EFFECTIVENESS OF KINESTHETIC AND BALANCE EXERCISE ALONG WITH CONVENTIONAL PHYSIOTHERAPY IN PATEINTS WITH KNEE OSTEOARTHRITIS

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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for the acceptance of this dissertation entitled

EFFECTIVENESS OF KINESTHETIC AND BALANCE EXERCISE ALONG WITH CONVENTIONAL PHYSIOTHERAPY IN PATEINTS WITH KNEE OSTEOARTHRITIS

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

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DECLERATION

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, presentation or dissemination of information of the study. I would bound to take written consent from the Department of Physiotherapy of Bangladesh Health Professions Institute (BHPI).

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Acronyms

BHPI	Bangladesh Health Professions Institute
BMRC	Bangladesh Medical & Research Council
CRP	Center for the Rehabilitation of the Paralysed
ICF	International Classification of Functioning, Disability and Health
IRB	Institutional Review Board
NSAID	Non-Steroidal Anti Inflammatory Drug
NPRS	Numerical Pain Rating Scale
OA	Osteoarthritis
RCT	Randomized Control Trial
ROM	Range of Motion
US	United States
SPSS	Statistical Package of the Social Sciences
WOMAC	Western Ontario McMaster University Osteoarthritis Index
WHO	World Health Organization

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Abstract

Background:Osteoarthritis is a global burden of disease and the most common musculoskeletal disorder. This study was conducted to find out a better intervention to reduce knee pain, functional disability and improve range of motion in participants with knee osteoarthritis. Objectives: To explore the effectiveness of kinesthetic and balance exercise with conventional Physiotherapy in patient with knee osteoarthritis. Methodology: A randomized control trial was conducted. 18 subjects were randomly selected into 2 groups from musculoskeletal unit, CRP, Savar. Among them 9 paeticipants were assigned into trial group received kinesthetic and balance exercise with conventional physiotherapy and another 9 into control group received only conventional Physiotherapy. Data was collected from the participants through face to face interview. Total treatment sessions were 8 (2 days per week) and double blinding procedure was uesd during data collection. Outcome measurement tools: Numeric pain rating scale (NPRS) was used to measure pain and universal goniometer ROM, and WOMAC to measure functional disability. Analysis of data: Between group of pain and disability was conducted by Mann- Whitney U test and Range of motion was conducted by Unpaired t test. Within group of pain and disability was conducted by Wilcoxon test and range of motion was conducted by paired t test using SPSS version 16. Results: Following treatment the study found that significant improvement in between group of pain ($p=0.011$), range of motion in flexion ($p=0.002$) and functional disability ($p= 0.031$). In within group, significant improvment showed pain in control group ($p= 0.008$) and trail group ($p= 0.012$), range of motion of flexion in control and trail group ($p= 0.000$), disability in control and trial group ($p= 0.016$). Conclusion: This research showed that kinesthetic and balance exercise combined with conventional Physiotherapy was more effective than only conventional Physiotherapy for patients with knee osteoarthritis.

Key words: Knee osteoarthritis, kinesthetic and balance exercise, conventional Physiotherapy

CHAPTER-I INTRODUCTION

1.1. Background:

Osteoarthritis is one of the most common arthritis and musculoskeletal problem in worldwide and approximately 10% of the world's population have symptomatic OA who are 60 years or older (Sambandam et al., 2011).

Degenerative disorder is not a single disease but also represents the various disorders of joints such as joint failure (Sambandam et al., 2011). Generally degenerative disorder is a disease of the elderly, but our recent local survey showed it to be very common in both males (53.3%) and females (60.9%) and the young individuals may be affected (Al-Arfaj et al., 2002).

Osteoarthritis is a chronic degenerative disorder with multifactorial etiology characterized by loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis and range of biochemical and morphological alteration of the synovial membrane and joint capsule (Harris et al., 2014).

Knee osteoarthritis is one of musculoskeletal condition affecting older people and is associated with most common symptoms of pain, inflammation, instability, decreased range of motion and lowering the quality of life (Rinkle et al., 2010).

The patients of knee osteoarthritis primarily complains of joint pain, morning stiffness, muscle weakness, loss off range of motion, instability and loss of functional ability such as walking, squatting, sit to stand, climbing stairs (Anita et al., 2006). But the progression of the disease is usually slow leading to joint failure with pain and disability (Litwic et al., 2013). Knee osteoarthritis is a main source of chronic disability (Colbert et al., 2013). It causes mark limitation in daily living activity of the patients (Marmon et al., 2013).

Vigorous levels of activity appeared to increase the risk of osteoarthritis recent study reported that daily walking of more than 10,000 steps per day may be associated with worsening of certain MRI features (Dore et al., 2012).

The risk factors of knee osteoarthritis including with age, gender, obesity, varus or valgus misalignment, previous knee injury, occupation, hereditary and others (Brouwer et al., 2007).

The prevalence of knee osteoarthritis in the Netherlands in 2007 was 14.3 per 1000 for men and 23.8 per 1000 for women (Jansen, et al., 2011). It affects more than 21 million people in the US with 36% of elderly aged 70 or older having some degree of radiographic knee osteoarthritis (D'Ambrosia, 2005).

Both drug and non-drug treatment are used to treat knee osteoarthritis, pain reduction and symptom improvement may be achieved by drug treatments but the drug treatment have side effect and drug overdose (NAM, et al., 2013). Physical therapies such as electrotherapy, hyperthermia, phototherapy, exercise therapy and manual therapy these are include of non-drug treatments (NAM et al., 2013).

The aim of physical therapy for knee osteoarthritis is to reduce pain, preserve joint physiology and maintain or recover normal activity of the joint (Mishel et al., 2013).

1.2. Rationale

Osteoarthritis of the knee also known as degenerative joint disease. It affects in the age of above 40 years and in both the genders. Risk factors such as older age, obesity, family history, muscle weakness increase sensibility to osteoarthritis. The most common features are knee pain, joint stiffness, muscle weakness and another symptoms may include joint swelling ,decrease range of motion from current episode if you to be proved. Proprioceptive and kinesthetic sensation defects may also be associated with the onset and progression of knee osteoarthritis.

Kinesthetic and balance techniques are designed to improve joint stability using a sequence of physical activities and used to treatment and rehabilitation.

Proprioceptive deficits may reduce dynamic knee stability .kinesthetic and balance exercise is important to decrease proprioceptive impairment, thereby decrease dynamic knee stability and activity of daily living function. Improved joint stability has the probability to improve symptoms and disease progression.

Knee osteoarthritis is one of the most common medical conditions regulating in CRP, Dhaka, Bangladesh. Physiotherapy professionals are continuing for evidence based practice in aspect of physiotherapy intervention. With conventional physiotherapy knee osteoarthritis patient's recovery was good effective.

In recent years kinesthetic and balance exercise we applied with knee osteoarthritis intervention and the result was good, however it could be more effective when it was applied with conventional physiotherapy.

The purpose of this study to evaluate the effectiveness of kinesthetic and balance exercise along with conventional physiotherapy to reduce pain, improve range of motion and disability.

1.3. Aim of this study: To explore the effectiveness of kinesthetic and balance exercise along with conventional physiotherapy in patients with knee osteoarthritis.

1.4. Objectives:

1.4. a. General objective: To evaluate theeffectiveness of kinesthetic and balance exercise along with conventional physiotherapy in patients with knee osteoarthritis.

1.4. b. Specific objectives:

- To find out the socio demographic information of the patient's with knee osteoarthritis.
- To explore the effect of kinesthetic and balance exercise along with conventional physiotherapy in between and within groups on reducing pain.
- To determine effects of kinesthetic and balance exercise along with conventional physiotherapy in between and within groups to increase range of motion.
- To evaluate the effect of kinesthetic and balance exercise along with conventional physiotherapy in between and within groups on reducing difficulties of daily living activities.

1.5. Null hypothesis: Kinesthetic and balance exercise along with conventional physiotherapy is no more effective than only conventional physiotherapy for the patients with knee osteoarthritis.

Ho: μ1-μ2 = 0 or μ1=μ2, where the experimental group and control group initial and final mean difference is same.

1.6.Alternative hypothesis: Kinesthetic and balance exercise along with conventional physiotherapy is more effective than only conventional physiotherapy for the patients with knee osteoarthritis.

Ha: μ1-μ2 = 0 or μ1=μ2, where the experimental group and control group initial and final mean difference isnot same.

1.7. Operational definition:

Osteoarthritis: Osteoarthritis is a type of joint disease that results from breakdown of joint cartilage and underlying bone. The most common symptoms are joint pain and stiffness.

Knee osteoarthritis: knee osteoarthritis is the occurrence of osteoarthritis in the knee joint. Osteoarthritis involves the degradation of joints, including particular cartilage and subchondral bone. But also ligaments, the capsule, and the synovial membrane degenerate. This will eventually lead to pain and loss of function. Osteoarthritis is the most common disease of joints adults suffer from worldwide. Osteoarthritis is a clinical syndrome characterized by varying degree of joint pain, functional limitation and reduced quality of life.

Conventional physiotherapy: Physiotherapy interventions are commonly and widely used by physiotherapist for the treatment of any disease. The researcher formulated a list of evidence based physiotherapy interventions of knee osteoarthritis provided those to the physiotherapist to mark the interventions commonly used as conventional physiotherapy for knee osteoarthritis.

Kinesthetic exercise: Kinesthetic relates to learning through feeling such as a sense of body position, muscle movement and weight as felt through nerve endings. It refers to the awareness you have of your surroundings through sensory experience. The kinesthetic sense is based on proprioception, which is awareness of the position of our joints.

Balance exercise: Balance is the ability tostay up right or stay in control of body. Balance exercise is one of the four types of exercise along with strength, endurance and flexibility. Besides improving joint stability, preventing injuries and falls. Balance is the key to all functional movement.

1.8. List of variables:

Independent variable: Conventional physiotherapy, Kinesthetic and balance exercise.

Dependent variable: Pain, ROM, Disability.

CHAPTER-II LITERATUREREVIEW

Musculoskeletal diseases remained one of the most common causes for severe long-term pain and disability (Apley & Solomon, 2008).Within the musculoskeletal disorders; osteoarthritis (OA) represented a complex musculoskeletal disorder with multiple genetic and biomechanical risk factors (Badley et al., 2009). The biomechanical risk factor caused degeneration of articular cartilage in joint. Articular cartilage situated in the knee was prone to damage among the regional area of the body.

In human body, knee OA demonstrated significant economic, social and psychological costs (March & Bachmeier, 2007). Even though it massive costing, knee OA represented the most common form of joint disease and disability in older people and ranked amongst the top five causes of disability (Leardini et al., 2004). Besides it, an increases in life expectancy and ageing populations are expected to make osteoarthritis the fourth leading cause of disability by the year 2020 (Woolf & Pfleger, 2003).

