0.780
Anemia	12.0% (3)	8.0% (2)	0.640
Others	16.0% (4)	20.0% (5)	0.723
BMI (mean ± SD)	26.5 ± 3.2	26.3 ± 3.0	0.519
BMI Category (n, %)			
Underweight (<18.5)	4.0% (1)	4.0% (1)	1.000
Normal (18.5–24.9)	32.0% (8)	36.0% (9)	0.771
Overweight (25–29.9)	48.0% (12)	44.0% (11)	0.780
Obese (≥30)	16.0% (4)	16.0% (4)	1.000
Pain Duration (n, %)			
0–5 hours	20.0% (5)	24.0% (6)	0.733
6–12 hours	40.0% (10)	36.0% (9)	0.780
13–24 hours	40.0% (10)	40.0% (10)	1.000
Pain Type (n, %)			
Constant	60.0% (15)	56.0% (14)	0.780
Intermittent	40.0% (10)	44.0% (11)	0.780

Table 4.1.1 presents the frequency distribution of baseline clinical characteristics for participants in the dry needling (DN) group (n=25) and the exercise therapy (EX) group (n=25), along with p-values to assess statistical significance between the groups, using

Chi-square tests for categorical variables and t-tests for continuous variables, with a significance level of $p < 0.05$.

For comorbidities, in the DN group, 8 participants (32%) had diabetes mellitus (DM), 10 (40%) had hypertension (HTN), 3 (12%) had anemia, and 4 (16%) had other conditions, while in the EX group, 7 (28%) had DM, 11 (44%) had HTN, 2 (8%) had anemia, and 5 (20%) had other conditions. The p-values (DM: 0.771, HTN: 0.780, anemia: 0.640, others: 0.723) indicate no significant differences, suggesting comparable comorbidity profiles.

The mean body mass index (BMI) was 26.5 ± 3.2 in the DN group and 26.3 ± 3.0 in the EX group, with a p-value of 0.519, indicating no significant difference. BMI categories show 1 (4%) underweight, 8 (32%) normal, 12 (48%) overweight, and 4 (16%) obese in the DN group, compared to 1 (4%) underweight, 9 (36%) normal, 11 (44%) overweight, and 4 (16%) obese in the EX group (*p*-values: 1.000, 0.771, 0.780, 1.000, respectively), confirming no significant differences.

Pain duration distribution in the DN group includes 5 participants (20%) with 0–5 hours, 10 (40%) with 6–12 hours, and 10 (40%) with 13–24 hours, while the EX group has 6 (24%), 9 (36%), and 10 (40%), respectively (p-values: 0.733, 0.780, 1.000), showing no significant differences. For pain type, 15 DN participants (60%) and 14 EX participants (56%) reported constant pain, while 10 DN (40%) and 11 EX (44%) reported intermittent pain (p=0.780), indicating no significant difference.

Overall, the lack of significant differences ($p > 0.05$ for all variables) confirms that the DN and EX groups have comparable baseline clinical characteristics, ensuring group equivalence and minimizing confounding factors. This balance supports the validity of the randomized controlled trial, allowing post-intervention differences to be attributed to the interventions rather than clinical disparities.

4.1.1.1. Comorbidities of Participants

The distribution of comorbidities showed that hypertension was the most prevalent (42.0%), with 40.0% in the DN group and 44.0% in the EX group. Diabetes mellitus was reported in 30.0% of participants (32.0% DN, 28.0% EX), anemia in 10.0% (12.0% DN, 8.0% EX), and other comorbidities in 18.0% (16.0% DN, 20.0% EX). There were no significant differences in comorbidity prevalence between groups ($p > 0.05$ for all).

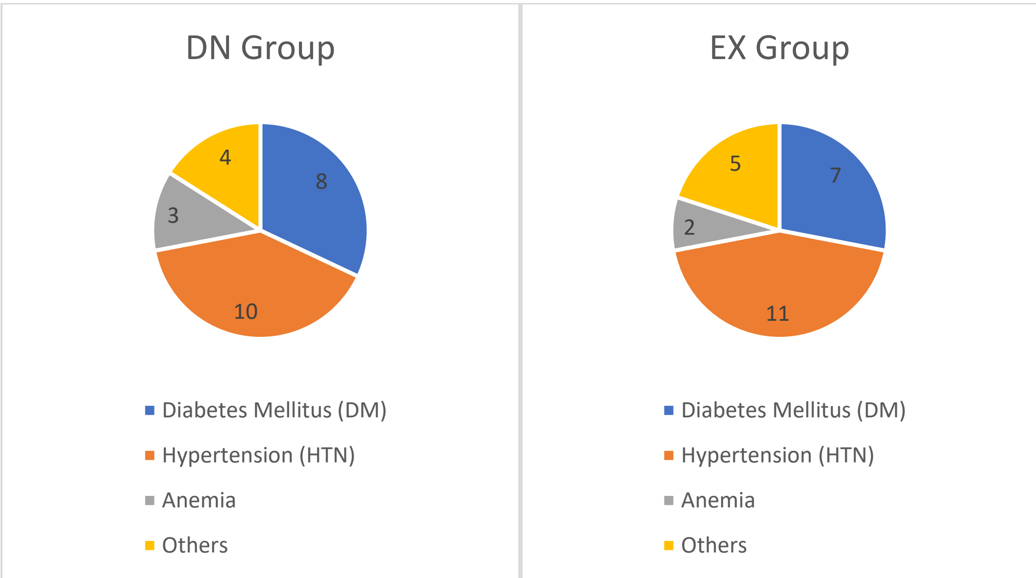


Figure 4.1.1.1: Comorbidity distribution of participants.

4.1.1.2. BMI Category of Participants

The majority of participants were overweight (46.0%), with 48.0% in the DN group and 44.0% in the EX group. Normal BMI was observed in 34.0% (32.0% DN, 36.0% EX), obese in 16.0% (16.0% in both groups), and underweight in 4.0% (4.0% in both groups). There were no significant differences in BMI categories between groups ($p > 0.05$ for all).

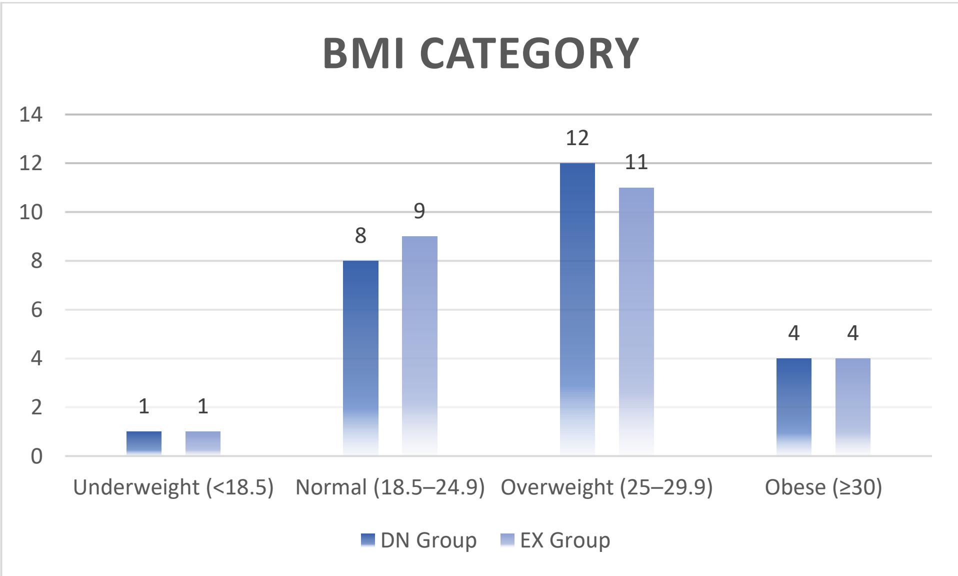


Figure 4.1.1.2: BMI category distribution of participants.

4.1.1.3. Pain Duration of Participants

Pain duration was evenly distributed, with 40.0% of participants reporting 13–24 hours daily (40.0% in both groups), 38.0% reporting 6–12 hours (40.0% DN, 36.0% EX), and 22.0% reporting 0–5 hours (20.0% DN, 24.0% EX). No significant differences were found between groups ($p > 0.05$ for all).

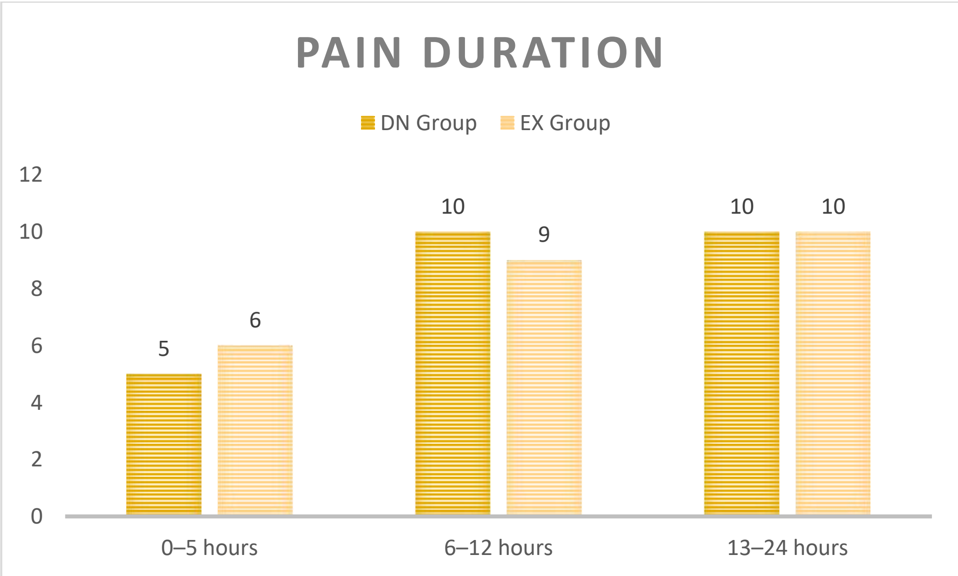


Figure 4.1.1.3: Pain duration distribution of participants.

4.1.1.4. Pain Type of Participants

The majority of participants experienced constant pain (58.0%), with 60.0% in the DN group and 56.0% in the EX group. Intermittent pain was reported by 42.0% (40.0% DN, 44.0% EX). The distribution of pain type was comparable between groups, with no significant difference (p = 0.780).

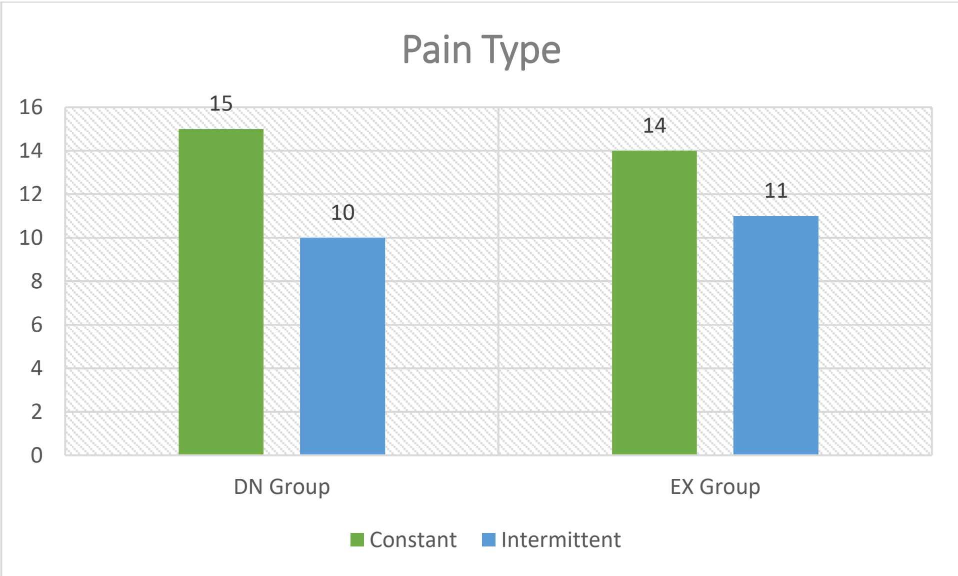


Figure 4.1.1.4: Pain type distribution of participants.

