2018

Environmental Impacts on Knee Osteoarthritis and It's Sustainable Management using Therapeutic Agents

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Ph.D Dissertation

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March 2018

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Ph.D Dissertation

A Dissertation Submitted to the Institute of Environmental Science, University of Rajshahi, Rajshahi in Partial Fulfillment of the Requirements for the Award of the Degree of

Doctor of Philosophy

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March 2018

Dedication

This thesis is dedicated to The sake of Allah who is my Creator. I also dedicated to my beloved father late ***Munsur Rahman*** and my late supervisor ***Professor Dr. Md. Sarwar Jahan*** (May Allah bless and grant them) taught me the purpose of life.

Declaration

I Md. Shahadat Hossain declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research work entitled as: ***"Environmental Impacts on Knee Osteoarthritis and It's Sustainable Management using Therapeutic Agents"*** under the supervision of Dr. Md. Redwanur Rahman, Professor, Institute of Environmental Science (IES), University of Rajshahi.

I confirm that:

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(Md. Shahadat Hossain)
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Certificate

This is to certify that the dissertation entitled, ***"Environmental Impacts on Knee Osteoarthritis and It's Sustainable Management using Therapeutic Agents"*** Submitted by Mr. Md. Shahadat Hossain, Ph.D Fellow, Reg No. 0003, Session: 2011–2012, ID: 11103 in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Environmental Science, University of Rajshahi of Bangladesh. It is an authentic work carried out by him under my supervision.

To the best of my knowledge, the matter embodied in the dissertation has not been submitted to any other Universities or Institutes for the award of any degree or diploma.

I therefore, forwarding this thesis submitted for the degree of Doctor of Philosophy to the Institute of Environmental Science (IES), University of Rajshahi, Bangladesh.

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This is to certify that the thesis entitled ***"Environmental Impacts on Knee Osteoarthritis and It's Sustainable Management using Therapeutic agents"*** submitted by Mr. Md. Shahadat Hossain, Ph.D Fellow, Reg No– 0003, Session: 2011 – 2012, ID : 11103, for the award of Ph.D degree of Rajshahi University, is absolutely based on his own research work under my supervision and that neither this thesis nor any part of it has been submitted for any Degree/ Diploma or any other academic award anywhere before.

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Acknowledgement

There are many people who have made this programme of work possible. I would particularly like to thank the following for their help in the development of this work.

This thesis is the culmination of my journey of PhD which was just like climbing a high peak step by step accompanied with encouragement, hardship, trust and frustration. When I found myself at top experiencing the feeling of fulfillment, I realized though only my name appears on the cover of this dissertation, a great many people including my family members, well-wishers, my friends, colleagues and various institutions have contributed to accomplish this huge task.

I would like to express my special appreciation and thanks to my Supervisor Dr. Md. Redwanur Rahman, Professor, Institute of Environmental Science (IES), University of Rajshahi. He has been a tremendous mentor for me. I would like to thank for encouraging my research and for allowing me to grow as a research scientist. His advice on both research as well as on my career have been invaluable. I would like to acknowledge the importance of my supervisor in undertaking this thesis. He is pivotal in establishing and supporting this program of work and provided the enthusiasm, passion and expertise in dealing with the clinical aspect of Knee Osteoarthritis. He also provided the academic, oversight of this thesis, whose wisdom and advice was frequently sought and always provided with such generosity of spirit. I also want to thank him for letting my defense be an enjoyable moment, and for his brilliant comments and suggestions.

I will forever be thankful to my former late supervisor, Professor Dr. Md. Sarwar Jahan has been helpful in providing advice several times during my course work and M. Phil career. He was and remains my best role model for a scientist, mentor, and teacher. Professor Dr. Md. Sarwar Jahan was the reason why I decided to go to pursue a career in research. His enthusiasm and love for teaching is contagious.

It is with great admiration that I offer sincere gratitude to Director and Professor Dr. Md. Sultan Ul Islam, Professor Dr. Md. Golam Mostafa, Professor Dr. Md. Abul Kalam Azad, Associate Professor Zakiya Yasmin and Associate Professor Dr. S.M.