Disability rates could be better understood by intersecting the epidemiology of OA and knee OA. Worldwide estimate showed that 10% of men and 18% of women aged over 60 years had symptomatic knee osteoarthritis (OECD 2011). The incidence of OA 2.3% in middle aged women worldwide.

In United States of America, the National Arthritis Data Workgroup (NADW) estimated that the prevalence of knee OA was 9.3 million (4.9%) in 2010 among adults age between 40 years and older in which the prevalence rises with age and may be higher in women than in men and in blacks than in whites (Murphy & Helmick, 2012).

In United Kingdom, 4.11 million people have been suffering from knee OA whereas 1.75 million people aged 75 years or over and 2.36 million working age people receiving treatment for knee OA. Meanwhile 97% initial knee replacements are

performed due to knee osteoarthritis and 85,920 initial knee replacements were reported in 2013 in England, Wales and Northern Ireland (Litwic et al., 2013).

In Australia, knee OA is the third leading cause of life-years lost due to disability (4.8% of total life-years lost due to disability). The prevalence of knee OA increases with age. The overall knee OA prevalence among Australians was 15%. Symptomatic knee OA is uncommon, occurring in fewer than 5% of people under the age of 40. Prevalence increases to 10% of men and 20% of women aged between 45–65 years. Radiological prevalence surveys suggested much higher rates than this, with changes of OA being present on x-ray in more than 50% of people over the age of 65 years, and almost universally after 85 years. Not all radiological OA is associated with clinical symptoms, and not all symptomatic knees OA is associated with disability. The total number of knee replacements due to knee OA in Australian hospitals rose from 34, 700 in 1996–97, to 44 552 in 2000–01; this is an increase of almost 30% in just 4 years (March & Bagga, 2004).

In Netherlands, the prevalence of knee OA in 2010 was 14.3 per 1000 for men and 23.8 per 1000 for women in which knee pain is a limiting factors to participate independently in activities of daily livings and the limitation is overwhelming with the progression of age of population (Jansen et al., 2011).

In Asia, it was estimated that the proportion of people aged 65 and over would be increased in India by 274%, Malaysia by 269% and Bangladesh by 261% between 2008- 2040. The increasing age of people would have more chance to develop degenerative disease like knee OA (Fransen et al., 2011).

In India, the prevalence of knee OA is increasingly day by day. In the year 2013, approximately 10 percent of total population was affected by knee OA and the prevalence increases with age and obesity (King et al., 2013). In a study, Patil et al. (2012) stated that 34.3% male and 67.7% female were suffered from knee OA with age range from 55- 59 years and there was positive correlation between obesity and knee OA compared with normal subjects. Among all musculoskeletal complains, 55.9% subjects suffered from knee OA.

In Pakistan, the prevalence of knee OA was 28% in urban area and 25% in rural area of total population. One cross sectional study in Pakistan by Iqbal et al., (2011) found that most common age range of knee osteoarthritis was between 44 to 64 years and most frequent age of knee OA was more than 55 years in which 74% female and 26% male were affected by knee OA. Finally, the study concluded that females of age greater than 55 years mostly noted to visit a tertiary care hospital due to knee osteoarthritis which has a vast economic burden of the country.

In china, the prevalence of OA was 13.65 in which prevalence of knee OA is 10.09% among other areas affected by osteoarthritis in the year 2002 (Wigley et al., 2007).

In Korea, the general prevalence of knee OA is unknown but one cross sectional study by Kim et al., (2010) stated that the prevalence of radiological knee OA was 37.3% and 24.2%, symptomatic knee OA respectively. The prevalence of both radiological knee OA and symptomatic knee OA was significantly higher among women than men.

In Bangladesh, there are not any current prevalence overall rate of knee OA. But one study by Haq et al., (2005) reported that the prevalence of radiographic knee OA was5.78% and symptomatic knee OA was 10.20% correspondingly. Another study by Shakoor et al., (2007) surprisingly found in their study that 59.3% male and 40.7% female were suffered from knee OA in which male: female ratio was 1: 0.68. The vulnerable age range of knee OA was from 42 to 64 years.

Therefore the higher prevalence of knee osteoarthritis caused a high proportion of personnel and country's economic effects. One recent research (Chen et al., 2012) demonstrated that increased prevalence of OA causing direct and indirect cost in individual's life. OA not only affect the individual's but also affect the country's economy as a whole. All these together affected the quality of life of patients. March & Bachmeier (2007) showed costs of illness had risen over recent decades accounting for up to 1-2.5% of the gross national product for the USA, Canada, the UK, France and Australia. This ultimately would develop socioeconomic damage of country's economy (Fransen et al., 2011).

The exact cause is unknown. The chances of getting osteoarthritis seem to increase with age. Overweight can increase the risk of getting osteoarthritis. Injury to a joint or repeated overuse can damage the cartilage and lead to osteoarthritis. Other types of arthritis can also damage joints and lead to osteoarthritis (Osteoarthritis, 2006).OA are idiopathic in most of the cases. These are variety of risk factor for the development of osteoarthritis which is aging, gender; race, obesity, congenital and acquired deformity, inheritance, injury and joint uses have all been implicated in disease causation (Chitnavis et al., 2012).Age related changes to the joint and muscles, hormonal changes, excess body weight, congenital abnormalities, and previous joint injury leading to muscle weakness and joint instability are the causes of OA. Although the incidence and prevalence of OA increase with age, OA is not an evitable consequence of aging (Hurley, 2012).A variety of mechanical, metabolic, genetic or constitutional may damage a synovial joint. Most often it is unclear but sometimes a clear such as trauma or ligament rupture may be apparent (Haslelt et al., 2013).The majority of the cases the precipitating causes of OA are increasing mechanical stress in some part of the articular surface. This may be due to increase load (Solomon et al., 2011).

Based on etiology this is familiar to clinicians and subdivided OA into ‘primary’ for which the etiology is uncertain and ‘secondary’ which is attributed to factor such as injury and deformity (Chitnavis et al., 2012).

The path physiology of knee OA mainly depends on its risk factors. Obesity is strongly linked with knee OA. It causes an activation of abnormal neuroendocrine and pro inflammatory pathways. This pathway cause abnormal food metabolism, fat accumulation and metabolic changes. Pro inflammatory cytokines increase and the regulatory cytokines decrease in the obese patient due to activate adipose tissue. Presence of large amount of leptin was observed in the cartilage and osteophytes of the OA patients, which is the product of obesity gene and also produced by osteoblasts and chondrocytes cells. This leptin plays an important role in onset and progression of OA. The pathological change are starts from subchondral bone, and

then affect bone marrow, causes meniscus tear and extrusion, and then leads to cartilage destruction (Heidari, 2011).

Pain, stiffness and reduced walking are typical presentation of knee OA (Winter et al., 2010). Aching and stiffness are also associated with these symptoms (Santos et al., 2011). Joint crepitus during movement, swelling, deformity, and increase temperature of the joint these clinical signs of knee OA are may found on physical examination. Biomechanical factors necessary for knee stabilization including muscle strength, lower limb proprioception and varus and valgus laxity of joint have been impaired in knee OA (Knoop et al., 2012). Whole lower limb pain, tenderness, palpable effusion, bony enlargement, fixed flexion deformity, reduced flexion ROM, and quadriceps muscle weakness these clinical features are present in knee OA patient (Peat et al., 2012). Pain usually increase by activity and relieves by rest (Peat et al., 2012; Heidari, 2011).

Pathological and radiological criteria usually used to diagnosed and categorized OA rather than clinical feature. Radiologically it is characterized by focal areas of damage to the articular cartilage, mild synovitis, and joint space narrowing, bony outgrowths from the joint margins called osteophytes and subchondral bone sclerosis (Hurley et al., 2012).

The prognosis of osteoarthritis depends on the joint involved and the severity of the condition. No proven disease or structure modifying drugs for osteoarthritis are currently known. Thus the medication based regimen is directed at symptom relief. Several clinical features associated with more rapid knee OA progression noted by systematic review of the literature. Knee OA has life time risk for developing estimated as 44.7% and the annual report of US showed that it is 4% per year (Chapple et al., 2011).

Osteoarthritis treatment has four general goals: improve joint care, maintain an acceptable body weight, control pain and achieves healthy lifestyle (Carol et al., 2006).

Physiotherapy is a therapeutic health profession concerned with enhancing mobility and quality of life by using clinical reasoning to deliver of the most suitable treatment for an injury or condition. Physiotherapist helps people gain as much movement and physical independence as possible so they can resume their normal job or lifestyle. Physiotherapists assess, diagnose and treat people with movement problems. They also deliver patient education and help people avoid injuries and maintain a fit, healthy body' (Australian Physiotherapy Association, 2006).

Exercise therapy program consisting of isometric exercise (Stenmark, 1995), isotonic exercise (Brandt, 1997), isokinetic exercise (Maurer et al., 1999), range of motion exercise (Deyle et al., 2000), aerobic or endurance exercise (Alayli et al., 2007), home based exercise (Baker et al., 2001), class based exercise (McCarthy et al., 2004). Deyle et al. (2005) suggested manual therapy for knee OA should comprised of manual mobilization of patella, muscle stretch and soft tissue mobilization. Besides these, electrotherapeutic modalities showed efficacy to minimize knee OA symptoms. Among them, pulsed shortwave (Fukuda et al., 2011), low level laser (Alfredo et al., 2011) and Transcutaneous Electrical Nerve Stimulation (TENS) (Vance et al., 2012) were commonly tested for knee osteoarthritis. In addition with these, hydrotherapeutic exercises (Silva et al., 2008), patellar tapping (Cushnaghan et al., 1994), educational booklet (Maurer et al., 1999) and life style modification (Coleman et al., 2012) also common form of techniques used in clinical practice for knee OA patients.

Exercise therapy is a prescription given by a professional after comprehensive assessment of a particular patient's problems. Exercise therapy implied a fixed dose, intensity and repetition of exercise for a particular problem. The objective of setting parameter of exercise was to achieve all core areas outcomes treated by physiotherapist. Exercise therapy focused in all areas of physiotherapy practice. In case of musculoskeletal physiotherapy area assessment of pain, range of motion, muscle strength and function, proprioception, joint stiffness and contractures were focused intimately (Huber et al., 2006). Principles of therapeutic exercises in osteoarthritis focused to i) pain relief ii) correction of impairment iii) enhance cardiovascular endurance iv) improve muscle strength and v) improve mobility

(Hallet al., 2009). These principles were achievable although the causes of problems were created by cartilage breakdown (Roy, 2007). Damage to articular cartilage could exhibit lubricant deficiency. This ultimately leads to less load-carrying ability which in term affects the muscular system of lower limb especially quadriceps muscle (Mow et al., 2001; Ebnezar, 2003).The main mechanism of overcoming the problem is to minimize the biomechanical factors by exercise therapy. Exercise therapy helped to maintain tissue balance around joint, improve movement of synovial fluid in joint, improve muscle strength, helped to control inflammation, restore muscle balance by regulation of protein synthesis, joint range and overall improve functional status of patient (Fisher et al., 2003; Bajotts et al., 2006; Bennell et al., 2012).