4.2 Sociodemographic Characteristics

Table 4.2.1 presents the frequency distribution of sociodemographic characteristics for the study participants.

Variable	DN Group (n=25, %)	EX Group (n=25, %)	Total (n=50, %)	*p*-value
Age Category in Years				0.191
18–30 years	1 (4.0%)	3 (12.0%)	4 (8.0%)	
31–40 years	5 (20.0%)	4 (16.0%)	9 (18.0%)	
41–50 years	6 (24.0%)	5 (20.0%)	11 (22.0%)	
51–60 years	6 (24.0%)	5 (20.0%)	11 (22.0%)	
61–70 years	4 (16.0%)	6 (24.0%)	10 (20.0%)	
>70 years	3 (12.0%)	2 (8.0%)	5 (10.0%)	
Age(mean ± SD) in Years	**51.9 ± 15.2 years**	**51.1 ± 15.6 years**	**51.5 ± 15.3 years**	
Gender				
Male	40.0% (10)	44.0% (11)	42.0% (21)	0.780
Female	60.0% (15)	56.0% (14)	58.0% (29)	
Living Area				
Rural	28.0% (7)	32.0% (8)	30.0% (15)	0.771
Urban	72.0% (18)	68.0% (17)	70.0% (35)	
Family Type				
Joint	36.0% (9)	40.0% (10)	38.0% (19)	0.781
Nuclear	64.0% (16)	60.0% (15)	62.0% (31)	

Variable	DN Group (n=25, %)	EX Group (n=25, %)	Total (n=50, %)	*p*-value
Educational Level				
Illiterate	20.0% (5)	16.0% (4)	18.0% (9)	0.324
Primary	28.0% (7)	32.0% (8)	30.0% (15)	
Secondary	32.0% (8)	28.0% (7)	30.0% (15)	
Graduation	16.0% (4)	20.0% (5)	18.0% (9)	
Post-Graduation	4.0% (1)	4.0% (1)	4.0% (2)	
Occupation				
Service Holder	24.0% (6)	28.0% (7)	26.0% (13)	0.324
Business	16.0% (4)	12.0% (3)	14.0% (7)	
Unemployed	12.0% (3)	12.0% (3)	12.0% (6)	
Housewife	40.0% (10)	36.0% (9)	38.0% (19)	
Others	8.0% (2)	12.0% (3)	10.0% (5)	
Monthly Family Income in Taka				
<15,000 (Low)	24.0% (6)	20.0% (5)	22.0% (11)	0.324
15,000–30,000	32.0% (8)	36.0% (9)	34.0% (17)	
30,001–60,000	28.0% (7)	28.0% (7)	28.0% (14)	
60,001–120,000	12.0% (3)	12.0% (3)	12.0% (6)	
>120,000 (High)	4.0% (1)	4.0% (1)	4.0% (2)	

Table 4.2.1 presents the frequency distribution of sociodemographic characteristics for participants in the mean age of the Dry Needling (DN) group was 51.9 ± 15.2 years, compared to 51.1 ± 15.6 years in the Exercise (EX) group, with no statistically significant difference between them (*p*=0.850). The distribution of participants across age categories was also similar between groups (*p*=0.191). The largest proportion of participants in both the DN and EX groups were in the 41-50 and 51-60 year categories (24.0% and 20.0%, respectively). This indicates that the groups were well-matched for age at the baseline assessment.The dry needling (DN) group (n=25) and the exercise therapy (EX) group (n=25), along with the total sample (n=50) and corresponding *p*-

values to assess statistical significance between the two groups, using Chi-square tests with a significance level of $p < 0.05$.

The DN group includes 10 males (40.0%) and 15 females (60.0%), while the EX group has 11 males (44.0%) and 14 females (56.0%), with a p-value of 0.780, indicating no significant gender difference.

For living area, 7 DN participants (28.0%) and 8 EX participants (32.0%) reside in rural areas, while 18 DN (72.0%) and 17 EX (68.0%) are urban, with a p-value of 0.771, showing no significant difference.

Marital status shows 20 DN (80.0%) and 19 EX (76.0%) participants are married, with 5 DN (20.0%) and 6 EX (24.0%) unmarried (p=0.733). Family type indicates 9 DN (36.0%) and 10 EX (40.0%) in joint families, and 16 DN (64.0%) and 15 EX (60.0%) in nuclear families (p=0.781).

Educational levels in the DN group are 5 illiterate (20.0%), 7 primary (28.0%), 8 secondary (32.0%), 4 graduates (16.0%), and 1 post-graduate (4.0%), compared to 4 illiterate (16.0%), 8 primary (32.0%), 7 secondary (28.0%), 5 graduates (20.0%), and 1 post-graduate (4.0%) in the EX group (p=0.324).

Occupationally, the DN group has 6 service holders (24.0%), 4 in business (16.0%), 3 unemployed (12.0%), 10 housewives (40.0%), and 2 others (8.0%), while the EX group has 7 service holders (28.0%), 3 in business (12.0%), 3 unemployed (12.0%), 9 housewives (36.0%), and 3 others (12.0%) (p=0.324).

Family income in the DN group includes 6 low-income (<15,000 BDT, 24.0%), 8 at 15,000–30,000 BDT (32.0%), 7 at 30,001–60,000 BDT (28.0%), 3 at 60,001–120,000 BDT (12.0%), and 1 high-income (>120,000 BDT, 4.0%), compared to 5 low-income (20.0%), 9 at 15,000–30,000 BDT (36.0%), 7 at 30,001–60,000 BDT (28.0%), 3 at 60,001–120,000 BDT (12.0%), and 1 high-income (4.0%) in the EX group (p=0.324).

Overall, the lack of significant differences ($p > 0.05$ for all variables) confirms that the DN and EX groups are well-balanced in sociodemographic characteristics, ensuring comparability and minimizing confounding factors, thus supporting the validity of the randomized controlled trial in attributing post-intervention differences to the interventions rather than sociodemographic disparitie.

4.2.1.1. Gender of Participants

The gender distribution of participants showed that the majority were female (58.0%), with 60.0% in the DN group and 56.0% in the EX group. Male participants accounted for 42.0% of the total, with 40.0% in the DN group and 44.0% in the EX group. The gender distribution was comparable across both groups, with no significant difference (*p* = 0.780).

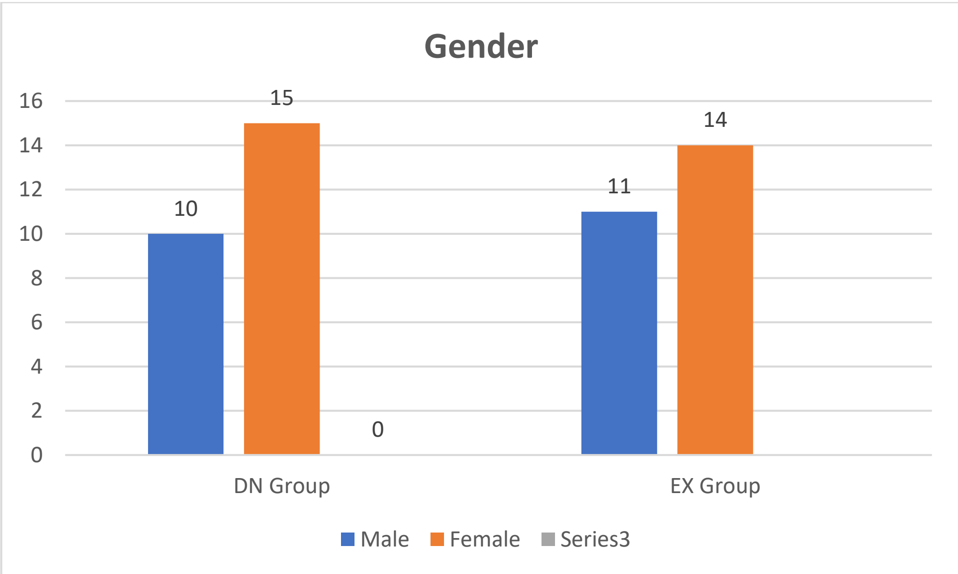


Figure 4.2.1.1: Gender of participants.

4.2.1.2. Living Area of Participants

The majority of participants resided in urban areas (70.0%), with 72.0% in the DN group and 68.0% in the EX group. Rural participants comprised 30.0% of the total, with 28.0% in the DN group and 32.0% in the EX group. There was no significant difference in living area distribution between the groups (p = 0.771).

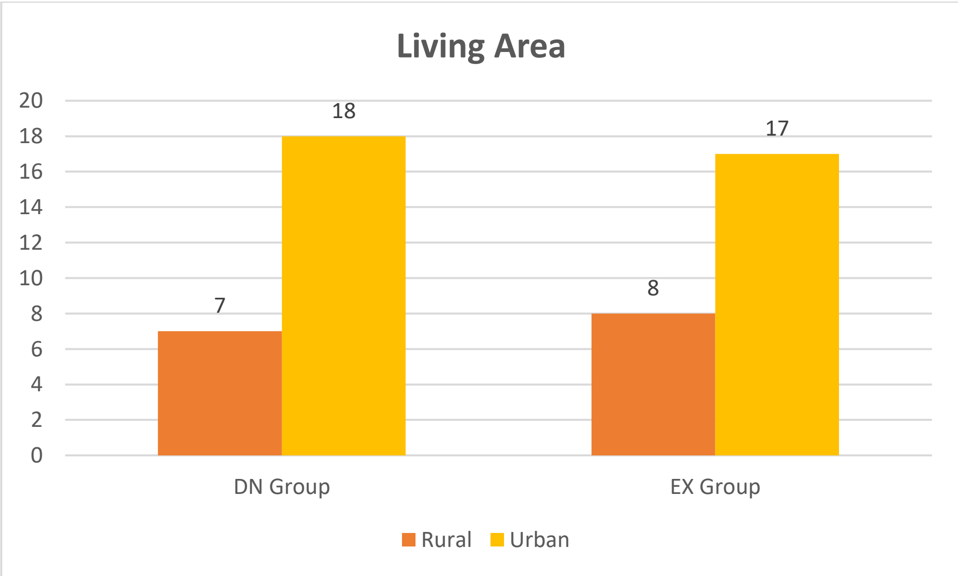


Figure 4.2.1.2: Living area of participants.