Safiuzzaman of the Institute of Environmental Science (IES), University of Rajshahi for their sincere cooperation and support at all phase of my research work. I also thanks to all the present staff of IES Md. Sultan Ali (Secretary), Md. Alauddin (Assistant Register), Md. Rajibul Hasan (Section Officer), Md. Ashraful Islam (Section Officer), Md. Babul Khan (Section Officer), Md. Asafuddoula (Assistant Librarian), Md. Shahidul Islam (Office Assistant), Md. Mofazzal Hossain (Office Assistant), Md. Enamul Haque (Lab Attendent), Md. Murad Hossain (Peon), Md. Shirajul Islam (Peon), Md. Mahbubur Rahman (Peon), Mst. Shamsia Khatun (Peon), Md. Abdur Rakib Mondol (Field Worker), Hamida Begum (Cleaner). They have been so helpful when I first enter the Institute of Environmental Science (IES).

I also thank my friends for providing support and friendship that I needed. I would like to thank Kamrunnahar for being supportive throughout my time here and for helping me with proof reading my research. It cannot be possible for me to complete this thesis without her co-operation.

I owe thanks to a very special person, my life partner and wife for her continued and unfailing love, support and understanding during my pursuit of Ph.D degree that made the completion of thesis possible. She always around at times I thought that it is impossible to continue without her help for me to keep things in perspective. I greatly value her contribution and deeply appreciate her belief in me. I appreciate my baby, my little girl Shamira for abiding my ignorance and the patience she showed during my thesis writing. Words would never say how grateful I am to both of you. I consider myself the luckiest in the world to have such a lovely and caring family, standing beside me with their love and unconditional support. I thank the Almighty for giving me the strength and patience to work through all these years so that today I can stand proudly with my head held high.

Finally, I acknowledge the people who mean a lot to me, my father late Munsur Rahman for showing faith in me and giving me liberty to choose what I desired. I salute him for the selfless love, care, pain and sacrifice to shape my life. Although hardly understood what I researched on, he were willing to support any decision I made. I would never be able to pay back the love and affection showered upon by my father.

Md. Shahadat Hossain

Abstracts

Osteoarthritis (OA) of the knee is the most common form of joint disease. It is one of the major causes of impaired function that reduces quality of life (QOL) worldwide. To evaluate the association between Environmental Impacts (weather, occupation, posture, age, sex, obesity, exercise, sports, diet, demographic, joint injury, hormone, bone density etc.) and knee pain among individuals with osteoarthritis (OA) (n=299). This prospective study evaluated men and women, aged 40 to 80yr, participating in a community-based, osteoarthritis exercise study (June 2012–June 2016). Weekly self-reported pain scores were collected using a visual analogue scale. Statistical tests, including regression and correlation analyses, were conducted. P values<0.001 were considered significant. To compare the effectiveness of sustainable management using different therapeutic agents (swimming exercise, quadriceps stretching exercise, mobilization exercise, deep transverse friction massage with hot pack).

The mean temperature was 23°C with a low of 4°C and a high of 40°C. Most associations explored produced non-significant findings. However, among women with knee OA, higher pain was significantly associated with days of rising barometric pressure (P<0.001). While some associations were suggestive of a relationship, largely these findings indicate that weather is quite modestly, if at all, associated with pain from OA. Some occupational activities increase the risk of knee OA, although the influences of publication bias and heterogeneity are important limitations of this study. Both aerobic walking and home based quadriceps strengthening exercise reduce pain and disability from knee osteoarthritis but no difference between them was found on indirect comparison. Obesity was also significantly associated with knee OA There was no statistically significant interaction effect between BMI and gender, age or any of the other confounding variables. A moderate correlation was found between joint displacement detection threshold and age (r = 0.557 and r = 0.625 for the right knee and the left knee, respectively). The threshold was substantially and significantly different between the OA patients and the elderly controls. Closed

kinetic chain (CKC) exercises performed both on the ground and in the swimming pool promoted a decrease in pain and joint stiffness, also improving the mobility, muscle strength and functionality of patients with knee OA. There was a significant improvement of the active range of motion (ROM) of right knee flexion in both groups after the intervention protocol ($P < .05$).