Pretella (2000) reviewed the results of exercise in osteoarthritis. The study was conducted from June 1966 to January 2000. The availability of the survey was a diagnosis of clinical and X-ray diagnosis. The second criterion was one of the treatments and at least one treatment was included. We identified 69 published articles, and in this study 17 randomized tests were performed. Most of the studies provided information about the effectiveness of exercise therapy for patients with OA knee in terms of pain reduction, self-reported disability in walking and stepping speed. Two experimental studies showed regular exercise therapy reduced disability. However, 18 months following the study; half of the study showed effectiveness of exercise therapy for knee OA patients (Ettinger et al., 1997; Van Baar et al., 1998). This review provided good information regarding knee OA. Though some studies showed effectiveness of exercise therapy for knee OA patients, they had poor control of drugs, irrelevant study designs and exclusion criteria. Only five randomized controlled trials had good statistical power. The recommendation of utmost trial was to involve the educational intervention for long term effects of exercise treatment on knee OA patients.

Maurer et al., (2009) demonstrated isokinetic quadriceps exercise was effective treatment in compare with only educational intervention for knee osteoarthritis. In this study, 113 patients were assigned to both groups where 57 in isokinetic exercise and 56 in educational intervention group. Both group subjects were almost equal at

baseline characteristics by sex, age, body weight and duration of knee OA. Isokinetic exercise was used in designed form in clinical group while educational program consisted of lecture by a rheumatologist, video on self-management techniques, nutritional guideline sessions and discussion by psychologist on pain coping. The duration of strength program was three times a week for 8 weeks. The study was conducted for 8 weeks and data analysis was done by intragroup and intergroup analysis from baseline to week 8. Intragroup analysis showed statistically significant in strength, pain variables and function variables with $P<.001$ in all variables. Intergroup analysis from baseline to 8 weeks demonstrated no differences in strength variables, improved pain change and improved AIMS mobility change in exercise group. Isokinetic exercise was supervised in clinic. Conversely, educational interventions were followed by patients at home without supervision. In this study isokinetic exercise group showed greater improvements in pain, strength and functions variables. The simple way to get more convenient result in the exercise group was by providing more attention to it.

McCarthy et al., (2004) developed class based exercise program. The class based exercise comprising of progressive resistive training, accelerated walking, stretching and balance exercises. These exercises were effective when combined with home exercise program for twice weekly with the class lasting for 45 minutes. The authors also recommended class based educational intervention should be adhering with home based exercise with supervision by Physiotherapist.

A randomized control trialed study conducted on Bangladesh found that modification of daily activities can results significant improvement. Activity modification include- avoiding bending of knee for more than 90 degree, use of high commode in bathroom, stick during walking, avoiding prolonged sitting and standing, avoiding high healed shoe, weight reduction, cooking and shower should done on sitting or standing position, avoiding kneeling etc (BMRC, 2007).

In the field of osteoarthritis research The Western Ontario McMaster University Osteoarthritis Index (WOMAC) was developed as an osteoarthritis specific measures of disability. It comprises three components pain, stiffness, physical function, which can be reported separately or as an overall index. It is recommended that, the use of

WOMAC as a primary measure of efficacy in osteoarthritis trials (Malgaonkar et al., 2014).

The goniometer is a simple and accurate way of objective assessment of ROM. It is used for measuring the range of motion (Lalit et al., 2012).

CHAPTER–III METHODOLOGY

3.1. Study design:

The study was conducted by Randomized control trial (RCT).

18 patients were selected by simple random sampling from musculoskeletal department, physiotherapy unit CRP;Savar. The researcher used computerized random sampling procedure for this research. 18 subjects were randomly selected in to 2 groups where 9 subjects were in control group and 9 subjects were in trial group.

Kinesthetic and balance exercise combined with conventional physiotherapy techniques applied to the treatment group and only conventional physiotherapy techniques applied to the control group.

A pretest (before intervention) and posttest (after intervention) was administered with each subject of both groups to compare the effects on pain, ROM and disability.

3.2. Study site:

Musculoskeletal unit of the Centre for the Rehabilitation of the Paralysed (CRP), Savar was selected for the study site.

3.3. Study population:

The study population was the patients diagnosed as knee osteoarthritis attended in the musculoskeletal unit of physiotherapy department at CRP, Savar, Dhaka.

3.4. Sample size:

Sample size for this study was 18. Among them 9 participants were in trial group and 9 participants in control group.

3.5. Sampling technique:

18 patients with knee OA who met the inclusion criteria selected conveniently from outpatient musculoskeletal unit of physiotherapy department of CRP, Savar, and Dhaka. All the participants had an equal probability of assigning to any of two groups and then 9 patients were randomly assigned to trial group comprising of treatment approaches of kinesthetic and balance exercise combined with conventional physiotherapy techniques and 9 patients to the control group treated by conventional physiotherapy techniques for this study. Double blinding procedure was followed in this study. After completion of sampling technique, the researcher randomly assigned the participants into trial group and control group, because it improves internal validity of the study. The participants were assigned into trial and control group by using computer generated random number from 1 to 18. An initial randomization was done by computer to identify the participants of trial and control group and the first participants came out in the control group. The samples was given numerical number C_1, C_2, C_3 etc. for the control group and T_1, T_2, T_3 etc. for trial group. The random numbers of samples in the control group was 1, 2, 6, 9, 10, 11, 13, 14, 18 and trial group was 3, 4, 5, 7, 8, 12, 15, 16, 17.

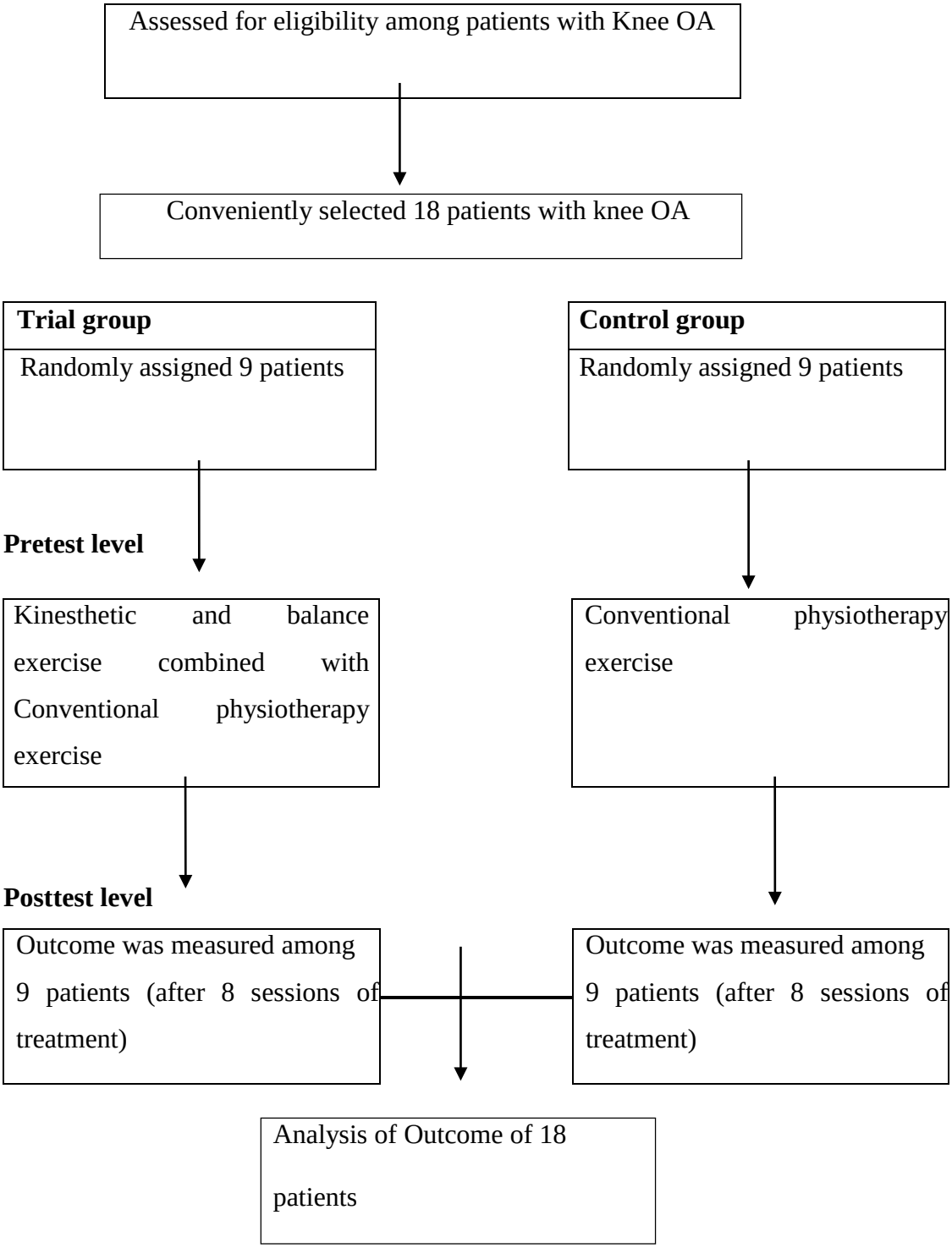


Figure 1: Flowchart of the phases of experimental research

3.6. Inclusion criteria:

- **Patient who was diagnosed as knee osteoarthritis:** Osteoarthritis can affect the main surfaces of knee joint and also the cartilage underneath knee cap (patella**).** Knee has to take extreme stresses, twists and turns. It is the most common presenting complaint (Shakoor et al., 2017)
- **Age more than 30 years:** Injury to the knee after age 30 years produces rapidly Progressive osteoarthritis, suggesting that the older joint is more vulnerable to major injury than the younger joint (Felson et al., 2004).
- **Both male and female were included**: Knee OA is degenerative joint disease which can occur both male and female those are found on research (Mishel et al**.,** 2013).
- **Pain duration more than 3 months** (Ashtian et al., 2018).
- **Numeric scale, pain was 5 or less than 5** (Snijders et al., 2013).
- **Unilateral or bilateral knee osteoarthritis:** Canaffect one or both limb (Mishel et al., 2013).
- **Patient who were willing to participate** (Takasaki et al., 2012).

3.7. Exclusion criteria:

- Recent surgery or fracture of femur, tibia, fibula and foot bones (Gilbert et al., 2013)
- Intra articular or epidural injection in the last 6 months (Maricar et al., 2017).
- Pathological conditions like heart disease (Eckstein et al., 2018).
- Current history of psychiatric or psychological treatment (Cubukcu et al., 2012)
- The participant who was participated in another study (Blumle et al., 2011).