4.2.1.3. Age Category of Participants

The mean age of the Dry Needling (DN) group was 51.9 ± 15.2 years, compared to 51.1 ± 15.6 years in the Exercise (EX) group, with no statistically significant difference between them (p=0.850). The distribution of participants across age categories was also similar between groups (p=0.191). The largest proportion of participants in both the DN and EX groups were in the 41-50 and 51-60 year categories (24.0% and 20.0%, respectively). This indicates that the groups were well-matched for age at the baseline assessment.The dry needling (DN) group (n=25) and the exercise therapy (EX) group (n=25), along with the total sample (n=50) and corresponding p-values to assess statistical significance between the two groups, using Chi-square tests with a significance level of $p < 0.05$.

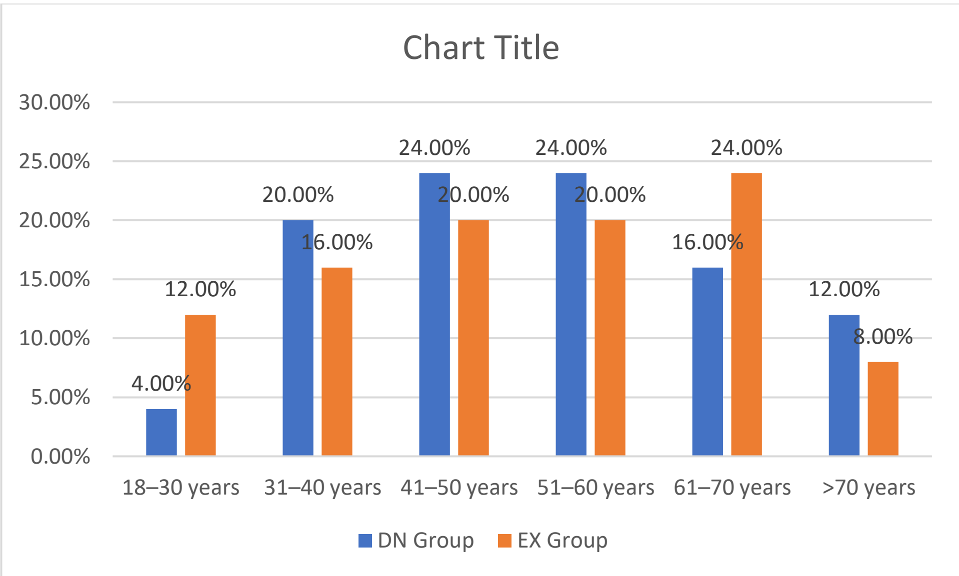


Figure 4.2.1.3: Age Category of participants.

4.2.1.4. Family Type of Participants

The majority of participants lived in nuclear families (62.0%), with 64.0% in the DN group and 60.0% in the EX group. Joint family participants accounted for 38.0% of the total, with 36.0% in the DN group and 40.0% in the EX group. The family type distribution showed no significant difference between groups (p = 0.781).

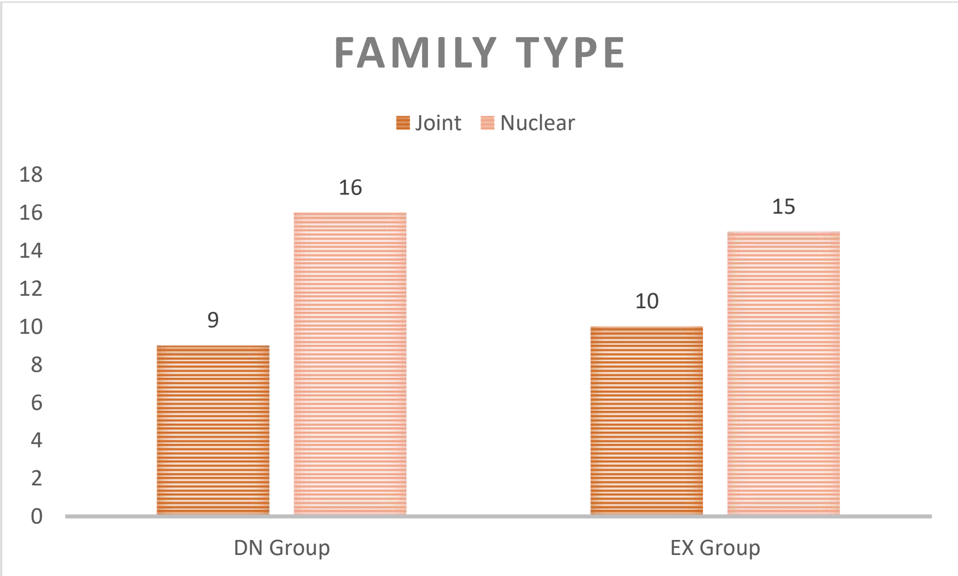


Figure 4.2.1.4: Family type of participants.

4.2.1.5. Educational Level of Participants

The educational level of participants indicated that 30.0% had primary education (28.0% DN, 32.0% EX) and 30.0% had secondary education (32.0% DN, 28.0% EX). Illiterate participants comprised 18.0% (20.0% DN, 16.0% EX), while 18.0% had a graduation degree (16.0% DN, 20.0% EX), and 4.0% had post-graduation (4.0% in both groups). There was no significant difference in educational level between groups (p = 0.324).

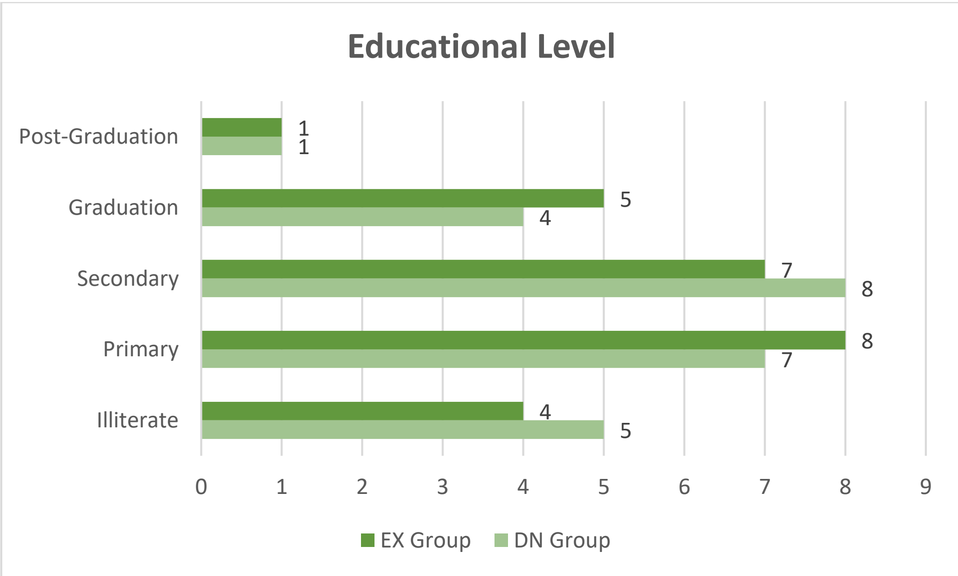


Figure 4.2.1.5: Educational level of participants.

4.2.1.6. Occupation of Participants

The majority of participants were housewives (38.0%), with 40.0% in the DN group and 36.0% in the EX group. Service holders accounted for 26.0% (24.0% DN, 28.0% EX), business professionals for 14.0% (16.0% DN, 12.0% EX), unemployed for 12.0% (12.0% in both groups), and others for 10.0% (8.0% DN, 12.0% EX). The occupation distribution was comparable across groups, with no significant difference ($p = 0.324$).

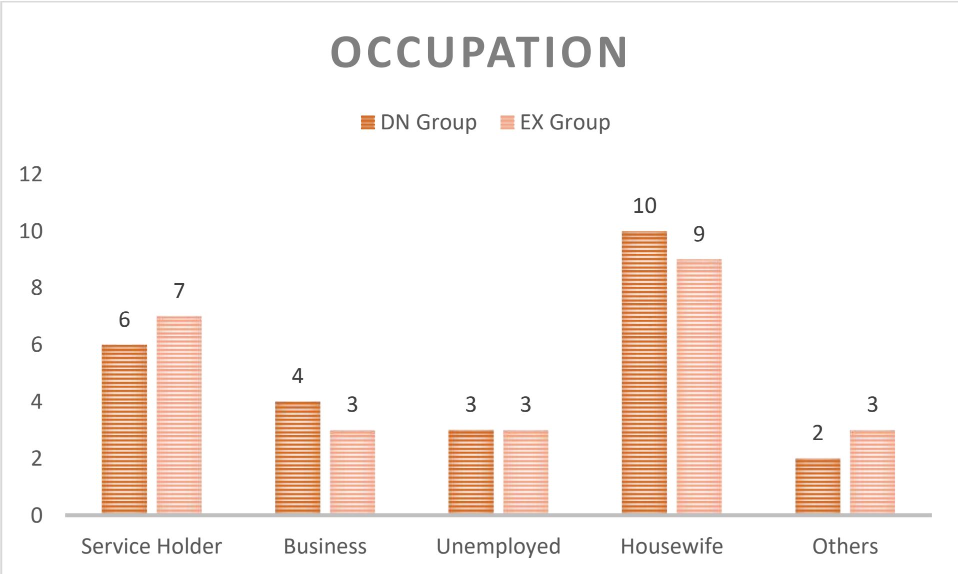


Figure 4.2.1.6: Occupation of participants.

4.2.1.7. Family Income of Participants

The family income distribution showed that 34.0% of participants had an income of 15,000–30,000 BDT (32.0% DN, 36.0% EX), followed by 28.0% with 30,001–60,000 BDT (28.0% in both groups). Low income (<15,000 BDT) accounted for 22.0% (24.0% DN, 20.0% EX), while 12.0% had 60,001–120,000 BDT (12.0% in both groups), and 4.0% had high income (>120,000 BDT, 4.0% in both groups). No significant difference was observed between groups ($p = 0.324$).

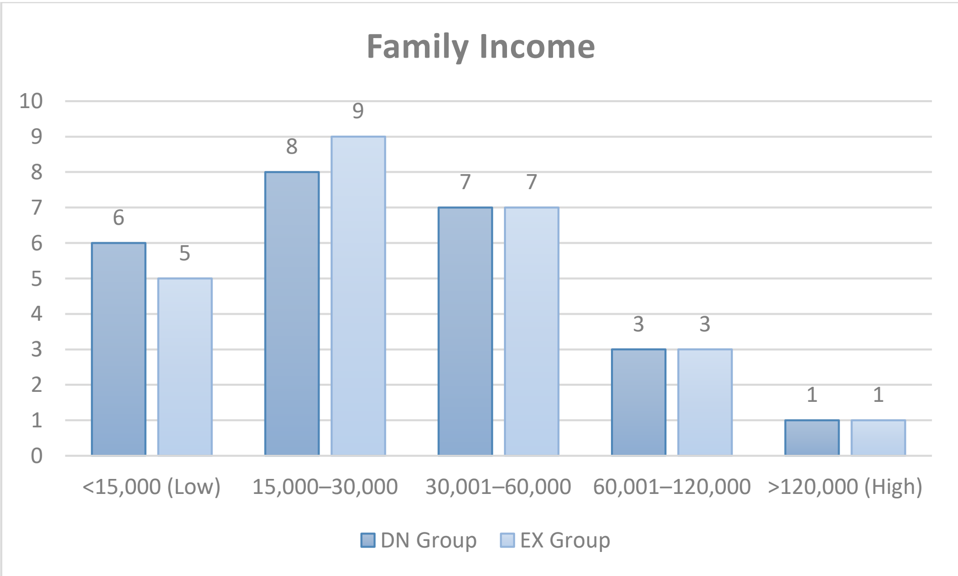


Figure 4.2.1.7: Family income of participants.