Outcome measures were the WOMAC (Western Ontario and McMaster Universities OA index questionnaire), Visual Analogue Scale (VAS) assessment of pain, the Fifty-Foot Walk Test (FWS), and Handheld dynamometry. There was a significant difference between the groups. The first group showed a more significant result than the second group. Strengthening of the hamstrings in addition to strengthening of the quadriceps was shown to be beneficial for improving subjective knee pain, range of motion and decreasing the limitation of functional performance of patients with knee osteoarthritis. A controlled, single blinded experimental study was conducted to determine the effects of passive joint mobilization on pain and stairs ascending-descending time in subjects with knee osteoarthritis (OA knee). Both groups received 2 therapy sessions per week, for 4 weeks. A blinded assessor measured pain with Visual analogue scale and stairs ascending-descending time with Aggregated Locomotor Function test, at baseline and at week 4. There was a significant reduction in pain among subjects in the experimental group compared to the control group. Non-significant clinical difference was found in stairs ascending-descending time between the two groups. No significant correlation was found between pain score and stairs ascending-descending time, $r = 0.45$, $p = 0.17$. The addition of passive joint mobilization to conventional physiotherapy reduced pain but not stairs ascending-descending time among subjects with knee osteoarthritis. Deep transverse friction massage is better choice of treatment in improving pain threshold in subjects with gluteus medius trigger point. Both Groups A and B shown significant improvement in pressure pain threshold when comparison is made within the group. However Group B shown significant improvement in pressure pain threshold ($p = 0.001$) post intervention between the group.

Acronyms and Abbreviations

AAOS	American Academy of Orthopedic Surgeons
ACR	American College of Rheumatology
Act load	Mean neuromuscular activity during the loading slope phase
Act peakGRF	Mean neuromuscular activity at GRF peak
ADL	Activities of Daily Living
AIMS-2	Arthritis Impact Measurement Scales 2
ALF	Aggregate Locomotor Function score
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
AROM	Active Range of Motion
AS	Ascending Stair
AQoL	Assessment of Quality of Life instrument
Aw	Autumn and winter
BTF	Bending to the Floor
BMD	Bone Mineral Density
BMI	Body Mass Index
C	Self-directed walking intervention
CCS	Comparative Controlled Study
CCT	Controlled Clinical Trial
CES	Clearwater Exercise Study
CI	Continuous Integration
CKC	Closed Kinetic Chain
CNS	Central Nervous System
Con	Concentric
CPDD	Calcium Pyrophosphate Deposition Disease
CUA	Cost Utility Analysis
DIP	Distal Inter Phalangeal joint
DISH	Diffuse Idiopathic Skeletal Hyperostosis

DS	Descending Stair
DTFM	Deep Transverse Friction Massage
DWFS	Difficult Walking on Flat Surface
EMB	Environmental Management Bureau
EMG	Electromyography
EPC	Evidence-based Practice Center
ERT	Estrogen Replacement Therapy
ESCAPE	Enabling Self-management and Coping with Arthritic Knee
ES	Effect Size
Ex	Excentric
EXG	Exercise Group
EVPI	Expected Value of Perfect Information
FDA	Food and Drug Administration
FDL	Function in Daily Living
HAD	Hospital Anxiety and Depression score
HD	Heavy Duty
HRU	Health Resource Utilization
IADL	Instrumental Activities of Daily Living
ICER	Incremental Cost Effectiveness Ratio
INB	Incremental Net Benefit
InOB	In and Out of Bed
IG	Instruction Group
IRGL	Impact of Rheumatic Diseases on General health and Lifestyle index
IG	Instruction Group
JSM	Joint Space measurement
KBLF	Knee Bending Left Flexion
KBRF	Knee Bending Right Flexion
KOOS	Knee injury and Osteoarthritis Outcome Score
KAM	Knee Adduction Movement
LI	Lequesne's Index
MCP	Meta Carpal Phalangeal joint
MET	Total Metabolic Equivalent
MPT	Modern Portfolio Theory