3.8. Data processing:

Data collection tools: Data collection tools were data collection form, informed consent form, structured questionnaire, papers, pen and pencil.

Measurement Tools

- 10 cm numeric pain rating scale for measuring pain intensity in resting position
- Universal Goniometer to measure range of motion in knee joint.
- 96 points WOMAC disability scale to measure the disability status among patients with knee OA.

3.9. Data collection procedure:

The data collection procedure was conducted through assessing the patient, initial recording, treatment and final recording. After screening at the department, patients were assessed by a graduate physiotherapist. 8 sessions (2 days per week) of treatment was provided for each participant. Data was gathered through a pre-test, intervention and post-test and the data was collected by using a written questionnaire form which was formulated by the researcher. Pre-test was performed before beginning the treatment and the intensity of pain was noted with numeric pain rating scale, range of motion (ROM) was measured by universal goniometer and disability by WOMAC scale. The same procedure was performed to take post-test at the end of 8 sessions of treatment. A data collector provided the assessment form to each subject before starting treatment and after 8 sessions of treatment and patient was instructed to put mark on the subjective portion and in objective portion like ROM was completed by Physiotherapist. The data collector collected the data of both trial and control group in front of the Physiotherapist in order to minimize the bias.

3.10. Data analysis: Statistical analysis was performed by using statistical package for social science (SPSS) version 16.

3.11. Intervention:

Control group:

Only received conventional physiotherapy including,

- Ice
- contraction
- Strengthening (isometric & isotonic)
- Soft tissue release
- Patella mobilization (superior, inferior, lateral)
- Knee mobilization
- Stretching exercise (quadriceps and hamstring)
- Gapping
- Movement with mobilization
- Quadriceps strengthening exercise
    - Vastus medialis
    - Vastus lateralis
    - Rectus femoris
- Accessory movement
- Joint play technique
- Electrical modalities
    - IRR
    - UST
- Gym activities
- Cycling

Trial group:

1. Week

- ✓ Modified Romberg exercise (standing in balance with eye closed)
  On hard ground
  On soft ground
- ✓ Retro walking

- ✓ Walking on heels
- ✓ Walking on toes
- ✓ Walking with eye closed
- ✓ Standing on one extremity for 30 seconds

Leaning forward, backward and to the sides on one extremity (eyes open)

Leaning forward, backward and to the sides on one extremity (eyes closed)

Sitting down and standing up from a high chair slowly

2. Week (in addition)

- ✓ Exercise with rocker bottom balance board
- ✓ Sitting down and standing up from a low chair slowly
- ✓ Plyometric exercise (crossing a height of 15cm by jumping)
- ✓ 8 exercise

  a. walking slowly, wide circle

  b. walking quickly, wide circle

  c. walking quickly, narrow circle

3. Week (in addition)

- ✓ Exercise with BAPS board balance board
  - ❍ Balance with 2 legs, eyes open, multidirectional
  - ❍ Balance with 2 legs, eyes closed, multidirectional
  - ❍ Balance with one leg, eyes open, unidimensional
  - ❍ Balance with one leg, eyes closed, unidimensional
  - ❍ Balance with one leg, eyes open, multidimensional
  - ❍ Balance with one leg, eyes closed, multidimensional

- ✓ Minitrampoline exercise
- ✓ Plyometric exercise
- ✓ Carioca crossover maneuver

3.12. Statistical test:

Statistical analysis refers to the well-defined organization and interpretations of the data by systemic and mathematical procedure and rules (DePoy & Gitlin, 2015). Between groups analysis of pain, and disability was calculated by Mann-Whitney U-test and range of motion (ROM) by Unpaired t test. In addition, within group analysis of ROM was carried by Paired t test and within group analysis of pain and disability was analyzed by Wilcoxon signed rank test (Hicks, 2009).

3.13. Level of significance:

In order to find out the significance of the study, the "p" value was calculated. The p values refer to the probability of the results for experimental study. The word probability refers to the accuracy of the findings. A p value is called level of significance for an experiment and a p value of <0.05 was accepted as significant result for health service research. If the p value is smaller than the significant level, the results are said to be significant (DePoy & Gitlin, 2015).

3.14. Ethical consideration:

The research proposal was submitted to the Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI) and approval was taken from the board. The whole process of this research project was done by following the Bangladesh Medical Research Council (BMRC) guidelines and World Health Organization (WHO) Research guidelines. Again before starting data collection, researcher obtained permission from the head of physiotherapy department to access patient data based management and allow full involvement of physiotherapist who have been working in musculoskeletal physiotherapy department, CRP, Savar. The researcher strictly maintained the confidentiality regarding participant's condition and treatments. The researcher obtained consent from each participant to take part in this study. A signed informed consent form was received from each participant. The participants they 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 did not affect their treatment in the physiotherapy department and they still had the chance to receive same facilities. Every subject had the opportunity to discuss their problems with the senior authority or administration of CRP and had any questioned answer to their satisfaction.

3.15. Elimination of confounding variables

Confounding variable has an effect on the study variables which can affect the result of the study. There were some confounding variables in this study such as patient's age, history of taking recent physiotherapy intervention, oral NSAID, steroid injection or other treatment which could influence the result of the study to control the confounding variables, inclusion criteria were set to include only those subjects who have no history of taking recent physiotherapy intervention, oral NSAID, steroid injection or other treatment

18 patients were enrolled in the study. 9 in the Kinesthetic and Balance Exercise along with conventional treatment group (experimental group) and 9 in the only conventional treatment group (control group). Every participants of both experimental and control group scored their pain on numerical pain rating scale (NPRS), Range of motion on goniometer and Disability on WOMAC questionnaire before and after completion of the treatment.

4.1. Socio demographic information:

Table 1: Comparison of baseline characteristic of participants

Variables	**Group (Mean ± SD)**			
	Control Group	**N**	**Experiment Group**	**N**
Age of the participant(y)	51.11± 11.76	9	50.78 ± 12.81	9
Gender	1.67 ± .500	9	1.67 ± .50	9
Living area	1.89 ± .33	9	1.67 ± .50	9
Occupation	1.78 ± .97	9	1.44 ± .73	9

Table 1 compares the baseline characteristics of participants between trial and control group. In addition, two groups did not show significant differences at baseline regarding demographic characteristics and disease-related parameters. In trial group, the mean age (± SD) of the participants was 50.78 (± 12.81) years and in control group 51.11 (± 11.76) years. In trial group and control group, male and female ratio was similar. The mean living area (± SD) was 1.67 (± .50) months in trial group and 1.89 (± .33) in control group. In addition, mean occupation (± SD) in trial group was 1.44 (± .73) and 1.78 (± .97) in control group.

4.2. Pretest and posttest score of patient rated pain (cm) in general

Table 2: Comparison of pretest and posttest patient rated pain in trial and control group

Serial	**Trial group**			**Serial**		**Control group**	
No.	**Pre test score**	**Posttest score**	**Difference**	**No.**	**Pre test score**	**Post test score**	**Difference**
T1	5	1	4	C1	5	3	2
T2	5	2	3	C2	4	2	2
T3	5	1	4	C3	4	2	2
T4	5	2	3	C4	4	1	3
T5	5	1	4	C5	4	2	2
T6	4	1	3	C6	4	2	2
T7	5	1	4	C7	4	2	2
T8	4	1	3	C8	4	2	2
T9	5	1	4	C9	4	2	2
Total	43	11	32	**Total**	37	18	19
Mean	4.77	1.22	3.55	**Mean**	4.11	2.0	2.11

Table 2 demonstrated the level of pretest and posttest pain score between trial and control group. Mean pretest pain score was 4.77 cm and posttest was 1.22 cm with a mean difference of 3.55 cm in the trial group. In contrast, the mean pretest pain score in the control group was 4.11cm and posttest was 2.0 cm with a mean difference of 2.11 cm. In this part, data analysis was done using *U* test as numerical pain rating scale was regarded as non-parametric scale and there was two different groups (one was kinesthetic and balance exercise combined with conventional Physiotherapy as trial group and other was only conventional Physiotherapy as control group). Conversely, the effectiveness of trial group treatment as well as control group treatment was analyzed by Wilcoxon signed- rank test (within group analysis).

4.2.1. Patient rated general pain between groups (control and trial)

Table 3: Rank and test statistics of patient rated general pain between trial and control group

Category of the participants	N	Mean of post-test pain ± SD	Mean Ranks	Mann Whitney U test score	p
Trial group	**9**	**1.22 ± .441**	**6.39**		
Control group	**9**	**2.0 ± 0.500**	**12.61**	**12.500**	**0.011**
Total	**18**				

Table3 showed that the calculated value of *U* is 12.50 for pain in resting position and the table value of *U* for n1= 9 and n2= 9 is 18 for 0.011 in one tailed hypothesis. From the calculated value (*U*= 12.500), it is clear that *U* value between trial and control groups have an associated probability level which is equal to .011 (1.1%). Therefore, the result is significant for one tailed hypothesis. Since the p value is equal to 1.1%, the result is said to be significant and the null hypothesis (no relationship) is now can be rejected and the experimental hypothesis is supported.

This means that difference between trial group treatment (kinesthetic and balance exercise combined with conventional physiotherapy) and control group treatment (Conventional physiotherapy) was significant i.e. improvement occur in the trial group were not same with control group. They differ significantly as trial group improvement was more than control group.

4.2.2Patient rated pain in general within control group

Table 4: Rank and test statistics of patient rated general pain in control group

Pain at resting position (cm) (Pretest) - Pain at resting position(cm) (Posttest)	**N**	**Mean rank**	**Sum of Ranks**	**Test statistics (Wilcoxon signed-rank test)**	
				Based on negative ranks Z	**p**
Negative ranks	9	5.00	45.00		
Positive ranks	0	.00	.00	-2.89	0.008
Ties	0				
Total	9				

Table 4 described the comparison of participant's before (pre) and after (post) pain score. The table's legend showed that any participants did not have increased pain after application of conventional physiotherapy. 9 participants had higher pain score before application of conventional physiotherapy compare with after conventional physiotherapy. In addition, no participants had equal amount of pain before and after treatment in control group.

By examining the final test statistics portion of table by Wilcoxon signed rank test it was discovered that control group for 8 sessions conventional Physiotherapy treatment showed a statistically significant change in knee osteoarthritis patient (z= -2.89, p= 0.008).

4.2.3. Patient rated pain in general within trial group

Table 5: Rank and test statistics of patient rated general pain in trial group.