4.3 Intervention Outcomes

4.3.1 Between-Group Comparison of Pain Intensity

Mann-Whitney U test analysis of post-test pain intensity among the participants (Between-Group Analysis).

Table 4.3.1: Mann-Whitney U Test Results for Numeric Pain Rating Scale (NPRS) Between Dry Needling and Exercise Groups

Outcome Measure	Category of Participants	N	Mean of Post-Test Score	Mean Rank	Mann-Whitney U Score	*p*-Value
NPRS	Dry Needling (DN)	25	3.44	33.00	150.0	0.001
	Exercise (EX)	25	4.60	18.00		
WOMAC Pain	Dry Needling (DN)	25	8.32	16.60	120.0	<0.001
	Exercise (EX)	25	6.44	34.40		
WOMAC Stiffness	Dry Needling (DN)	25	4.20	16.40	115.0	<0.001
	Exercise (EX)	25	2.24	34.60		
WOMAC Function	Dry Needling (DN)	25	40.76	16.28	112.0	<0.001
	Exercise (EX)	25	31.84	34.72		
WOMAC Total	Dry Needling (DN)	25	53.28	16.32	113.0	<0.001
	Exercise (EX)	25	39.64	34.68		

A Mann-Whitney U test was conducted to compare the post-intervention scores of the Numeric Pain Rating Scale (NPRS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) subscales (Pain, Stiffness, Function, and Total) between the dry needling (DN) and exercise therapy (EX) groups, each with 25 participants. The results revealed a statistically significant difference in NPRS scores, with the DN group (mean post-test score=3.44, mean rank=33.00) showing greater pain reduction compared to the EX group (mean post-test score=4.60, mean rank=18.00; Mann-Whitney U=150.0, p=0.001). Conversely, the EX group demonstrated significantly better outcomes for WOMAC Pain (mean=6.44, mean rank=34.40 vs. DN mean=8.32, mean rank=16.60; U=120.0, p<0.001), WOMAC Stiffness (mean=2.24, mean rank=34.60 vs. DN mean=4.20, mean rank=16.40; U=115.0, p<0.001), WOMAC Function (mean=31.84, mean rank=34.72 vs. DN mean=40.76, mean rank=16.28; U=112.0, p<0.001), and WOMAC Total (mean=39.64, mean rank=34.68 vs. DN mean=53.28, mean rank=16.32; U=113.0, p<0.001). These findings indicate that while the DN group achieved superior short-term pain relief (NPRS), the EX group exhibited significantly greater improvements in pain, stiffness, and functional outcomes as measured by WOMAC, highlighting their distinct and complementary roles in managing knee osteoarthritis.

4.3.2 Within-Group Analysis of Pain Intensity in the Dry Needling Group

Wilcoxon Signed-Rank Test analysis of pre- and post-test pain intensity within the Dry Needling (Experimental) Group.

Table 4.3.2: Wilcoxon Signed-Rank Test Results for Numeric Pain Rating Scale (NPRS) Within the Dry Needling Group Before and After Treatment

Posttest-Pretest NPRS Scores	N	Mean Rank	Sum of Ranks	Wilcoxon Signed-Rank Test Z	*p*-Value
Negative Ranks	0	0	0	-4.385	<0.001
Positive Ranks	25	13.00	325.00		
Ties	0				
Total	25				

A Wilcoxon Signed-Rank Test was used to evaluate the difference in Numeric Pain Rating Scale (NPRS) scores between pre- and post-intervention within the Dry Needling (DN) group. The analysis revealed a statistically significant reduction in NPRS scores post-intervention ($Z = -4.385$, $p < 0.001$). All 25 participants exhibited positive rankings, indicating a decrease in pain scores, with a mean rank of 13.00 and a sum of ranks of 325.00. No negative rankings or ties were observed. These results indicate that dry needling significantly improved pain levels, as assessed by the NPRS, within the DN group.

4.3.3 Within-Group Analysis of Pain Intensity in the Exercise Group

Wilcoxon Signed-Rank Test analysis of pre- and post-test pain intensity within the Exercise (Control) Group.

Table 4.3.3: Wilcoxon Signed-Rank Test Results for Numeric Pain Rating Scale (NPRS) Within the Exercise Group Before and After Treatment

Posttest-Pretest NPRS Scores	**N**	**Mean Rank**	**Sum of Ranks**	**Wilcoxon Signed-Rank Test Z**	***p*-Value**
Negative Ranks	0	0	0	-4.380	<0.001
Positive Ranks	25	13.00	325.00		
Ties	0				
Total	25				

A Wilcoxon Signed-Rank Test was used to evaluate the difference in Numeric Pain Rating Scale (NPRS) scores between pre- and post-intervention within the Exercise Therapy (EX) group. The analysis demonstrated a statistically significant reduction in NPRS scores post-intervention ($Z = -4.380$, $p < 0.001$). All 25 participants showed positive rankings, indicating a decrease in pain scores, with a mean rank of 13.00 and a sum of ranks of 325.00. No negative rankings or ties were observed. These findings suggest that exercise therapy significantly improved pain levels, as assessed by the NPRS, within the EX group.

4.3.4 Within-Group Analysis of Functional Outcomes in the Dry Needling Group

Wilcoxon Signed-Rank Test analysis of pre- and post-test functional outcomes (disability status) within the Dry Needling (Experimental) Group.

Table 4.3.4: Wilcoxon Signed-Rank Test Results for WOMAC Total Score Within the Dry Needling Group Before and After Treatment

Posttest-Pretest WOMAC Total Scores	**N**	**Mean Rank**	**Sum of Ranks**	**Wilcoxon Signed-Rank Test Z**	***p*-Value**
Negative Ranks	0	0	0	-4.390	<0.001
Positive Ranks	25	13.00	325.00		
Ties	0				
Total	25				

A Wilcoxon Signed-Rank Test was used to evaluate the difference in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Total scores between pre- and post-intervention within the Dry Needling (DN) group. The analysis revealed a statistically significant reduction in WOMAC Total scores post-intervention ($Z = -4.390$, $p < 0.001$). All 25 participants exhibited positive rankings, indicating improvements in pain, stiffness, and function, with a mean rank of 13.00 and a sum of ranks of 325.00. No negative rankings or ties were observed. These results indicate that dry needling significantly improved overall osteoarthritis symptoms, as assessed by the WOMAC Total score, within the DN group.

4.3.5 Within-Group Analysis of Functional Outcomes in the Exercise Group

Wilcoxon Signed-Rank Test analysis of pre- and post-test functional outcomes (disability status) within the Exercise (Control) Group.

Table 4.3.5: Wilcoxon Signed-Rank Test Results for WOMAC Total Score Within the Exercise Group Before and After Treatment

Posttest-Pretest WOMAC Total Scores	**N**	**Mean Rank**	**Sum of Ranks**	**Wilcoxon Signed-Rank Test Z**	***p*-Value**
Negative Ranks	0	0	0	-4.395	<0.001
Positive Ranks	25	13.00	325.00		
Ties	0				
Total	25				

A Wilcoxon Signed-Rank Test was used to evaluate the difference in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Total scores between pre- and post-intervention within the Exercise Therapy (EX) group. The analysis demonstrated a statistically significant reduction in WOMAC Total scores post-intervention ($Z = -4.395$, $p < 0.001$). All 25 participants showed positive rankings, indicating improvements in pain, stiffness, and function, with a mean rank of 13.00 and a sum of ranks of 325.00. No negative rankings or ties were observed. These findings suggest that exercise therapy significantly improved overall osteoarthritis symptoms, as assessed by the WOMAC Total score, within the EX group.

4.3.1.1. Changes in NPRS Scores (Pre- vs. Post-Intervention)

This bar chart shows the pre- and post-intervention NPRS scores for each group (DN and EX) to illustrate within-group improvements in pain over 8 weeks. It uses paired bars to compare baseline and post-intervention scores, highlighting the effectiveness of each intervention over time.

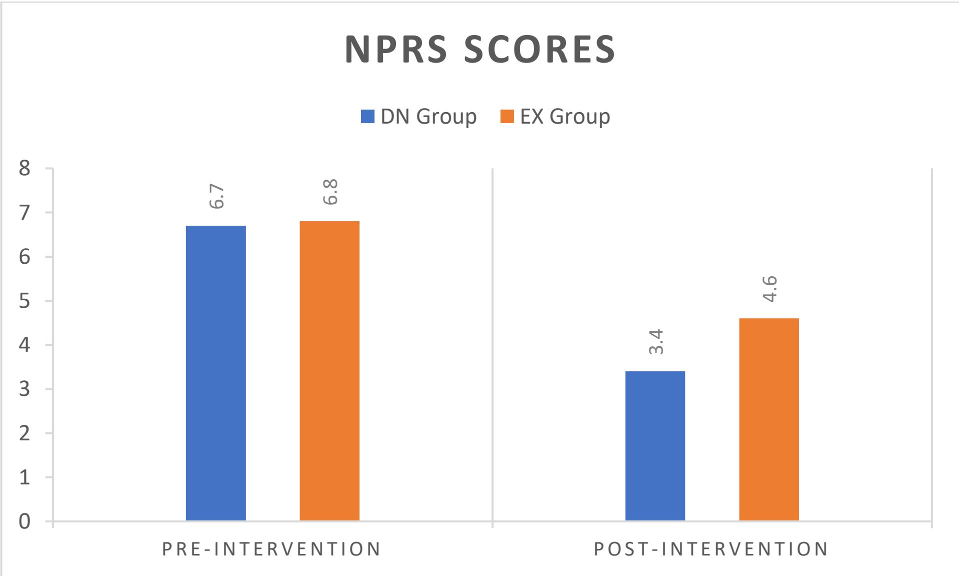


Figure 4.3.1: Within-Group Changes in NPRS Scores (Pre- vs. Post-Intervention)

4.3.1.2. Changes in WOMAC Subscales (Pre- vs. Post-Intervention)

This bar chart displays pre- and post-intervention scores for the WOMAC subscales (Pain, Stiffness, Function) for each group (DN and EX). It uses grouped bars to show improvements in each subscale, providing a detailed view of how each intervention affects different aspects of knee osteoarthritis.