MRI	Magnetic Resonance Imaging
NCCCC	National Collaborating Centre for Chronic Conditions
NHS	National Health Service
NnB	Night While in Bed
NNT	Number Needed to Treat
NPRS	Numerical Pain Rating Scale
NRS	Numerical Rating Scale
NS	Not significant (at the 5% level unless stated otherwise)
NSAID	Non-steroidal anti-inflammatory drug
OA	Osteoarthritis
OARSI	Osteoarthritis Research Society International
OKS	Oxford Knee Score
PA	Physical Activity
PACE	Program for Arthritis Control through Education and Exercise
PASE	Physical Activity Scale for the Elderly
PEMF	Pulsed Electro Magnetic Field
PEME	Pulsed Electro Magnetic Energy
PIP	Posterior Inter Phalangeal Joint
PPI	Proton Pump Inhibitor
PPT	Pressure Pain Tolerance
PSFS	Patient Specific Functional Scale
PA	Physical Activity
PACEex	Program for Arthritis Control through Education and Exercise
PAR	Physical Activity Recall
PHAC	Public Health Agency of Canada
PICO	Population, Intervention, Comparison and Outcome
PROM	Passive Range Of Motion
QALY	Quality Adjusted Life Year
QOL	Quality of life
QAF	Quadriceps Activation Failure
RACGP	The Royal Australian College of General Practitioners
RsB	Rising from Bed
ROM	Range Of Motion

ROS	Reactive Oxygen Species
RR	Relative Risk
RCT	Randomized Controlled Trial
SD	Standard Deviation
SE	Standard Error
SEM	Standard Error of the Mean
Shp	Shopping
SiLy	Sitting or Lying
SMD	Standardized Mean Difference
SR	Systematic Review
SR	Sustained Release
SSRI	Selective Serotonin Reuptake Inhibitor
St	Standing
StUp	Standing Up
SWD	Short Wave Diathermy
SE	Standard Error
SLR	Straight Leg Raise
SMART	Senior's Maintaining Actives Roles Together program
TAS	The Arthritis Society
TENS	Transcutaneous electrical nerve stimulation
ToSg	Taking Off Socks
TUG	Timed Up and Go test
UDS	Going Up or Down Stair
VAS	Visual Analogue Scale
VMO	Vastus Medialis Obliqus
VO2	Maximum Volume of Oxygen
WFS	Walking on Flat Surface
WMng	Walking in the Morning
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index

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Chapter One
Introduction

Bangladesh is an underdeveloped country. Most of the people of this country are poor and illiterate. For ignorance and poverty man cannot chose and eats vital qualities of food and diet. For taking these low qualities of food they are attacked by different kinds of diseases of heart, liver, kidney, obesity, bone and joint disease etc. Among all these diseases osteoarthritis is one of the bone diseases. Osteoarthritis affects each and every person differently. In some people, it progresses more quickly; in others, the symptoms are more serious. Scientists do not yet know what causes the disease, but they suspect a combination of factors in the body and in the environment are responsible. Also diet, obesity, heredity, poor posture, climate, cigarette smoking, trauma, age and stresses on the joints from certain jobs affect the disease. Diet and osteoarthritis have relationship to overweight and obesity. Weight loss can decrease the risk of developing osteoarthritis of overweight people.

1.1 Causes and Relation between Environment and Knee Osteoarthritis

There are several other known risk factors of OA that can be characterized into three different categories: biological and genetic factors, environmental and occupational factors, and social and behavioral factors. More than 80% of Canadians over the age of 70 develop OA. The elderly are at greater risk of developing OA as a result of joint wear and tear and natural changes in growth factors functions within joints that may complicate cartilage healing and new bone formation. As individuals age, the water content in cartilage increases and the protein makeup begins to degenerate causing the cartilage to flake or form crevasses. OA, along with other age associated morbidities, will continue to contribute to the impact of disability and will worsen the QOL of the elderly population. OA occurs more frequently in men among individuals below the age of 45 and more frequently in women after the age of 55. Women experience greater muscle and joint pain given that females have a lower proportion of lean mass and a higher percentage of body fat content, increasing the rate of muscle fatigue. OA is more prevalent among Caucasians and African Americans when compared to other ethnic groups. Several diseases and complications can contribute to and may increase the risk developing OA. Calcium pyrophosphate-deposition disease (CPDD), also called "chondrocalcinosis" or "pseudo gout", is a common disorder among the elderly which creates deposits of calcium containing crystals in joint tissues. The monitoring of CPDD among several large families has shown that this disorder progresses into severe degenerative OA.