Pain at resting position (cm) (Pretest) - Pain at resting position(cm) (Posttest)	**N**	**Mean rank**	**Sum of Ranks**	**Test statistics (Wilcoxon signed-rank test)**	
				Based on negative ranks Z	**p**
Negative ranks	9	5.00	45.00		
Positive ranks	0	.00	.00	-2.74	0.012
Ties	0				
Total	9				

Table 5described the date on the comparison of participants' before (pre) and after (post) pain score. The table's legend showed that any participants did not have increased pain after application of kinesthetic and balance exercise combined with conventional physiotherapy (trial group). 9 participants had higher pain score before application of kinesthetic and balance combined with conventional physiotherapy compare with after same treatment. Conversely, no participants had equal amount of pain before and after treatment in trial group.

By examining the final test statistics portion of table by Wilcoxon signed-rank test it was discovered that the trial group for 8 sessions kinesthetic and balance exercise combined with conventional physiotherapy (trial group) treatment showed a statistically significant change in knee osteoarthritis patient ($Z= -2.74$, $p= 0.012$).

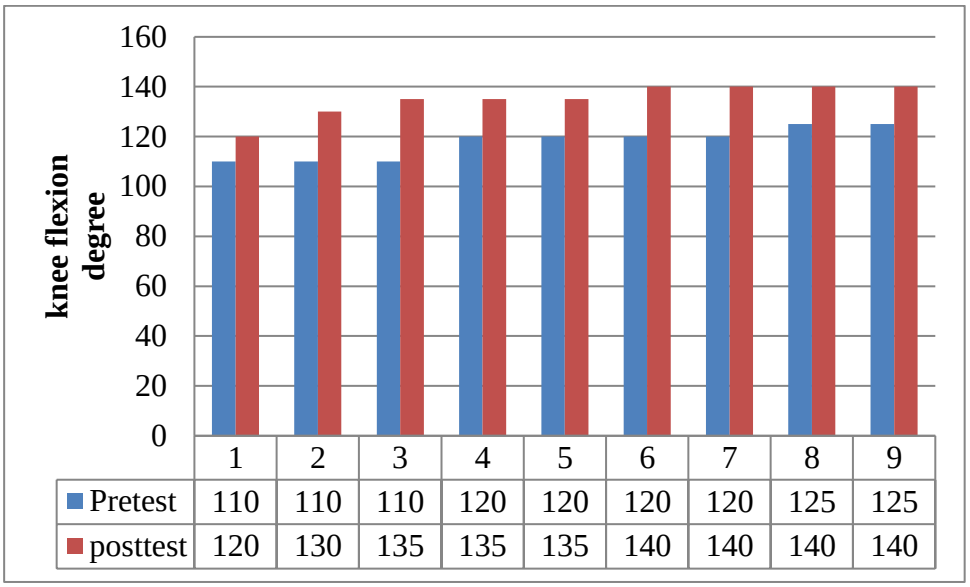
4.3. Knee range of motions (degree) in Pretest and Posttest Score of Trial and Control group

Table 6: Knee range of motions (degree) at pretest and posttest level with mean difference

	Trial group			**Control group**		
	Pretest	**Post test**	**Mean difference**	**Pretest**	**Post test**	**Mean difference**
Flexion, mean (degree)	117.78	135.00	17.22	111.67	123.89	12.22
Extension, mean (degree)	0.00	0.00	0.00	0.00	0.00	0.00

Table 6 showed mean differences of knee range of motion (degree) between trial and control group. In addition, each type of movements showed higher mean difference in trial group compared with control group.

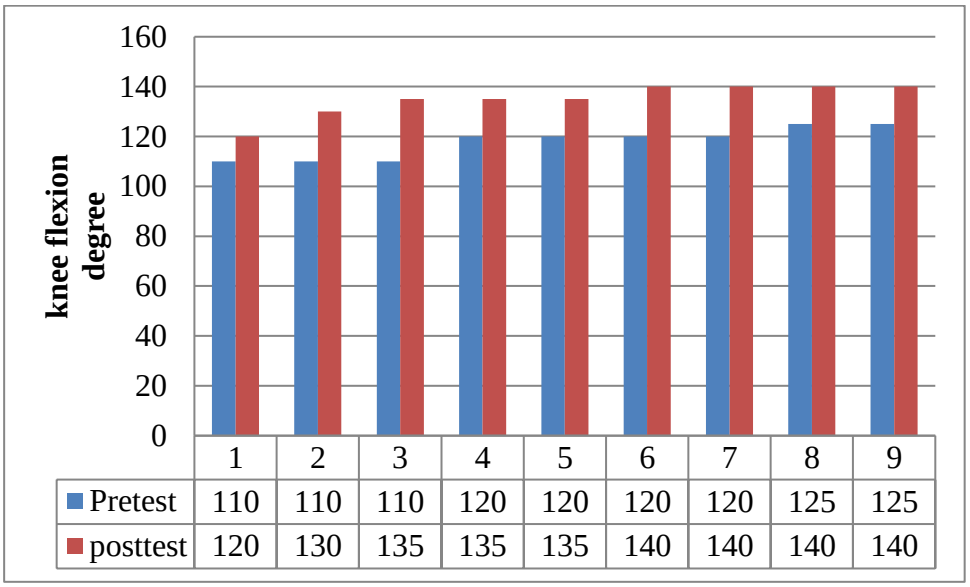
4.4. Pretest and posttest flexion (degree) in control group.



	1	2	3	4	5	6	7	8	9
Pretest	110	110	110	120	120	120	120	125	125
posttest	120	130	135	135	135	140	140	140	140

Figure 2: Pretest and posttest score comparison of flexion (degree) in control group

4.5. Pretest and posttest flexion (degree) in trial group.



	1	2	3	4	5	6	7	8	9
Pretest	110	110	110	120	120	120	120	125	125
posttest	120	130	135	135	135	140	140	140	140

Figure 3: Pretest and posttest score comparison of flexion (degree) in trial group

4.6. Flexion of knee between trial and control group

Table 7: Statistical outcome of flexion (degree) between trial and control group

	Unpaired t	**df**	**P**
Difference between trial and control group in flexion (degree)	1.689	16	.002

Table 7 described that the calculated *t* value is 1.689 and for df =16, the calculated t value is smaller than table value that has an associated probability level of .2 %. This means that the probability of random error being responsible for the outcome of this experiment is 0.2 in 100. As the usual cut- off point for claiming support for the experimental hypothesis was .2% and it could be said that the result was significant. Thus, Kinesthetic and balance exercise combined with conventional physiotherapy was more effective than among patients with knee osteoarthritis.

4.6.1.Flexion of knee within control and trial group

Table 8: Statistical outcome of flexion (degree) within trial and control group

	Mean	**Std.Deviation**	**Paird t**	**df**	**p**
Flexion (degree) of knee (control group)	-12.22	3.63	-10.09	8	0.000
Flexion (degree) of knee (trial group)	-17.22	6.180	-8.360	8	0.000

Table 8 showed that within group analysis of knee flexion (degree), the improvement of ROM was highly significant and in fact in control group (p= 0.000) and trial group (p= 0.000)

4.7. Functional disability information:

4.7.1. Pretest and posttest score of WOMAC score in control group

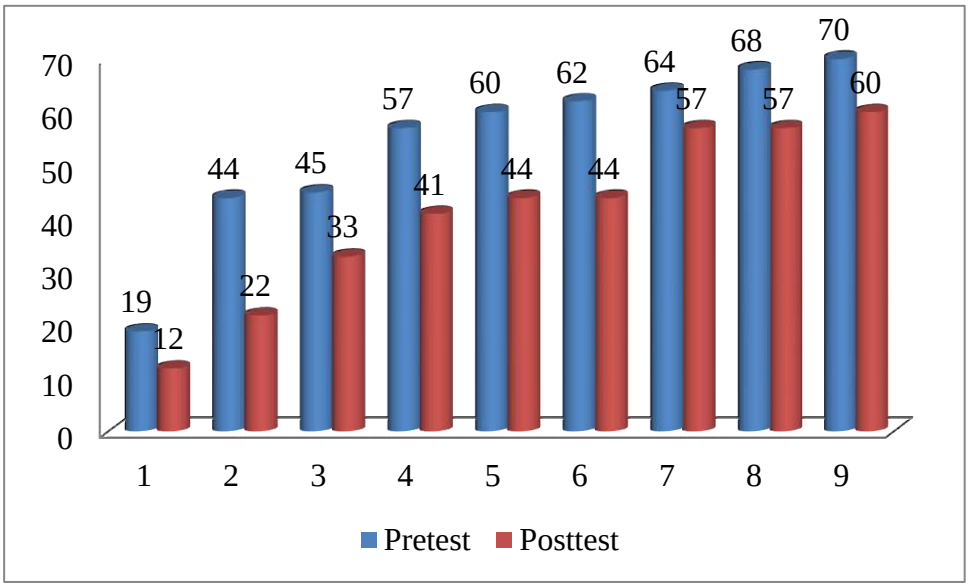


Figure 4: Pretest and posttest score comparison of functional disability in control group

4.7.2.Pretest and posttest score of WOMAC score in trial group

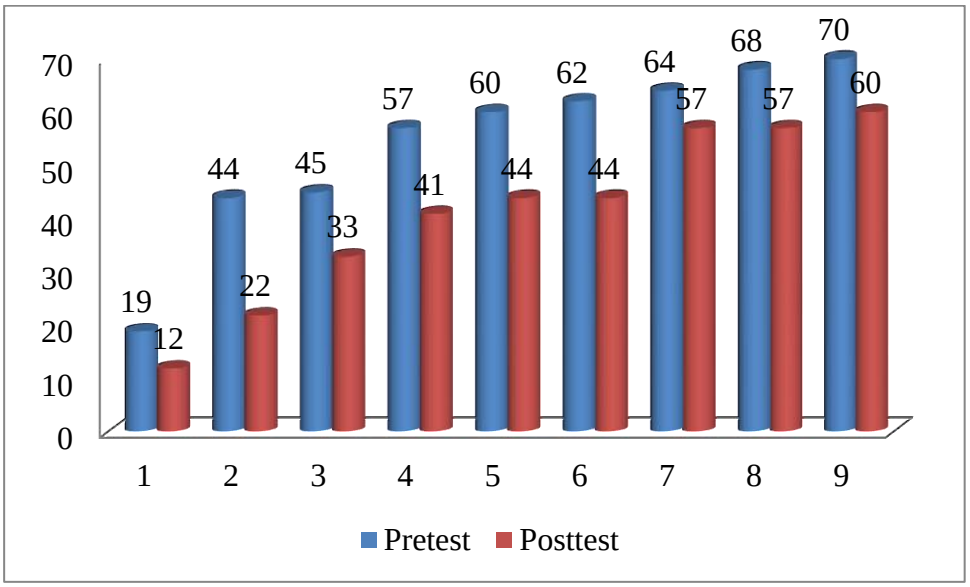


Figure 5: Pretest and posttest score comparison of functional disability in trial group.