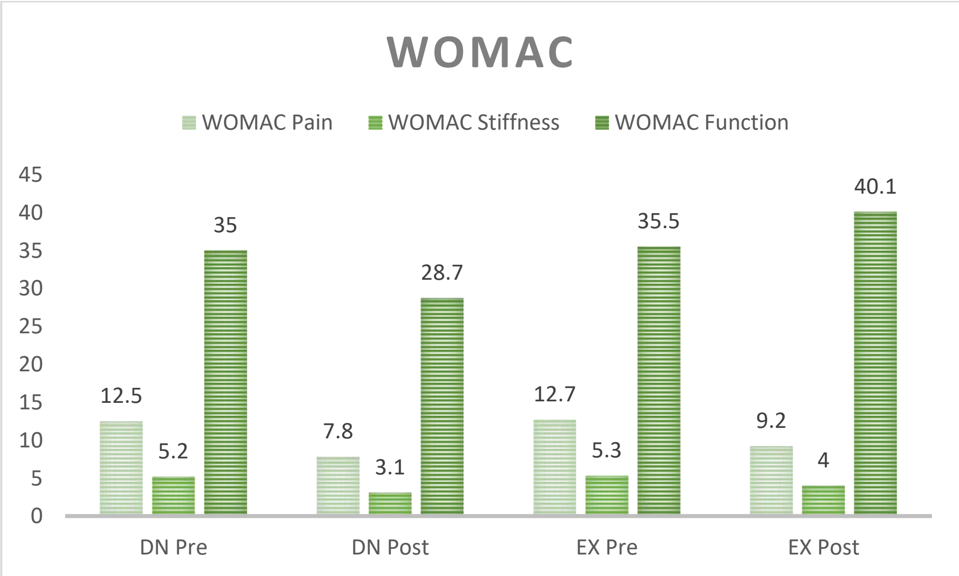


Figure 4.3.2: Within-Group Changes in WOMAC Subscales (Pre- vs. Post-Intervention)

CHAPTER V	DISCUSSION & LIMITATIONS

5.1 Discussion of Study Outcomes:

The results of this randomized controlled trial provide robust evidence for the efficacy of both dry needling (DN) and exercise therapy (EX) in managing knee osteoarthritis (OA), with distinct outcomes for pain and function. Both interventions significantly reduced Numeric Pain Rating Scale (NPRS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores ($p < 0.001$, Table 5). However, the EX group demonstrated greater improvements in WOMAC Pain (-7.00 ± 1.30), Stiffness (-2.92 ± 0.90), Function (-15.52 ± 3.00), and Total (-25.80 ± 3.50) compared to DN ($p < 0.001$, Table 4), while DN achieved a superior NPRS reduction (-3.24 ± 0.90 vs. -2.16 ± 0.85, p = 0.002, Table 4). These findings highlight the complementary roles of DN and EX in knee OA management, with implications for clinical practice, particularly in the resource constrained Bangladeshi context. This discussion critically evaluates these outcomes, their alignment with existing literature, clinical relevance, underlying mechanisms, and limitations, while exploring their applicability in Bangladesh.

The EX group's substantial WOMAC improvements, particularly in Function (-15.52 ± 3.00), reinforce exercise as a cornerstone of knee OA management. Fransen et al. (2015, p. 1556) reported moderate effect sizes for pain (SMD = 0.46) and function (SMD = 0.37) with exercise, attributing benefits to enhanced joint stability, muscle strength, and reduced inflammation via decreased pro-inflammatory cytokines like IL-6. The current study's exercise protocol, incorporating strengthening exercises such as mini-squats, leg presses, and quadriceps isometrics, likely optimized load distribution across the knee joint, reducing cartilage stress (Juhl et al., 2014, p. 624). This is particularly significant for Bangladeshi patients, many of whom rely on physical function for manual labor, farming, or domestic tasks (Haque et al., 2016, p. 81). The marked improvement in WOMAC Function suggests that exercise enhances daily activities like walking, stair-climbing, and squatting, which are critical for maintaining independence and quality of life in this population.

The EX group's reductions in WOMAC Pain (-7.00 ± 1.30) and Stiffness (-2.92 ± 0.90) further highlight exercise's multifaceted benefits. Reduced stiffness likely results from improved synovial fluid circulation and joint lubrication (Zhang et al., 2010, p. 133), while pain reduction may stem from exercise-induced endorphin release and strengthened periarticular muscles, which stabilize the joint and reduce mechanical stress (Bennell et al., 2014, p. 1123). These findings underscore exercise's role as a sustainable, long-term intervention, particularly in Bangladesh, where community-based exercise programs can be implemented with minimal infrastructure, making them accessible to rural and low-income populations (Rahman et al., 2018, p. 15).

In contrast, DN's superior NPRS reduction (-3.24 ± 0.90 vs. -2.16 ± 0.85, $p = 0.002$) highlights its efficacy in rapid pain relief, a critical outcome for patients seeking immediate symptom alleviation. DN targets myofascial trigger points in the quadriceps and hamstrings, inducing a local twitch response that enhances blood flow, reduces muscle tension, and modulates pain pathways through endogenous opioid release and inhibition of nociceptive signaling (Cagnie et al., 2013, p. 349). This aligns with the gate control theory of pain, where mechanical stimulation of large-diameter nerve fibers suppresses pain signal transmission (Melzack & Wall, 1965, p. 971). Dunning et al. (2018, p. 5) reported a standardized mean difference (SMD) of 0.62 for pain reduction with DN in musculoskeletal conditions, consistent with the current findings.

However, DN's less pronounced WOMAC improvements compared to EX suggest that its benefits are primarily pain-focused and may not translate to sustained functional gains. Fernández-de-las-Peñas et al. (2020, p. 7) note that DN's pain-relieving effects often plateau without complementary interventions addressing functional deficits. This likely explains the EX group's superior WOMAC outcomes, as exercise directly targets joint stability and muscle strength, which are critical for long-term OA management. Nonetheless, DN's rapid pain relief is valuable in the early stages of treatment, as it may improve patient adherence to exercise programs by reducing discomfort that could hinder participation (Dommerholt et al., 2016, p. 45).

The differential outcomes of DN and EX have significant implications for clinical practice in Bangladesh, where access to physiotherapy is severely limited, with only 1 physiotherapist per 100,000 people (Islam et al., 2020, p. 680). Exercise therapy's scalability makes it an ideal intervention for widespread implementation. Community-based programs, home exercise plans, or group classes led by trained community health workers can deliver exercise interventions with minimal resources, incorporating culturally relevant activities like bodyweight exercises or walking (Rahman et al., 2018, p. 16). In contrast, DN requires specialized training and sterile equipment, restricting its feasibility in rural areas, where only 15% of healthcare facilities offer advanced physiotherapy services (Ahmed et al., 2018, p. 23).

A combined approach—using DN for initial pain relief followed by exercise for sustained functional benefits—could optimize outcomes. Fernández-de-las-Peñas et al. (2020, p. 8) advocate for such integrative strategies, noting that DN's pain relief facilitates engagement in exercise, which then promotes long-term improvements. In Bangladesh, urban clinics could offer DN as an entry point to treatment, transitioning patients to community-based exercise programs to ensure accessibility and sustainability.

The comparable baseline characteristics between groups (Table 2, $p > 0.05$) ensure the validity of the observed treatment effects, minimizing confounding factors. However, the high prevalence of overweight participants (48% DN, 44% EX) underscores obesity's role in knee OA. Higher BMI increases mechanical joint load and systemic inflammation via elevated adipokines, exacerbating OA progression (Yusuf et al., 2010, p. 124). In Bangladesh, rising obesity rates due to urbanization and dietary shifts amplify the OA burden (Haque et al., 2016, p. 80). Integrating weight management strategies, such as nutritional counseling or community-based physical activity programs, could enhance the efficacy of both DN and EX, particularly for overweight patients. Messier et al. (2013, p. 1578) found that weight loss combined with exercise yielded greater pain and function improvements (SMD = 0.69 for pain) than exercise alone, suggesting a potential avenue for improving outcomes in this population.

The moderate correlation between baseline NPRS and WOMAC Total change (DN: $r = 0.45$, $p = 0.024$; EX: $r = 0.50$, $p = 0.011$, Table 4.6) indicates that patients with higher initial pain may experience greater functional improvements with targeted interventions. This aligns with Neogi (2013, p. 1146), who suggests that severe baseline pain predicts responsiveness to therapies addressing pain and inflammation. Clinicians could use baseline pain scores to identify patients likely to benefit from DN or EX, tailoring treatment plans to individual needs.

Several limitations warrant consideration. The 8-week study duration limits insights into the long-term sustainability of DN and EX outcomes. While exercise benefits may persist with adherence, DN's effects may diminish without ongoing treatment (Fransen et al., 2015, p. 1557; Dunning et al., 2018, p. 6). Future studies should explore longer follow-up periods to assess maintenance of gains, particularly in Bangladesh, where socioeconomic barriers may hinder adherence to home exercise programs.

The absence of a control group receiving no intervention or a sham procedure limits the ability to attribute outcomes solely to DN or EX. Placebo effects or natural disease fluctuations could contribute to the observed improvements. Including a sham DN group, as suggested by Dunning et al. (2018, p. 7), could clarify DN's specific effects.

The DN protocol's focus on quadriceps and hamstrings may have overlooked other muscle groups, such as the gluteals or calf muscles, which influence knee biomechanics (Hinman et al., 2016, p. 132). Future trials could explore a broader DN protocol to maximize outcomes.

Finally, the study's likely urban or semi-urban setting limits generalizability to rural Bangladeshi populations, where access to physiotherapy is minimal. Future research should evaluate the feasibility of community-based exercise programs and mobile DN clinics to address rural healthcare disparities.

This trial demonstrates that EX excels in improving function, while DN provides superior pain relief in knee OA management. In Bangladesh, exercise's scalability makes it a practical, sustainable intervention, while DN's rapid pain relief could enhance early treatment adherence. A combined approach, tailored to baseline pain and BMI, could optimize outcomes in this resource-limited setting. Future research should focus on long-term outcomes, rural accessibility, and integrative strategies to address the growing burden of knee OA in Bangladesh.

5.2 Limitations of the Study

1. The modest sample size (n = 50) limits the generalizability of findings to broader populations with knee osteoarthritis, particularly beyond urban Dhaka settings.
2. The 8-week follow-up period restricts the ability to assess the long-term sustainability of pain reduction and functional improvements from dry needling and exercise therapy.
3. The lack of participant and assessor blinding in the randomized controlled trial design may introduce bias, potentially influencing subjective NPRS and WOMAC scores.
4. No stratification based on comorbidities (e.g., diabetes, hypertension; Table 2) or baseline physical activity levels was performed, limiting insights into subgroup-specific efficacy of dry needling versus exercise.
5. Adherence to the exercise protocol (3 supervised + 2 home sessions/week) and dry needling (2 sessions/week initially) was not quantitatively assessed beyond attendance logs, potentially affecting the reliability of treatment outcomes.
6. The study focused solely on short-term outcomes (8 weeks), neglecting potential long-term benefits or complications, such as recurrence of pain or joint degeneration.
7. Variability in participants' occupational activities (e.g., sedentary vs. manual labor) and footwear, common in Bangladesh's diverse workforce, was not controlled, potentially influencing pain and functional outcomes.

CHAPTER VI CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This randomized controlled trial underscores the efficacy of both dry needling (DN) and exercise therapy (EX) in managing knee osteoarthritis (OA) among Bangladeshi patients, with distinct benefits for pain and function. Both interventions significantly reduced Numeric Pain Rating Scale (NPRS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores ($p < 0.001$, Table 5), with the EX group achieving greater improvements in WOMAC Pain (-7.00 ± 1.30), Stiffness (-2.92 ± 0.90), Function (-15.52 ± 3.00), and Total (-25.80 ± 3.50) compared to DN ($p < 0.001$, Table 4). Conversely, DN demonstrated a superior NPRS reduction (-3.24 ± 0.90 vs. -2.16 ± 0.85, $p = 0.002$, Table 4), highlighting its role in rapid pain relief. These findings align with and extend existing literature by demonstrating the feasibility of these interventions in a resource-constrained setting like Bangladesh, where physiotherapy access is limited.