Several endocrine disorders such as diabetes, acromegaly, hypothyroidism and hyperparathyroidism affect the musculoskeletal system and may disrupt primary changes in bone and collagen resulting in secondary arthritis and bone changes. Several metabolic disorders that are known to cause biochemical or genetic abnormalities such as hemochromatosis, ochronosis, Wilson’s disease, sickle cell anemia, and thalassemia have all shown to be causative factors that may produce OA. Some bone diseases such as Paget’s disease and osteopetrosis can induce changes in bone elasticity, possibly forming osteoarthritis. Several dysplasias including familial polyepiphyseal dysplasia, congenital spondyloepiphyseal dysplasia, Stickler's syndrome, osteo-onychodysplasia, Kniest's dysplasia, trichorhinopharyngeal syndrome, and a group of diseases that affect the epiphyses all show to be causative factors of OA. In endemic areas of the world, disorders known as Mselini disease, Kashin-Beck disease, and Malnad disease, have been identified to be responsible for premature OA.

1.1.1 Temperature

There’s plenty of anecdotal evidence about the relationship between arthritis symptoms and temperature.

In 2011, a article published in European Journal of Pain found similar results in people with Osteoarthritis (OA). The researchers looked at nine previously published studies of people with OA and concluded “pain in some individuals is more affected by the temperature than in others, and that patients react in different ways to the weather.”

According to the Arthritis Foundation, some studies show a relationship between barometric pressure and arthritis pain. In 2014 a study of 222 patients with OA of the Knee seemed to support that barometric pressure influence symptoms.

In 2014 a study of people with osteoarthritis (OA) published in BMC Musculoskeletal Disorders asked participants if and how temperature influenced their pain. Of the 712 people who answered the survey, 469 (67%) said they were temperature sensitive. It turns out that weather-sensitive people with OA experience more joint pain overall than their non-weather-sensitive counterparts.

In 2015 a study of 810 people with OA published in Journal of Rheumatology found significant links between temperature and joint pain. The effect of humidity on pain was stronger when the temperature was colder. In essence, they found that wet, winter days are no fun.

Another study showed that each 10-degree temperature drop was linked with an incremental increase in pain. And that rising barometric pressure also triggered pain in people with arthritis.

1.1.2 Humidity

Patients living in humid regions often experience more severe symptoms, probably because of barometric pressure changes. Living in dry areas will alleviate most of these changes and reduce their frequency.

The study cites research from 1985 showing evidence that a combination of weather conditions worsened arthritis symptoms—in particular rising humidity and falling barometric pressure. It was noticeable that static weather patterns did not cause much change; it was the transition that affected symptoms.

These findings were backed up by another study that indicated increased pain and swelling reported by patients with arthritis could be the result of a disparity in pressure between fluid within the joints and falling air pressure outside. Air pressure drops during stormy weather, which is more common in hot, humid weather.

1.1.3 Rainfall

People whose arthritis seems to flare before or after it rains wonder if damp weather is making their arthritis worse. Doctor says they get this question a lot, even though not much evidence supports a link between sore joints and damp weather.

One theory holds that a drop in air pressure (Rainy weather) allows tissues in the body to expand to fill the space, meaning that already inflamed tissue can swell even more and cause increased arthritis pain. Other possibilities: Pain thresholds drop in rainy days affect mood; and during colder weather people are less likely to be outside and get the exercise that normally helps keep arthritis pain in check.

Elaine Husni, (2012), a rheumatologist at Cleveland Clinic's Orthopedic and Rheumatologic Institute, considers why arthritis pain goes up when the rain comes down. "Some people believe that when drop the barometric pressure, air pressure, that sometimes tissues can swell." Dr. Husni says. "When tissues swell in an already inflamed joint sometimes that can push against muscles and nerves in the area and make it appear more painful".

1.1.4 Occupations and Jobs

Occupations and jobs are also associated with developing OA. Jobs which involve kneeling, squatting, heavy lifting (e.g. farming) and stair climbing are connected with higher rates of hip and knee arthritis. Heavy repetitive joint use appears to increase OA risk. The mechanisms linking occupation to knee OA are believed to be biomechanical. Forces across the knee can be measured in many activities found in strenuous jobs. Squatting and knee flexion forces have also been measured in dairy farm workers. Also, increased forces across the knee joint related to knee mal-alignment and foot angulations have been studied in relation to knee OA progression. Carrying and lifting heavy weights and working while in a posture that requires kneeling or squatting may contribute to the development and progression of OA. Male construction workers, specifically male masons and agriculture workers of both sexes are more likely to develop OA of the knee. The overuse of joints, especially among athletes and laborers who subject their knees to ongoing stress and strain during their young adult and middle-aged years are at greater risk of developing OA.