4.8. WOMAC osteoarthritis index between trial and control group

Table 9: Rank and test statistics of WOMAC osteoarthritis index between trial and control group

Category of the participants	N	Mean of post-test disability score on W0MAC	Mean Ranks	Mann Whitney U test score	p
Trial group	**9**	**26.78 ± 11.13**	**6.83**		
Control group	**9**	**41.11 ± 16.42**	**12.17**	**16.500**	**0.031**
Total	**18**				

Table 9 showed that the calculated value of *U* is 16.500 for WOMAC osteoarthritis index. From the calculated value (*U*= 16.500), it was clear that *U* value between trial and control groups had an associated probability of equal to 0.00. Therefore, the result was significant for one tailed hypothesis. This means that difference between trial group treatment (kinesthetic and balance exercise combined with conventional physiotherapy) and control group treatment (conventional physiotherapy) was significant i.e. improvement occur in the trial group were not same than control group. They differ significantly as trial group improvement was more than control group. Thus, kinesthetic and balance exercise combined with conventional physiotherapy was effective than conventional physiotherapy among patients with knee osteoarthritis.

4.8.1. WOMAC osteoarthritis index within control group

Table 10: Rank and test statistics of WOMAC osteoarthritis index within control group.

Disability score in WOMAC at pre-test - Disability score in WOMAC at post test	N	Mean Rank	Sum of Ranks	Test Statistics (Wilcoxon Signed-Rank Test)	
				Based on positive ranks Z	P
Negative rank	9	5.00	45.00		
Positive rank	0	0.00	.00	-2.670	0.016
Ties	0				
Total	9				

Table 10 described the comparison of participant's before (pre) and after (post) WOMAC osteoarthritis index score. The table's legend showed that any participants did not have increased disability after application of conventional physiotherapy. In addition, 9 participants had higher disability score before application of conventional physiotherapy compare with after application of conventional physiotherapy. Besides, no participants had equal amount of disability score in WOMAC before and after treatment in control group.

By examining the final test statistics portion of table by Wilcoxon signed-rank test it was discovered that the control group for 8 sessions conventional physiotherapy treatment showed a statistically significant change in WOMAC score with knee osteoarthritis($Z= -2.670$, $p= 0.016$)

4.8.2. WOMAC osteoarthritis index within trial group

Table 11: Rank and test statistics of WOMAC osteoarthritis index within the trail group.

Disability score in WOMAC at pre-test - Disability score in WOMAC at post test	N	Mean Rank	Sum of Ranks	Test Statistics(Wilcoxon Signed-Rank Test)	
				Based on positive ranks Z	P
Negative rank	9	5.00	45.00		
Positive rank	0	.00	.00	-2.668	0.016
Ties	0				
Total	9				

Table 11 described the comparison of participants' before (pre) and after (post) WOMAC osteoarthritis index score. The table's legend showed that any participants did not have increased disability after application of kinesthetic and balance exercise combined with conventional physiotherapy. In addition, 9 participants had higher WOMAC score before application of kinesthetic and balance exercise combined with conventional physiotherapy compare with after application of kinesthetic and balance exercise combined with conventional physiotherapy. Besides, no participants had equal amount of disability before and after treatment in trial group. By examining the final test statistics portion of table by Wilcoxon signed-rank test it was discovered that the trial group for 8 sessions kinesthetic and balance exercise combined with conventional physiotherapy treatment showed a statistically significant change in WOMAC score with knee osteoarthritis ($Z= -2.668$, $p= 0.016$).

Both the results showed equal amount of statistical significant difference within control and trail group but there was variation of median in each group at pretest and posttest score.

CHAPTER-V DISCUSSION

In this study, the researcher investigated the effects of kinesthetic and balance exercise on knee osteoarthritis. For this study, the researcher measured age, gender, living area, occupation, height, weight, BMI, duration of pain and the changes in resting position pain, knee flexion and functional ability.

This study found the effects of kinesthetic and balance exercise on knee osteoarthritis with 18 participants. In contrast 18 participants, age range was 30 to 70 years. On the other hand, a study about effectiveness of kinesthetic and balance exercise in knee osteoarthritis with 66 participants. In their study, age range was 35 to 65 years. This is almost similar as this study. However patients' participation was not similar with this study (Duracoglu et al., 2005).

The current study demonstrated that, gender was also important variable. Both male and female were included in this study. Among 18 participants, male participants were 6 and female participants were 12. On the other hand, another study revealed gender as an important variable. In terms of their study, participants were only female (Dorcoglu et al., 2005). This is similar in terms of both study that female were more affected than male. Meanwhile, difference between 2 studies was patient participation. In their study participants were 66 and in contrast, the present study participants were 18.

The present study also discovered that various occupation as housewife, businessman and service holder. Meanwhile others found, different occupation includes students, housewife and working women (Doracoglu et al., 2005). In addition, both studies found that knee osteoarthritis was no relation with any specific occupation.

In present study, Numeric pain rated scale (NPRS) was used to examine the pain. On the other hand, another study revealed that pain intensity was measured by visual analogue scale in two periods of before and after treatment (Ashtian et al., 2018). The basic difference between two studies was significant results. In their study, significant value was 0.28 and in contrast, the current study significant value was 0.011 in between group analysis.

The current study found that, significant improvement in knee range of motion within and between group analyses. In this study, significant value was 0.002 in between group and 0.00 in within group. MS et al.,(2008) conducted the effects of home based knee stretching exercise on knee range of motion and gait speed in patients with knee osteoarthritis. In their study significant improvement observed in knee range of motion in supine position (p= 0.007) and during gait (p= 0.001). In current study, range of motion was measured by goniometer. MS et al., (2008) found similar findings, knee range of motion in supine position measured by goniometer. In addition, knee range of motion during gait measured by 10m walking test.

In current study, WOMAC scale (Western Ontario and McMaster Universities Index) was used to explore functional disability. Meanwhile (Sled et al., 2010) found similar findings; functional disability was measured by WOMAC scale. Based on the results of the study disability was reduced significantly after application of kinesthetic and balance exercise with conventional Physiotherapy. In addition, only conventional physiotherapy was also found effective. Between groups results in terms of WOMAC osteoarthritis index showed significant (p= 0.031) improvement of disability. In addition, within group analysis (within trial, p = 0.016 and within control, p= 0.016) also found significant improvement in disability. On the other hand, another study demonstrated that significant improvement in terms of hip abductor strength (p= 0.036) but not in the knee adduction moment (p= 0.52) (Sled et al., 2010).

5.1. Limitation of the study:

It is extremely difficult to do a research without any limitations. This research has also some limitations and barriers in this research project which had affect the accuracy of the study, these are as follows:

- There were a small number of samples in both groups. Only 18 patients were selected for this study and it was not sufficient enough for the study because wider population were affected in this condition.
- The samples were collected only from the selected area of CRP musculoskeletal department which could not be generalized the result for the wider population of knee osteoarthritis in Bangladesh.

- This is the first study provided data on kinesthetic and balance exercise among the patients with knee osteoarthritis in the perspective of Bangladesh, so there were little evidence to support the result of this study and difficult to compare with the other research.
- Study was done from undergraduate level. So there were limited experience with techniques and strategies in terms of the practical aspects of research. As it was the first study so might be there were some mistakes that overlooked by the supervisor and the honorable teacher.

CHAPTER-VI RECOMMENDATION & CONCLUSION

6.1. Recommendation:

As a consequence of this research it is recommended to do further study including comparison of the conventional Physiotherapy alone and kinesthetic and balance exercise with conventional Physiotherapy to assess the effectiveness of these interventions with-

- This research is done by use of small sample size. So it is recommended for next generation to done this research with large sample.
- Randomization control trial is the higher aches of evidence of quantitative research to find out more valid result. In this research subjects were selected by convenience sampling.
- Like other countries, knee osteoarthritis patients are likely to be an upcoming burden for Bangladesh, for this reason, it is important to develop research based evidence of Physiotherapy practice in this area. Physiotherapist's practice which is evidence based in all aspect of health care.

6.2. Conclusion:

The result of this experimental study have identified that the effectiveness of kinesthetic and balance exercise with conventional Physiotherapy are better treatment than the conventional Physiotherapy in patient with knee osteoarthritis. Participants in trail group who received conventional Physiotherapy with kinesthetic and balance exercise showed a greater benefit than those in only conventional Physiotherapy that is control group, which indicate that the kinesthetic and balance exercise with conventional Physiotherapy can be an effective therapeutic approach for patient with knee osteoarthritis.

From this research the researcher wishes to explore the effectiveness of kinesthetic and balance exercise with conventional Physiotherapy in patient with knee osteoarthritis, which will be helpful to facilitate their rehabilitation and to enhance functional activities.

Knee osteoarthritis is the cause of global functional disability for elderly people which have the manifestations are not only pain but also limitation in range of motion and restriction to activities of daily living. From this research, researcher also concluded the specific variables and comparison of their improvement rates. This will aid the professionals to decide the specific evidence based protocol for applying interventions in knee osteoarthritis patients.

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APPENDIX I

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)
Bangladesh Health Professions Institute (BHPI)
(The Academic Institute of CRP)

Ref. CRP-BHPI/IRB/10/18/1263

Date: 22/10/2018

To,
Sharmin Akter
B.Sc. in Physiotherapy,
Session: 2013-2014, Student ID:112130229
BHPI, CRP, Savar, Dhaka-1343, Bangladesh.

Subject: Approval of the thesis proposal **"Effectiveness of Kinesthetic and Balance Exercise along with Conventional Physiotherapy in patient with Knee Osteoarthritis"** by ethics committee.

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

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

The purpose of the study is to find out the effectiveness of kinesthetic and balance exercise along with conventional physiotherapy in patient with knee osteoarthritis. The study involves use of a questionnaire of self-structure and measurement tools to explore theresult 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 11 AM on 24th January, 2018 at BHPI.

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

Best regards,

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

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ, ফোন ঃ ৭৭৪৫৪৬৪-৫, ৭৭৪১৪০৪ ফ্যাক্স ঃ ৭৭৪৫০৬৯
CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404, Fax : 7745069, E-mail : contact@crp-bangladesh.org, www.crp-bangladesh.org

APPENDIX II

CONSENT FORM (ENGLISH)

Assalamu-alaikum,

I am Sharmin Akter, Student 4th Professional year B.Sc in Physiotherapy at Bangladesh Health Professions Institute (BHPI), CRP. I shall have to conduct a research and it is a part of my academic activity. My research title is "Effectiveness of Kinesthetic and Balance Exercise along with Conventional Physiotherapy among Patients with Knee Osteoarthritis". Through this experimental research I will test the hypothesis "Kinesthetic and balance exercise along with conventional Physiotherapy is more effective than only conventional Physiotherapy for the treatment of patients with knee osteoarthritis.