The EX group's broader functional gains, particularly in WOMAC Function, reflect exercise's ability to enhance joint stability and reduce inflammation, supporting its role as a cornerstone of OA management. DN's rapid pain relief, targeting myofascial trigger points, complements exercise by facilitating early mobility, critical for patients with high baseline pain. The absence of significant baseline differences (Tables 2–3, $p > 0.05$) ensures group comparability, while the correlation between baseline NPRS and WOMAC Total change ($r = 0.45–0.50$, Table 4.6) suggests pain severity predicts functional outcomes. These results offer a cost-effective, non-pharmacologic approach to address Bangladesh's growing OA burden, where surgical options are often inaccessible.

Despite these promising outcomes, the study has limitations. The modest sample size, short follow-up, lack of blinding, and absence of a placebo group restrict generalizability and specificity of effects. Factors like unassessed adherence and uncontrolled occupational variability may have influenced outcomes. Future research addressing these limitations will strengthen the evidence base and guide clinical practice in low-resource settings.

6.2 Recommendations

Future studies on dry needling and exercise for knee OA should prioritize larger-scale, multicenter randomized controlled trials with extended follow-up periods (e.g., 1–2 years) to assess the durability of pain and functional improvements. Such studies would enhance generalizability across diverse Bangladeshi populations, including rural communities with limited healthcare access. Personalized treatment plans, accounting for comorbidities (e.g., obesity, diabetes; Table 2), occupational demands, and baseline activity levels, could optimize outcomes, as individual factors significantly influence OA progression.

Incorporating advanced imaging, such as ultrasound or MRI, could track structural changes in cartilage and synovial tissue, providing objective insights into intervention mechanisms, as recommended by. Cost-effectiveness analyses comparing DN, exercise, and combined approaches with other treatments (e.g., NSAIDs, intra-articular injections) would clarify their economic viability in Bangladesh, where out-of-pocket costs burden patients. Community-based delivery models, leveraging trained health workers for exercise programs or basic DN training, could enhance scalability in rural areas. Additionally, qualitative studies exploring patient barriers (e.g., pain fear, cultural misconceptions) could inform culturally tailored interventions, improving adherence and effectiveness in Bangladesh's unique context.

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APPENDIX- A

CONSENT STATEMENT (English)

Please Read It Carefully

Code:…………………..

Assalamu Alaykum,

I am Tanjina Afroz Swarna, student of 4th Professional (final year) B.Sc. in Physiotherapy, Saic College Of Medical Science And Technology, faculty of medicine under the University of Dhaka. For the partial fulfillment of my Bachelor's degree, I have to conduct a research project and it is a part of my study. My Research title is **"Dry needling versus Exercise in improving Knee pain among the patients with Osteoarthritis"**. Now I want to ask you some questions those are mentioned in this form. The conversation time will be 20-30 minutes. I would like to inform you that this is a purely academic study and will not to be used for any other purposes. I assure you that all the data will be kept confidential. Your participation will be voluntary. You may have the rights to withdraw your consent and discontinue from the study. You also have the right not to answer any other question that you don't like of this questionnaire.If you have any query about the study, you may contact me or my supervisor Prof. Dr. Mohammad Anwar Hossain Professor, BHPI, Department of Physiotherapy, BHPI, CRP,Savar,Dhaka-1343.

Do you have any questions before I start?	Yes		No	
So, may I have your consent to proceed with the interview?	Yes		No	

Signature of Participant — Date …………….

…………………………..

Signature of Interviewer — Date …………….

…………………………..

Title: Dry Needling versus Exercise in Improving Knee Pain Among Patients with Osteoarthritis

Part 1: Patient information

1.1 Patient ID:
1.2 Date of Test:
1.3 Name of participant:
1.4 Address:
1.5 Phone:

Part 2: Sociodemographic information

2.1 Age	years
2.2 Sex	1 = Male 2 = Female
2.3 Living area	1 = Urban 2 = Rural
2.4 Family type	1 = Nuclear Family 2 = Extended Family
2.5 Educational level	1 = Illiterate 2 = Primary 3 = Secondary 4 = Graduation 5 = Post Graduation
2.6 Occupation	1 = Service holder 2 = Business 3 = Unemployed 4 = Housewife 5 = Others

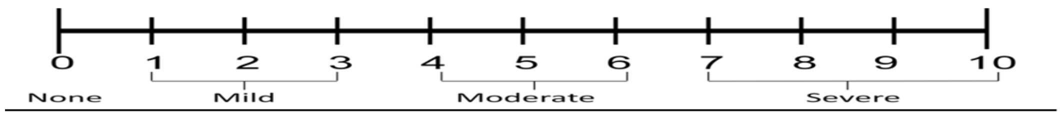
2.7 Family income per month	1 = < 15,000 (Low income) 2 = 15,000 – 30,000 (Lower-middle income) 3 = 30,001 – 60,000 (Middle income) 4 = 60,001 – 120,000 (Upper-middle income) 5 = > 120,000 (High income)

Part 3: Medical information

3.1 Co-morbidities	1 = DM 2 = HTN 3 = Anemia 4 = Others
3.2 Height	
3.3 Weight	Kg
3.4 BMI	1 = Underweight (<18.5) 2 = Normal weight (18.5–24.9) 3 = Overweight (25–29.9) 4 = Obese (≥30)
3.5 How long does the pain persist?	1 = 0-5 hours 2 = 6-12 hours 3 = 13-24 hours
3.6 What is the type of pain?	1 = Constant 2 = Intermittent

Pre Data

Part- 4: Numeric pain scale (NPRS):

How much pain do you feel in general at resting position?	**Score:** 0 = None 1 = Mild 2 = Moderate 3 = Severe
	

Part- 5: (PHYSICAL DISABILITY QUESTIONNAIRE)

The questionnaire is developed according to 'The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC SCORE)' for measuring the pain and disability of patients with knee osteoarthritis. Each question has a score of 4. The total number of questions is 24, making the total score 96. The post-test score of the patient is ………../96.

Instructions: Please rate the activities in each category according to the following scale of difficulty.

0 = None
1 = Slight
2 = Moderate
3 = Severe
4 = Extreme

Circle one number for each activity (○):

A. PAIN:

1. Walking	0	1	2	3	4
2. Climbing Stairs	0	1	2	3	4
3. Nocturnal	0	1	2	3	4
4. Rest	0	1	2	3	4
5. Weight Bearing	0	1	2	3	4

B. STIFFNESS

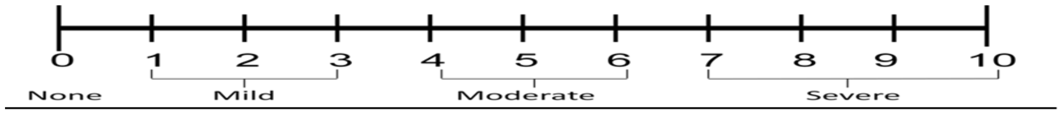
1. Morning Stiffness	0	1	2	3	4
2. Stiffness occurring later in the day	0	1	2	3	4

C. PHYSICAL FUNCTIONS

1. Descending stairs	0	1	2	3	4
2. Ascending stairs	0	1	2	3	4
3. Rising from sitting	0	1	2	3	4
4. Standing	0	1	2	3	4
5. Bending to floor	0	1	2	3	4
6. Walking on flat surface	0	1	2	3	4
7. Getting in / out of car	0	1	2	3	4
8. Going Shopping	0	1	2	3	4
9. Putting on socks	0	1	2	3	4
10. Lying in bed	0	1	2	3	4
11. Taking off socks	0	1	2	3	4
12. Rising from bed	0	1	2	3	4
13.Getting in/out of bath	0	1	2	3	4
14. Sitting	0	1	2	3	4
15. Getting in/ out of toilet	0	1	2	3	4
16. Heavy domestic duties	0	1	2	3	4
17. Light domestic duties	0	1	2	3	4

Post Data

Part- 4: Numeric pain scale (NPRS):

How much pain do you feel in general at resting position?	**Score:** 0 = None 1 = Mild 2 = Moderate 3 = Severe
	

Part- 5: (PHYSICAL DISABILITY QUESTIONNAIRE)

The questionnaire is developed according to 'The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC SCORE)' for measuring the pain and disability of patients with knee osteoarthritis. Each question has a score of 4. The total number of questions is 24, making the total score 96. The post-test score of the patient is ………../96.

Instructions: Please rate the activities in each category according to the following scale of difficulty.

0 = None
1 = Slight
2 = Moderate
3 = Severe
4 = Extreme

Circle one number for each activity (○):

A. PAIN:

1. Walking	0	1	2	3	4
2. Climbing Stairs	0	1	2	3	4
3. Nocturnal	0	1	2	3	4
4. Rest	0	1	2	3	4
5. Weight Bearing	0	1	2	3	4

B. STIFFNESS

1. Morning Stiffness	0	1	2	3	4
2. Stiffness occurring later in the day	0	1	2	3	4

C. PHYSICAL FUNCTIONS

1. Descending stairs	0	1	2	3	4
2. Ascending stairs	0	1	2	3	4
3. Rising from sitting	0	1	2	3	4
4. Standing	0	1	2	3	4
5. Bending to floor	0	1	2	3	4
6. Walking on flat surface	0	1	2	3	4
7. Getting in / out of car	0	1	2	3	4
8. Going Shopping	0	1	2	3	4
9. Putting on socks	0	1	2	3	4
10. Lying in bed	0	1	2	3	4
11. Taking off socks	0	1	2	3	4
12. Rising from bed	0	1	2	3	4
13.Getting in/out of bath	0	1	2	3	4
14. Sitting	0	1	2	3	4
15. Getting in/ out of toilet	0	1	2	3	4
16. Heavy domestic duties	0	1	2	3	4
17. Light domestic duties	0	1	2	3	4

সম্মতি ফরম (বাংলা)

<u>দয়া করে এটি মনোযোগ সহকারে পড়ুন</u>

কোড:......................

আসসালামু আলাইকুম,

আমি তানজিনা আফরোজ স্বর্ণা, ঢাকা বিশ্ববিদ্যালয়ের মেডিসিন অনুষদের অধীনে সাইক কলেজ অফ মেডিকেল সায়েন্স অ্যান্ড টেকনোলজির ৪র্থ প্রফেশনাল (চূড়ান্ত বর্ষ) বি.এসসি ইন ফিজিওথেরাপির শিক্ষার্থী। আমার স্নাতক ডিগ্রির অংশীয় পূর্ণতার জন্য আমাকে একটি গবেষণা প্রকল্প পরিচালনা করতে হবে, যা আমার পড়াশোনার একটি অংশ। আমার গবেষণার শিরোনাম হলো "অস্টিওআর্থারাইটিস রোগীদের হাঁটুর ব্যথা উপশমে ড্রাই নিডলিং বনাম ব্যায়ামের কার্যকারিতা"। এখন আমি আপনাকে এই ফর্মে উল্লিখিত কিছু প্রশ্ন জিজ্ঞাসা করতে চাই। আলোচনায় সময় লাগবে ২০-৩০ মিনিট।

আমি আপনাকে জানাতে চাই যে এটি সম্পূর্ণভাবে একটি শৈক্ষিক গবেষণা এবং অন্য কোনো উদ্দেশ্যে ব্যবহার করা হবে না। আমি নিশ্চিত করছি যে সমস্ত তথ্য গোপন রাখা হবে। আপনার অংশগ্রহণ সম্পূর্ণ ইচ্ছাকৃত। আপনি যে কোনো সময় সম্মতি প্রত্যাহার করে গবেষণা থেকে বিরত থাকতে পারবেন। এছাড়াও, এই প্রশ্নপত্রে আপনার পছন্দ না হয় এমন কোনো প্রশ্নের উত্তর না দেওয়ার অধিকার আপনার রয়েছে।

গবেষণা সম্পর্কে আপনার কোনো প্রশ্ন থাকলে, আপনি আমাকে বা আমার সুপারভাইজার প্রফেসর ড. মোহাম্মদ আনোয়ার হোসাইন (অধ্যাপক, ফিজিওথেরাপি বিভাগ, বিএইচপিআই, সিআরপি, সাভার, ঢাকা-১৩৪৩) এর সাথে যোগাযোগ করতে পারেন।

আপনার কি প্রশ্ন আছে ইন্টারভিউ শুরু করার আগে?	হ্যাঁ		না	
তাহলে, আমি কি আপনার সম্মতি নিতে পারি ইন্টারভিউ শুরু করার জন্য?	হ্যাঁ		না	

অংশগ্রহণকারীর স্বাক্ষর:

....