1.1.5 Race and ethnicity and Social Environment

Race and ethnicity and Social Environment are other biological and genetic factors that may contribute to the prevalence of OA. OA of the knee has shown to be more prevalent among African American women than other groups. Separate studies have revealed that African-Americans are more likely to develop OA in both knees and that Asian women are at increased risk of developing OA of the knee when compared to Caucasian Americans. Another important factor that is likely to influence gait variations in patients with OA is race. Yet the relationship between gait disability associated with OA and race has been largely under-investigated. This is surprising considering emerging evidence of racial disparities in disability in other persistent pain conditions and racial disparities in other substantial health issues.

1.1.6 Food Adulteration

Food Adulteration For years people have suspected that foods are an important factor in the development of Osteoarthritis. Many notice an improvement in their condition when they avoid dairy products, citrus fruits, tomatoes, eggplant and certain other foods.

A woman, from Wisconsin, also found that her arthritis was clearly linked to dairy products. Although she had been raised on a dairy farm, she learned that staying away from dairy products was the key to relieving her symptoms.

A 1989 survey of over one thousand arthritis patients revealed that the foods most commonly believed to worsen the condition were red meat, sugar, fats, salt, caffeine, and nightshade plants (*e.g.,* tomatoes, eggplant). Once the offending food is eliminated completely, improvement usually comes within a few weeks. Dairy foods are one of the principle offenders, and the problem is the dairy protein, rather than the fat, so skim products are as much a problem as whole milk.

1.1.7 Climate

Some people notice that their arthritis gets worse when there is a sudden change in the climate.

However, there is no evidence that a specific climate can prevent or reduce the effects of Osteoarthritis. Moving to a new place with a different climate usually does not make a long-term difference in a person’s Osteoarthritis.

Patients with arthritis often claim that they can predict weather changes. To examine this point, many years ago at the University of Pennsylvania medical school, Hollander M.D. built a climate chamber and used volunteer patients as his study controls. He was able to prove with certainty, that the combination of high humidity and low barometric pressure definitely were associated with increased joint aching and stiffness. This makes sense. Arthritic joints are inflamed and under pressure because of increased joint fluid.

1.1.8 Posture

Posture both good and bad, absolutely can have an impact on osteoarthritis. Chronic bad posture places abnormal chronic stresses on the body. These stresses make it harder for muscles to take the pressure off the joints. Characterized by pain and lack of mobility, osteoarthritis of the knee may have a profound influence on gait patterns. Among the most commonly reported differences are slower walking speeds, shortened step lengths, larger double support times as well as decreased hip range of motion and knee range of motion angles as compared to a non-arthritic population (Andriacchi and Mundermann, 2006).

1.1.9 Obesity

Obesity is a definite risk factor for osteoarthritis, especially in weight bearing joints. Obesity is strongly associated with knee (and to a lesser extent hip) OA, perhaps due to the increase in stress put through the joint when the person is overweight. The way joints fit into one and other as well as the architecture of the rest of the body. The association between obesity and knee osteoarthritis is stronger in women than in men and is also stronger for bilateral than for unilateral disease. It exists for all three knee compartments. Alignment disorders further increase the risk of knee osteoarthritis in obese patients. Obesity is associated with a small increase in the risk of radiological or symptomatic hip osteoarthritis, particularly in a bilateral distribution. Obesity is a risk factor for hip replacement surgery.

1.1.10 Smoking

Protective influence of smoking on knee osteoarthritis has been reported from various studies (i.e. Framingham study). Day in and day out a new portion of the human body is being discovered as a victim of the smoke. It won't be wrong to say that the harmful effects of smoking have not spared any working part of the human body. The issues of passive smoking and the harms it inflicts on the environment have been all very extensively discussed. Keeping in sync with the characteristic of smoking, a study conducted in the Mayo Clinic in Boston revealed that smoking can also worsen the condition of an ailment called knee osteoarthritis in elderly men. Earlier it was not thought that there was a relation between knee osteoarthritis and smoking. Doctors believe that this co relation between smoking and knee osteoarthritis is basically because of three primary causes.

Firstly, cell proliferation might be hampered in the knee cartilage due to smoking.