To fulfill my research project, I need to collect data. So you can be a respected participant of my research and I would like to request you as a subject of my study. I want to meet you couple of sessions, during your regular physiotherapy treatment. I am assuring you that exercises which will be given are pain free and safe for you.

I would like to inform you that this is a purely academic study and will not be used for any other purposes. I assure that all data will be kept confidential. Your participation will be voluntary. You may have the right to withdraw consent and discontinue participation at any time of the experiment. You also have the right not to answer a particular question that you don't like.

If you have any query about the study or right as a participant, you may contact with me or my Supervisor Mohammad Habibur Rahman, Associate Professor of Physiotherapy, BHPI.

Do you have any questions before I start?

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

☐ Yes ☐ No

Signature of the participant …… Date ……

Signature of the data collector ……. Date ……

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

APPENDIX III

সম্মতিপত্র

আসসালামু আলাইকুম,

আমি শারমিন আক্তার, বাংলাদেশ হেলথ প্রফেশন্স ইনস্টিটিউট (বি.এইচ.পি.আই), সি.আর.পি এর বি.এস.সি ইন ফিজিওথেরাপী কোর্সের ৪র্থ বর্ষের শিক্ষার্থী। আমার প্রাতিষ্ঠানিক কাজের অংশ হিসেবে আমাকে একটি গবেষণা করতে হবে। আমার গবেষণার বিষয় হলো, "হাঁটুর অস্থিসন্ধির রোগের চিকিৎসায় প্রচলিত ফিজিওথেরাপী সহ কাইনেসথেটিক এবং ভারসাম্য এক্সারসাইজের কার্যকারিতা"। এ পরীক্ষামূলক গবেষণার মাধ্যমে আমি একটি পরীক্ষা করবো যে, হাঁটুর অস্থিসন্ধির রোগীদের ক্ষেত্রে শুধুমাত্র প্রচলিত ফিজিওথেরাপী অপেক্ষা প্রচলিত ফিজিওথেরাপীর সাথে কাইনেসথেটিক এবং ভারসাম্য এক্সারসাইজ বেশী কার্যকারী হবে।

গবেষণাটি সম্পাদনের জন্য, আমার তথ্য সংগ্রহ করা প্রয়োজন হবে। এজন্য, আপনি আমার গবেষণার একজন সম্মানিত অংশগ্রহনকারী হতে পারেন। আপনার নিয়মিত ফিজিওথেরাপীর সময় আমি আপনার সাথে কয়েকবার দেখা করব। আমিনিশ্চিত করছি যে, চিকিৎসা পদ্ধতি প্রয়োগ করা হবে তা আপনার জন্য ব্যথামুক্ত ও নিরাপদ।

আমি আপনাকে অবগত করছি যে, এটি একটি সম্পূর্ণ প্রাতিষ্ঠানিক গবেষণা এবং এটি অন্য কোনো উদ্দেশ্যে ব্যবহৃত হবে না। আমি আপনাকে আরো নিশ্চিত করছি যে, আপনার প্রদত্ত সকল তথ্য গোপন রাখা হবে। আপনার অংশগ্রহন হবে ইচ্ছাকৃত। এই গবেষণা থেকে আপনি যে কোনো মুহূর্তে সম্মতি প্রত্যাহার করতে পারবেন।

আপনার যদি এই গবেষণা সম্পর্কে এবং অংশগ্রহণকারী হিসেবে আপনার অধিকার সম্পর্কে কোনো জিজ্ঞাসা থাকে তবে আপনি আমার সাথে অথবা আমার পর্যবেক্ষক মোহাম্মদ হাবিবুর রহমান, ফিজিওথেরাপী সহযোগী অধ্যাপক, বি.এইচ.পি.আই এর সাথে যোগাযোগ করতে পারবেন।

উপাত্ত সংগ্রহের পূর্বে আপনার কি কোনো প্রশ্ন আছে?
আমি কি আপনার সাক্ষাৎকার গ্রহনের সম্মতি পেতে পারি?

☐ হ্যাঁ ☐ না

অংশগ্রহণকারীর স্বাক্ষর.....তারিখ.....

তথ্যসংগ্রহকারীর স্বাক্ষর.....তারিখ.....

স্বাক্ষীর স্বাক্ষর.....তারিখ.....

APPENDIX IV

English questionnaire

Patient Name: **Mobile No:**

Patient code no: **Address:**

Date:

This questionnaire was developed to identify the effectiveness of Kinesthetic and Balance Exercise Along with conventional Physiotherapy .There are few question listed in the below table and few possible answers were selected as per each question. Its seems that you may feel comfortable in multiple answers of a single question but please give tick (√) mark on single answer seems that you may feel comfortable in multiple which seems most closely linked to you.

Part I: Socio demographic characteristics

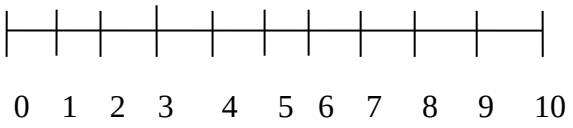
SL No.	**Question**	**Response**
1.	Age of the participant	……(years)
2.	Gender	☐ Male ☐ Female
3.	Living area	☐ Rural ☐ Urban
4.	Occupation	……

Part II: Medical Information

SL No.	Question	Response
5.	Height	……(m)
6.	Weight	……(Kg)
7.	BMI	……(Kg/m^2)
8.	Duration of pain	……..(months)

Pretest data

Part III: Pain related information

SL No.	Question	Response
9.	Current pain state in the knee at resting position (please give a circle in appropriate rating)	

Part IV: Range of motion related information

SL No.	Question	Response
10.	Flexion	……...(Degree)
11.	Extension	……....(Degree)

Part V: Disability related information

Instructions: Please rate the activities in each category according to the following

Scale of difficulty:
0 = none
1 = Slight
2 = Moderate
3 = Very
4 = extremely

Circle **one number** for each activity.

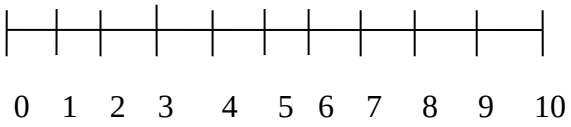
Total Score: _____ / 96 = _____%

SL No.	Question	Response
12. Stiffness	**Pain:**	
	• Walking	0 1 2 3 4
	• Stair Climbing	0 1 2 3 4
	• Nocturnal	0 1 2 3 4
	• Rest	0 1 2 3 4
	• Weight bearing	0 1 2 3 4
13.Stiffness	• Morning stiffness	0 1 2 3 4
	• Stiffness occurring	0 1 2 3 4

	later in the day	
14. Physical Function	• Descending stairs	0 1 2 3 4
	• Ascending stairs	0 1 2 3 4
	• Rising from sitting	0 1 2 3 4
	• Standing	0 1 2 3 4
	• Bending to floor	0 1 2 3 4
	• Walking on flat surface	0 1 2 3 4
	• Getting in / out ofcar	0 1 2 3 4
	• Going shopping	0 1 2 3 4
	• Putting on socks	0 1 2 3 4
	• Lying in bed	0 1 2 3 4
	• Taking off socks	0 1 2 3 4
	• Rising from bed	0 1 2 3 4
	• Getting in/out of bath	0 1 2 3 4
	• Sitting	0 1 2 3 4
	• Getting on/off toilet	0 1 2 3 4
	• Heavy domestic duties	0 1 2 3 4
	• Light domestic duties	0 1 2 3 4

Post Test data

Part III: Pain related information

SL No.	Question	Response
9.	Current pain state in the knee at resting position (please give a circle in appropriate rating)	

Part IV: Range of motion related information

SL No.	Question	Response
10.	Flexion	……...(Degree)
11.	Extension	……....(Degree)

Part V: Disability related information

Instructions: Please rate the activities in each category according to the following

Scale of difficulty:
0 = none
1 = Slight
2 = Moderate
3 = Very
4 = extremely

Circle **one number** for each activity

Total Score: _____ / 96 = _____%

SL No.	Question	Response
12. Stiffness	**Pain:**	
	• Walking	0 1 2 3 4
	• Stair Climbing	0 1 2 3 4
	• Nocturnal	0 1 2 3 4
	• Rest	0 1 2 3 4
	• Weight bearing	0 1 2 3 4
13.Stiffness	• Morning stiffness	0 1 2 3 4
	• Stiffness occurring later in the day	0 1 2 3 4
14. Physical Function	• Descending stairs	0 1 2 3 4
	• Ascending stairs	0 1 2 3 4
	• Rising from sitting	0 1 2 3 4
	• Standing	0 1 2 3 4
	• Bending to floor	0 1 2 3 4
	• Walking on flat surface	0 1 2 3 4

	• Getting in / out of car	0 1 2 3 4
	• Going shopping	0 1 2 3 4
	• Putting on socks	0 1 2 3 4
	• Lying in bed	0 1 2 3 4
	• Taking off socks	0 1 2 3 4
	• Rising from bed	0 1 2 3 4
	• Getting in/out ofbath	0 1 2 3 4
	• Sitting	0 1 2 3 4
	• Getting on/off toilet	0 1 2 3 4
	• Heavy domestic duties	0 1 2 3 4
	• Light domestic duties	0 1 2 3 4

APPENDIX V

প্রশ্নপত্র

রোগীর নামঃ তারিখঃ

রোগীরকোডনম্বরঃ ঠিকানাঃ

মোবাইল নম্বরঃ

হাঁটুর অস্থিসন্ধি রোগের চিকিৎসায় প্রচলিত ফিজিওথেরাপী সহ কাইনেসথেটিক এবং ভারসাম্য এক্সারসাইজের কার্যকারীতা প্রমাণ করতে এই প্রশ্নপত্রটি ধার্য করা হয়েছে। এটা মনে হতে পারে যে, আপনি একক প্রশ্নের একাধিক উত্তরগুলিতে সন্তুষ্ট অনুভব করতে পারেন দয়া করে একক উত্তরটি টিক (√)চিহ্ন দিন যেটা আপনি একাধিকের মধ্যে সন্তুষ্টিজনক মনে করেন যা আপনার সমস্যাটিকে সঠিকভাবে নির্দেশ করে।

পর্ব ১: সামাজিক ও বৈশ্বয়িক বিষয়ক বৈশিষ্ট্য

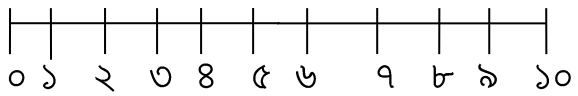
ক্রমিক নং	প্রশ্ন	উত্তর
১.	অংশগ্রহণকারীর বয়স	.....বছর
২.	লিঙ্গ	☐পুরুষ ☐মহিলা
৩.	বসবাসের এলাকা	☐গ্রাম ☐শহর
৪.	পেশা	.....