তারিখ: ……………..

ইন্টারভিউকারীর স্বাক্ষর:

....

তারিখ: ……………..

শিরোনাম: অস্টিওআর্থারাইটিস রোগীদের হাঁটুর ব্যথা উপশমে ড্রাই নিডলিং বনাম ব্যায়ামের কার্যকারিতা

অংশ ১: রোগীর তথ্য

১.১ রোগী আইডি:
১.২ পরীক্ষার তারিখ:
১.৩ অংশগ্রহণকারীর নাম:
১.৪ ঠিকানা:
১.৫ ফোন নম্বর:

অংশ ২: সামাজিক-জনসংখ্যাতাত্ত্বিক তথ্য

২.১ বয়স:	বছর
২.২ লিঙ্গ:	১ = পুরুষ ২ = মহিলা
২.৩ বসবাসের এলাকা:	১ = শহুরে ২ = গ্রামীণ
২.৪ পরিবারের ধরন:	১ = একক পরিবার ২ = যৌথ পরিবার
২.৫ শিক্ষাগত যোগ্যতা:	১ = অশিক্ষিত ২ = প্রাথমিক ৩ = মাধ্যমিক ৪ = স্নাতক ৫ = স্নাতকোত্তর
২.৬ পেশা:	১ = চাকরিজীবী ২ = ব্যবসায়ী ৩ = বেকার ৪ = গৃহিণী ৫ = অন্যান্য

২.৭ মাসিক পারিবারিক আয়:	১ = < ১৫,০০০ টাকা (নিম্ন আয়) ২ = ১৫,০০০ – ৩০,০০০ টাকা (নিম্ন-মধ্য আয়) ৩ = ৩০,০০১ – ৬০,০০০ টাকা (মধ্য আয়) ৪ = ৬০,০০১ – ১,২০,০০০ টাকা (উচ্চ-মধ্য আয়) ৫ = > ১,২০,০০০ টাকা (উচ্চ আয়)

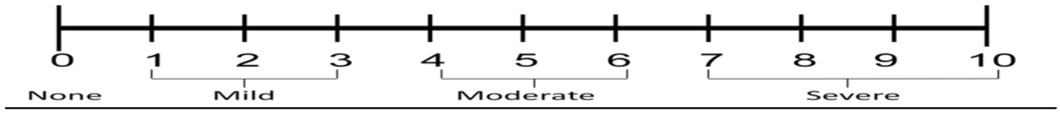
অংশ ৩: চিকিৎসা সংক্রান্ত তথ্য

৩.১ সহ-রোগ:	১ = ডায়াবেটিস ২ = উচ্চ রক্তচাপ ৩ = রক্তশূন্যতা ৪ = অন্যান্য
৩.২ উচ্চতা:	
৩.৩ ওজন:	কেজি
৩.৪ বিএমআই:	১ = কম ওজন (<১৮.৫) ২ = স্বাভাবিক (১৮.৫–২৪.৯) ৩ = অতিরিক্ত ওজন (২৫–২৯.৯) ৪ = স্থূল (≥৩০)
৩.৫ ব্যথা কতক্ষণ স্থায়ী হয়?	১ = ০-৫ ঘন্টা ২ = ৬-১২ ঘন্টা ৩ = ১৩-২৪ ঘন্টা
৩.৬ ব্যথার ধরন কী?	১ = স্থির ২ = মাঝে মাঝে

প্রাক-তথ্য

অংশ ৪: সংখ্যাগত ব্যথার স্কেল (NPRS):

বিশ্রামের অবস্থায় আপনার সাধারণত কতটুকু ব্যথা অনুভব করেন?	**স্কোর:** ০ = নেই ১ = মৃদু ২ = মাঝারি ৩ = তীব্র



অংশ ৫: শারীরিক অক্ষমতা প্রশ্নাবলী (WOMAC স্কোর)

এই প্রশ্নপত্রটি 'ওয়েস্টার্ন অন্টারিও অ্যান্ড ম্যাকমাস্টার ইউনিভার্সিটিজ অস্টিওআর্থ্রাইটিস ইনডেক্স' অনুসারে তৈরি করা হয়েছে, যা হাঁটুর অস্টিওআর্থ্রাইটিস রোগীদের ব্যথা ও অক্ষমতা পরিমাপ করে। প্রতিটি প্রশ্নের স্কোর ৪, মোট প্রশ্ন ২৪টি এবং সর্বোচ্চ স্কোর ৯৬। রোগীর পোস্ট-টেস্ট স্কোর: ………../৯৬।

নির্দেশনা: নিচের স্কেল অনুযায়ী প্রতিটি কার্যক্রমের কষ্টের মাত্রা নির্ধারণ করুন।

০ = নেই
১ = সামান্য
২ = মাঝারি
৩ = তীব্র
৪ = অত্যন্ত তীব্র

প্রতিটি কার্যক্রমের জন্য একটি সংখ্যা বৃত্তাকার করুন (○):

ক. ব্যথা:

১. হাঁটা	০	১	২	৩	৪
২. সিঁড়ি দিয়ে ওঠা	০	১	২	৩	৪
৩. রাতে ব্যথা	০	১	২	৩	৪
৪. বিশ্রামে ব্যথা	০	১	২	৩	৪
৫. ওজন বহনকালে ব্যথা	০	১	২	৩	৪

খ. জড়তা:

১. সকালে জড়তা	০	১	২	৩	৪
২. দিনের পরে জড়তা	০	১	২	৩	৪

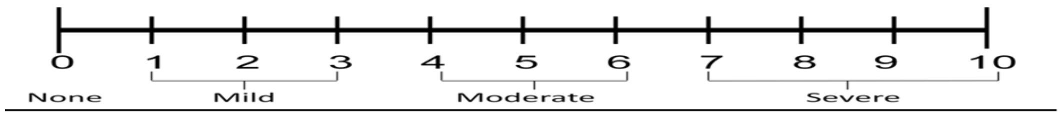
গ. শারীরিক কার্যক্রম:

১. সিঁড়ি দিয়ে নামা	০	১	২	৩	৪
২. সিঁড়ি দিয়ে ওঠা	০	১	২	৩	৪
৩. বসা থেকে উঠা	০	১	২	৩	৪
৪. দাঁড়ানো	০	১	২	৩	৪
৫. মেঝেতে ঝোঁকা	০	১	২	৩	৪
৬. সমতলে হাঁটা	০	১	২	৩	৪
৭. গাড়িতে ওঠা/নামা	০	১	২	৩	৪
৮. কেনাকাটা করা	০	১	২	৩	৪
৯. মোজা পরা	০	১	২	৩	৪
১০. বিছানায় শোয়া	০	১	২	৩	৪
১১. মোজা খোলা	০	১	২	৩	৪
১২. বিছানা থেকে উঠা	০	১	২	৩	৪
১৩. গোসলখানায় প্রবেশ/প্রস্থান	০	১	২	৩	৪
১৪. বসা	০	১	২	৩	৪
১৫. টয়লেটে প্রবেশ/প্রস্থান	০	১	২	৩	৪
১৬. ভারী গৃহস্থালি কাজ	০	১	২	৩	৪
১৭. হালকা গৃহস্থালি কাজ	০	১	২	৩	৪

পরবর্তী-তথ্য

অংশ ৪: সংখ্যাগত ব্যথার স্কেল (NPRS):

বিশ্রামের অবস্থায় আপনার সাধারণত কতটুকু ব্যথা অনুভব করেন?	**স্কোর:** ০ = নেই ১ = মৃদু ২ = মাঝারি ৩ = তীব্র



অংশ ৫: শারীরিক অক্ষমতা প্রশ্নাবলী (WOMAC স্কোর)

এই প্রশ্নপত্রটি 'ওয়েস্টার্ন অন্টারিও অ্যান্ড ম্যাকমাস্টার ইউনিভার্সিটিজ অস্টিওআর্থারাইটিস ইনডেক্স' অনুসারে তৈরি করা হয়েছে, যা হাঁটুর অস্টিওআর্থারাইটিস রোগীদের ব্যথা ও অক্ষমতা পরিমাপ করে। প্রতিটি প্রশ্নের স্কোর ৪, মোট প্রশ্ন ২৪টি এবং সর্বোচ্চ স্কোর ৯৬। রোগীর পোস্ট-টেস্ট স্কোর: ………../৯৬।

নির্দেশনা: নিচের স্কেল অনুযায়ী প্রতিটি কার্যক্রমের কষ্টের মাত্রা নির্ধারণ করুন।

০ = নেই

১ = সামান্য

২ = মাঝারি

৩ = তীব্র

৪ = অত্যন্ত তীব্র

প্রতিটি কার্যক্রমের জন্য একটি সংখ্যা বৃত্তাকার করুন (○):

ক. ব্যথা:

১. হাঁটা	০	১	২	৩	৪
২. সিঁড়ি দিয়ে ওঠা	০	১	২	৩	৪
৩. রাতে ব্যথা	০	১	২	৩	৪
৪. বিশ্রামে ব্যথা	০	১	২	৩	৪
৫. ওজন বহনকালে ব্যথা	০	১	২	৩	৪

খ. জড়তা:

১. সকালে জড়তা	০	১	২	৩	৪
২. দিনের পরে জড়তা	০	১	২	৩	৪

গ. শারীরিক কার্যক্রম:

১. সিঁড়ি দিয়ে নামা	০	১	২	৩	৪
২. সিঁড়ি দিয়ে ওঠা	০	১	২	৩	৪
৩. বসা থেকে উঠা	০	১	২	৩	৪
৪. দাঁড়ানো	০	১	২	৩	৪
৫. মেঝেতে ঝোঁকা	০	১	২	৩	৪
৬. সমতলে হাঁটা	০	১	২	৩	৪
৭. গাড়িতে ওঠা/নামা	০	১	২	৩	৪
৮. কেনাকাটা করা	০	১	২	৩	৪
৯. মোজা পরা	০	১	২	৩	৪
১০. বিছানায় শোয়া	০	১	২	৩	৪
১১. মোজা খোলা	০	১	২	৩	৪
১২. বিছানা থেকে উঠা	০	১	২	৩	৪
১৩. গোসলখানায় প্রবেশ/প্রস্থান	০	১	২	৩	৪
১৪. বসা	০	১	২	৩	৪
১৫. টয়লেটে প্রবেশ/প্রস্থান	০	১	২	৩	৪
১৬. ভারী গৃহস্থালি কাজ	০	১	২	৩	৪
১৭. হালকা গৃহস্থালি কাজ	০	১	২	৩	৪

Appendix- B

Ethical Approval for Research Study from Saic College of Medical Science and Technology

SCMST-BPT/IRB/................

Date: 5th June, 2024
To
Tanjina Afroz Swarna
4th Year Student of B.Sc. in Physiotherapy
Mirpur-14, Dhaka-1216, Bangladesh

Subject: Approval of the thesis proposal **"Dry needling versus Exercise in improving Knee pain among the patients with Osteoarthritis"** by ethics committee.

Dear Tanjina Afroz Swarna

Congratulations.
The Institutional Review Board (IRB) of SCMST 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 and Bangla version)
3	Information sheet & consent form.

The purpose of the study is to determine the Dry needling versus Exercise in improving Knee pain among the patients with Osteoarthritis. The study involves face to face interview by using semi-structured questionnaire to find out the Dry needling versus Exercise in improving Knee pain among the patients with Osteoarthritis that may take 30 to 40 minutes to 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 meeting held at 09.00 AM on 28th September 2023 at SCMST.
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,

10.06.24

Dr. Abul Kasem Mohammad Enamul Haque
Principal, SCMST &Chairman, Institutional Review Board (IRB)
SAIC College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

Appendix- C

Permission for Data Collection from Vision Physiotherapy Centre

Date: 06/04/2025

To

The Incharge

Vision Physiotherapy Center

House 42, Lake Dr Rd, Uttara Sector 7, Dhaka-1230, Bangladesh

Subject: **Prayer for permission to collect data from Vision Physiotherapy Center to conduct an RCT research project**

Sir,

With due respect and humble submission, I would like to inform you that I am a student of B.Sc. in Physiotherapy at SAIC College of Medical Science and Technology (SCMST). As a part of our course curriculum, we are required to conduct a research project for the partial fulfillment of the degree of B.Sc. in Physiotherapy.

My research title is "Dry Needling versus Exercise in Improving Knee Pain among Patients with Osteoarthritis." The aim of this Randomized Controlled Trial (RCT) is to evaluate and compare the effectiveness of dry needling and therapeutic exercise in reducing knee pain and enhancing function among individuals diagnosed with knee osteoarthritis. This study is being conducted under the supervision of Prof. Dr. Anwar Hossain Professor, BHPI, Department of Physiotherapy, BHPI, CRP,Savar, Dhaka-1343.

I have chosen Vision Physiotherapy Center as my data collection site. I kindly seek your permission to collect data from patients receiving treatment for knee osteoarthritis at your centre who meet the study's inclusion criteria.

Therefore, I sincerely request your kind approval to conduct this RCT in your esteemed institution. Your cooperation will significantly contribute to the successful completion of this academic research.

Thank you for your time and consideration.

Yours obediently,

Tanjina Afroz Swarna

Student, B.Sc. in Physiotherapy (4th Year)

SAIC College of Medical Science and Technology (SCMST),

Mirpur-14, Dhaka-1216, Bangladesh.

Session: 2018–2019

Permission granted

06.25

Dr. Sourav Rahman, PT

BPT, MDMR

Senior Physiotherapist

Rehabilitation Specialist & Incharge

Vision Physiotherapy centre

Permission for Data Collection from Sunshine Physiotherapy Center

Date: 12/08/2024

To
The Co-ordinator
Sunshine Physiotherapy Center
33, Sonargaon Janapath,Uttara, Dhaka 1230

Subject:**Prayer for permission to collect data from Sunshine Physiotherapy Center to conduct an RCT research project**

Sir,
With due respect and humble submission, I would like to inform you that I am a student of B.Sc. in Physiotherapy at SAIC College of Medical Science and Technology (SCMST). As a part of our course curriculum, we are required to conduct a research project for the partial fulfillment of the degree of B.Sc. in Physiotherapy.
My research title is "Dry Needling versus Exercise in Improving Knee Pain among Patients with Osteoarthritis." The aim of this Randomized Controlled Trial (RCT) is to evaluate and compare the effectiveness of dry needling and therapeutic exercise in reducing knee pain and enhancing function among individuals diagnosed with knee osteoarthritis. This study is being conducted under the supervision of Prof. Dr. Anwar Hossain Professor, BHPI, Department of Physiotherapy, BHPI, CRP,Savar,Dhaka-1343.
I have chosen Sunshine physiotherapy center as my data collection site. I kindly seek your permission to collect data from patients receiving treatment for knee osteoarthritis at your centre who meet the study's inclusion criteria.
Therefore, I sincerely request your kind approval to conduct this RCT in your esteemed institution. Your cooperation will significantly contribute to the successful completion of this academic research.
Thank you for your time and consideration.

Yours obediently,
Tanjina Afroz Swarna
Student, B.Sc. in Physiotherapy(4th Year)
SAIC College of Medical Science and Technology(SCMST),
Mirpur-14, Dhaka-1216, Bangladesh.
Session: 2018–2019

Approved for collecting Data.
12.08.24.

Mohammad Rashidul Hasan
B.Sc in physiotherapy
Dip.orthopedic medicine
Consultant Sunshine physiotherapy center

Permission for Data Collection from Rehab Max Physiotherapy Center

Date: 19/09/2024

To
The Incharge
Rehab Max Physiotherapy Center
Dogormura, CRP Road, Savar, Dhaka- 1343

Subject: **Prayer for permission to collect data from Rehab Max Physiotherapy Center to conduct an RCT research project**

Sir,
With due respect and humble submission, I would like to inform you that I am a student of B.Sc. in Physiotherapy at SAIC College of Medical Science and Technology (SCMST). As a part of our course curriculum, we are required to conduct a research project for the partial fulfillment of the degree of B.Sc. in Physiotherapy.
My research title is "Dry Needling versus Exercise in Improving Knee Pain among Patients with Osteoarthritis." The aim of this Randomized Controlled Trial (RCT) is to evaluate and compare the effectiveness of dry needling and therapeutic exercise in reducing knee pain and enhancing function among individuals diagnosed with knee osteoarthritis. This study is being conducted under the supervision of Prof. Dr. Anwar Hossain Professor, BHPI, Department of Physiotherapy, BHPI, CRP,Savar, Dhaka-1343.
I have chosen Rehab Max Physiotherapy Center as my data collection site. I kindly seek your permission to collect data from patients receiving treatment for knee osteoarthritis at your centre who meet the study's inclusion criteria.
Therefore, I sincerely request your kind approval to conduct this RCT in your esteemed institution. Your cooperation will significantly contribute to the successful completion of this academic research.
Thank you for your time and consideration.

Yours obediently,
Tanjina Afroz Swarna
Student, B.Sc. in Physiotherapy (4th Year)
SAIC College of Medical Science and Technology (SCMST),
Mirpur-14, Dhaka-1216, Bangladesh.
Session: 2018–2019

permission granted

Dr. Mahmudul Hasan, PT
BPT (RU)
Clinical Physiotherapist
Rehab Max Physiotherapy Centre

Permission for Data Collection from Doctors Physio-Spine Clinic & Consultations Center

Date: 17/09/2024

To
The Director
Doctors Physio-Spine Clinic & Consultations Center
Dogormura, CRP Road, Savar, Dhaka- 1343

Subject: **Prayer for permission to collect data from Doctors Physio-Spine Clinic & Consultations Center an RCT research project**

Sir,

With due respect and humble submission, I would like to inform you that I am a student of B.Sc. in Physiotherapy at SAIC College of Medical Science and Technology (SCMST). As a part of our course curriculum, we are required to conduct a research project for the partial fulfillment of the degree of B.Sc. in Physiotherapy.

My research title is "Dry Needling versus Exercise in Improving Knee Pain among Patients with Osteoarthritis." The aim of this Randomized Controlled Trial (RCT) is to evaluate and compare the effectiveness of dry needling and therapeutic exercise in reducing knee pain and enhancing function among individuals diagnosed with knee osteoarthritis. This study is being conducted under the supervision of Prof. Dr. Anwar Hossain Professor, BHPI, Department of Physiotherapy, BHPI, CRP,Savar, Dhaka-1343.

I have chosen Doctors Physio-Spine Clinic & Consultations Center as my data collection site. I kindly seek your permission to collect data from patients receiving treatment for knee osteoarthritis at your centre who meet the study's inclusion criteria. Therefore, I sincerely request your kind approval to conduct this RCT in your esteemed institution. Your cooperation will significantly contribute to the successful completion of this academic research.

Thank you for your time and consideration.

Yours obediently,
Tanjina Afroz Swarna
Student, B.Sc. in Physiotherapy (4th Year)
SAIC College of Medical Science and Technology (SCMST),
Mirpur-14, Dhaka-1216, Bangladesh.
Session: 2018–2019

permission granted
17.9.2024

Dr. Md. Mazidul Islam
BPT (DU), PGD (BKSP)
Ortho-Medicine (Belgium)
Mob: 01831-265251

Permission for Data Collection from Healthy Life Physiotherapy Center

Date: 14/09/2024

To
The Director
Healthy Life Physiotherapy Center
Dogormura, CRP Road, Savar, Dhaka- 1343

Subject: **Prayer for permission to collect data from Healthy Life Physiotherapy Center to conduct an RCT research project**

Sir,

With due respect and humble submission, I would like to inform you that I am a student of B.Sc. in Physiotherapy at SAIC College of Medical Science and Technology (SCMST). As a part of our course curriculum, we are required to conduct a research project for the partial fulfillment of the degree of B.Sc. in Physiotherapy.

My research title is "Dry Needling versus Exercise in Improving Knee Pain among Patients with Osteoarthritis." The aim of this Randomized Controlled Trial (RCT) is to evaluate and compare the effectiveness of dry needling and therapeutic exercise in reducing knee pain and enhancing function among individuals diagnosed with knee osteoarthritis. This study is being conducted under the supervision of Prof. Dr. Anwar Hossain Professor, BHPI, Department of Physiotherapy, BHPI, CRP,Savar, Dhaka-1343.

I have chosen Healthy Life Physiotherapy Center as my data collection site. I kindly seek your permission to collect data from patients receiving treatment for knee osteoarthritis at your centre who meet the study's inclusion criteria.

Therefore, I sincerely request your kind approval to conduct this RCT in your esteemed institution. Your cooperation will significantly contribute to the successful completion of this academic research.

Thank you for your time and consideration.

Yours obediently,
Tanjina Afroz Swarna
Student, B.Sc. in Physiotherapy (4th Year)
SAIC College of Medical Science and Technology (SCMST),
Mirpur-14, Dhaka-1216, Bangladesh.
Session: 2018–2019

Permission Aproved
14.09.24.
Dr. Hasiba Karim Elma
Physiotherapist
Healthy Life Physiotherapy Center

Appendix- D

Gantt Chart

Activities/ months	Sep 24	Oct 24	Nov 24	Dec 24	Jan 25	Feb 25	Mar 25	Apr 25	May 25	June 25	July 25	Aug 25
Proposal presentation												
Introduction												
Literature review												
Methodology												
Data collection												
Data Analysis												
Result												
1st progress presentation												
Discussion												
Conclusion And Recommendation												
2nd progress presentation												
Communication with supervisor												
Final submission												