পর্ব ২: চিকিৎসা বিষয়ক তথ্য

ক্রমিক নং	প্রশ্ন	উত্তর
৫.	উচ্চতা	.....(মিটার)
৬.	ওজন	.....(কেজি)
৭.	বি.এম.আই	.....(কেজি/মিটার^২)
৮.	ব্যথার সময়কাল	.....(মাস)

পরীক্ষার আগের উপাত্ত

পর্ব ৩: ব্যথা সম্পর্কিত তথ্য

ক্রমিক নং	প্রশ্ন	উত্তর
৯.	বিশ্রাম অবস্থায় হাঁটুর মধ্যে বর্তমান ব্যথার অবস্থা (অনুগ্রহ করে উপযুক্ত সিদ্ধান্তে একটি বৃত্ত দিন)	

পর্ব ৪: গতির রেঞ্জ সম্পর্কিত তথ্য

ক্রমিক নং	প্রশ্ন	উত্তর
১০.	ফ্লেক্সন	.....ডিগ্রী
১১.	এক্সটেনশন	.....ডিগ্রী

পর্ব ৫: অক্ষমতা সম্পর্কিত তথ্য

নির্দেশঃ অনুগ্রহ করে প্রতিটি বিভাগের কার্যক্রম নিম্নলিখিত অনুযায়ী নির্ধারণ করি।

প্রতিবন্ধক স্কেলঃ

০= কোনোটা না

১= কিছুটা

২= মাঝামাঝি

৩= অনেক

৪= অত্যাধিক

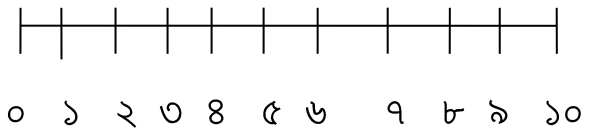
প্রতিটি কার্যক্রমের জন্য একটি সংখ্যা বৃত্ত করি

সম্পূর্ণ ফলাফলঃ ...../৯৬= .....%

ক্রমিক নং	প্রশ্ন	উত্তর
১২.	ব্যথা	
	• হাঁটা	০ ১ ২ ৩ ৪
	• সিঁড়ি আরোহন	০ ১ ২ ৩ ৪
	• রাত্রীকাল	০ ১ ২ ৩ ৪
	• বিশ্রাম অবস্থা	০ ১ ২ ৩ ৪
	• ভার বহন	০ ১ ২ ৩ ৪
১৩.	স্টিফনেজ	
	• সকালের স্টিফনেজ	০ ১ ২ ৩ ৪
	• দিনের সাথে আগত স্টিফনেজ	০ ১ ২ ৩ ৪
১৪.	শারীরিক কাজ	
	• ক্রমবর্ধমান সিঁড়ি	০ ১ ২ ৩ ৪
	• আরোহন সিঁড়ি	০ ১ ২ ৩ ৪
	• বসা থেকে উঠা	০ ১ ২ ৩ ৪
	• দাঁড়ানো	০ ১ ২ ৩ ৪
	• মেঝের দিকে ঝোকা	০ ১ ২ ৩ ৪
	• সমতল পৃষ্ঠের উপর হাঁটা	০ ১ ২ ৩ ৪
	• গাড়ির মধ্যে/বাহিরের অভিজ্ঞতা	০ ১ ২ ৩ ৪
	• কেনাকাটা করতে যাওয়া	০ ১ ২ ৩ ৪
	• মোজা পড়ার সময়	০ ১ ২ ৩ ৪
	• বিছানায় শয়ন	০ ১ ২ ৩ ৪
	• মোজা খোলার সময়	০ ১ ২ ৩ ৪
	• বিছানা থেকে উঠা	০ ১ ২ ৩ ৪
	• গোসলের মধ্যে/বাহিরে	০ ১ ২ ৩ ৪
	• বসা	০ ১ ২ ৩ ৪
	• শৌচাগার চালু/বন্ধ হচ্ছে	০ ১ ২ ৩ ৪
	• ভারী সাংসারিক কর্তব্য	০ ১ ২ ৩ ৪
	• সহজ সাংসারিক কর্তব্য	০ ১ ২ ৩ ৪

পরীক্ষার পরের উপাত্ত

পর্ব ৩: ব্যথা সম্পর্কিত তথ্য

ক্রমিক নং	প্রশ্ন	উত্তর
৯.	বিশ্রাম অবস্থায় হাঁটুর মধ্যে বর্তমান ব্যথার অবস্থা (অনুগ্রহ করে উপযুক্ত সিদ্ধান্তে একটি বৃত্ত দিন)	

পর্ব ৪: গতির রেঞ্জ সম্পর্কিত তথ্য

ক্রমিক নং	প্রশ্ন	উত্তর
১০.	ফ্লেক্সন	.....ডিগ্রী
১১.	এক্সটেনশন	.....ডিগ্রী

পর্ব ৫: অক্ষমতা সম্পর্কিত তথ্য

নির্দেশঃ অনুগ্রহ করে প্রতিটি বিভাগের কার্যক্রম নিম্নলিখিত অনুযায়ী নির্ধারণ করি।

প্রতিবন্ধক স্কেলঃ

০= কোনোটা না

১= কিছুটা

২= মাঝামাঝি

৩= অনেক

৪= অত্যাধিক

প্রতিটি কার্যক্রমের জন্য একটি সংখ্যা বৃত্ত করি

সম্পূর্ণ ফলাফলঃ ...../৯৬= .....%

ক্রমিক নং	প্রশ্ন	উত্তর
১২.	ব্যথা	
	• হাঁটা	০ ১ ২ ৩ ৪
	• সিঁড়ি আরোহন	০ ১ ২ ৩ ৪
	• রাত্রীকাল	০ ১ ২ ৩ ৪
	• বিশ্রাম অবস্থা	০ ১ ২ ৩ ৪
	• ভার বহন	০ ১ ২ ৩ ৪
১৩.	স্টিফনেজ	
	• সকালের স্টিফনেজ	০ ১ ২ ৩ ৪
	• দিনের সাথে আগত স্টিফনেজ	০ ১ ২ ৩ ৪
১৪.	শারীরিক কাজ	
	• ক্রমবর্ধমান সিঁড়ি	০ ১ ২ ৩ ৪
	• আরোহন সিঁড়ি	০ ১ ২ ৩ ৪
	• বসা থেকে উঠা	০ ১ ২ ৩ ৪
	• দাঁড়ানো	০ ১ ২ ৩ ৪
	• মেঝের দিকে ঝোকা	০ ১ ২ ৩ ৪
	• সমতল পৃষ্ঠের উপর হাঁটা	০ ১ ২ ৩ ৪

	• গাড়িরমধ্যে/বাহিরের অভিজ্ঞতা	০	১	২	৩	৪
	• কেনাকাটা করতে যাওয়া	০	১	২	৩	৪
	• মোজা পড়ার সময়	০	১	২	৩	৪
	• বিছানায় শয়ন	০	১	২	৩	৪
	• মোজা খোলার সময়	০	১	২	৩	৪
	• বিছানা থেকে উঠা	০	১	২	৩	৪
	• গোসলের মধ্যে/বাহিরে	০	১	২	৩	৪
	• বসা	০	১	২	৩	৪
	• শৌচাগার চালু/বন্ধ হচ্ছে	০	১	২	৩	৪
	• ভারী সাংসারিক কর্তব্য	০	১	২	৩	৪
	• সহজ সাংসারিক কর্তব্য	০	১	২	৩	৪

APPENDIX VI

Treatment protocol

Centre for the Rehabilitation of the Paralysed (CRP)
Department of Physiotherapy
CRP, P.O: CRP-Chapain, Savar, Dhaka-1343, Bangladesh
Tel: 880-2-7745464-5, Fax: 880-2-7745069, E-mail: contact@crp-bangladesh.org, Website: www.crp-bangladesh.org

Ref :

Date : 19/07/18

Title: Effectiveness of Kinesthetic and Balance Exercise along with Conventional Physiotherapy in Patient with Knee Osteoarthritis

Conventional Physiotherapy for patients with Knee Osteoarthritis:

1. Isometric contraction
2. strengthening exercise (isometric & isotonic)
3. Soft tissue release
4. Patella mobilization (superior, interior, lateral)
5. Knee mobilization
6. Stretching exercise (quadriceps & hamstring)
7. Gapping
8. Movement with mobilization
9. Quadriceps strengthening exercises
    - Vastus medialis
    - Vastus lateralis
    - Rectus femoris
10. Accessory movement
11. Joint play technique
12. Electrical modalities
    - Ice
    - IRR
    - Gym activities
    - Cycling

19/07/18

Mohammad Anwar Hossain
Associate Professor & Head of Dept.
Physiotherapy Department
CRP, Savar, Dhaka-1343

Branch Offices: CRP-Mirpur, Plot: A/5, Block-A, Section-14, Mirpur, Dhaka-1216, Tel: +8802-8020178, 8053652, 8053663, 8053664, CRP-Gonokbari: P.O: Echarafa Bazar, P.S. Ashulia, Savar, Dhaka, Tel: 880-2-7791281, CRP-Gobindapur: P.O. Kazoldhara, P.S. Kulaura, Dist. Moulvibazar, Mobile: 01711 445064

APPENDIX VII

Date: 12.07.2018

To,

Head of the Physiotherapy Department

Centre for the Rehabilitation of the Paralysed (CRP)

CRP-Chapain Savar, Dhaka- 1343

Through Head, Department of physiotherapy, BHPI

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

Sir,

With due respect and humble submission I am Sharmin Akter a student of 4th Professional B.Sc in Physiotherapy at Bangladesh Health Professions Institute (BHPI). In 4th year we have to do a research project for the partial fulfillment of the requirement for the degree of B.Sc in Physiotherapy. My research project title is, "Effectiveness of Kinesthetic and Balance Exercise along with Conventional Physiotherapy among Patients with Knee Osteoarthritis". It is an experimental study. I am conducting this research project under supervision of Mohammad Habibur Rahman, Associate Professor of Physiotherapy, BHPI, CRP. I have chosen physiotherapy musculoskeletal department of CRP, Savar to collect required data. Now I am looking for your kind approval to start data collection. I would like to assure that anything of my research project will not be harmful for the participants and department as well.

So, I therefore pray and hope that you would be kind enough to give me permission for data collection and oblige thereby.

Forwarded
12.7.18

Yours faithfully

Sharmin Akter

Roll no: 32

Session: 2013-2014

Student of 4th Professional B.Sc in Physiotherapy

Department of Physiotherapy

BHPI, CRP, Savar, Dhaka - 1343

12/07/18

Prof. Md. Obaidul Haque
Head, Department of Physiotherapy
BHPI, CRP, Savar, Dhaka-134

Approved
14/07/18

fhffnfvnnnffnndnndsjhfnfnvhffsnhfnvnsjfnvnnvnd