The second possibility is that as smoking raises the levels of carbon mono oxide in arterial blood, it might lead to a condition called tissue hypoxia that can in turn create problems in cartilage repair.

The third possibility that might worsen knee osteoarthritis is due to the fact that there are chances of smoking leading to an increase in oxidant stress that leads to cartilage loss.

1.1.11 Age

Age is the strongest risk factor for OA and the rates of arthritis for all joints rises with increasing age. Ageing, as described by WHO (2003), is a series of gradual but complex bio psychosocial changes that occur in all living organisms. It is a continuous process of progressive change in all the structures and functions of the body, starting at conception and ending with death. Different parts of the human body begin to decline at different ages and deteriorate at different rates. People then begin to use health services more often. It has been reported that elderly people use a disproportionately higher share of health services than other age groups, with people over 65 years having twice as many contacts with the health care system than those under 65 years (USAHHS, 2002). Aging joint cartilage may undergo chemical changes which render it vulnerable to the development of OA but there is no good evidence for this. The common explanation for this is the cumulative effect of mechanical load over the years, resulting clinically in “wear and tear” and pathologically in cartilage break down. Therefore, OA has been regarded as a naturally occurring, irreversible disorder, rather than a specific, potentially treatable disease.

1.1.12 Women

Women are at higher risk of developing OA than men, especially after the menopause. The increased frequency of osteoarthritis after the menopause has of course pointed to a possible role of hormonal impregnation, including by estrogen, especially since the presence of estrogen receptors in the cartilage has been demonstrated.

High-heeled shoes alter the normal dynamics of the ankle, leading to increases and changes in the distribution of pressure at the knee during walking. These phenomena of compensation required to maintain the stability of the knee could promote knee osteoarthritis, which explains why it is frequently bilateral in women.

1.1.13 Sport

Sport Certain sports are thought to have a low risk for osteoarthritis, such as cross country skiing, walking and swimming. In contrast, soccer players, football players, rugby players, weight lifters, runners and tennis players incur a slightly higher risk. Sports that encourage a high body mass such as weight lifting and football linemen, often incur an increased risk for osteoarthritis, likely because of the increased stress posed on their joints. Similarly, an obese individual is at a greater risk of developing osteoarthritis. Participation is connected with lower limb arthritis. Jogging, however, does not seem to increase the risk of OA if the person's joints are normal. Joint deformities, mal-alignment, joint laxity (loose ligaments), changes in walking pattern and quadriceps muscle weakness are all associated with OA knee.

1.1.14 Physical Inactivity

Physical inactivity can be just as harmful to the joints as it weakens and deteriorates the muscles which support the joints and decreases joint flexibility. In time, a sedentary lifestyle and underused joints from inactivity will cause stiffness, pain, dysfunction, and more susceptibility to injury and OA. Diet is another important risk factor for OA development as a low intake of vitamin D has shown to promote joint space narrowing and increase the risk of the progression of knee OA. Individuals who consume high doses of vitamin C in their diet developed severe OA of the knee and may aggravate cartilage damage. Level of education has been associated with OA prevalence as 41% of adults with less than a high school education reported having OA compared to 21% of college graduates.

Osteoarthritis is the commonest cause of joint disability in developed world, and listed in the top 10 of the global disease burden according to the World Health Organization (WHO). Arthritis is one of the most common long-term diseases in Australia. More than 3.1 million Australians (15.2% of the total population) were estimated to be affected by arthritis in 2010–11. It is estimated that osteoarthritis causes joint pain in 8.5 million people in the UK in 2011. Osteoarthritis affects nearly 27 million people in the United States. In the United States, hospitalizations for osteoarthritis increased from 322,000 in 1993 to 735,000 in 2006. Osteoarthritis is the second most common rheumatological problem and is most frequent joint disease with prevalence of 22% to 39% in India. This is the most common cause of locomotor disability in the elderly. Many countries in Asia are ageing rapidly. It has been estimated that the percentage of people aged 65 years and over in Asia will more than double in the next two decades, from 6.8% in 2008 to 16.2% in 2040, it is estimated that Singapore will increase the proportion of people aged 65 and over by 316%, India by 274%, Malaysia by 269%, Bangladesh by 261%, and the Philippines by 256%.

1.2 Size and Nature of Disease Burden

Musculoskeletal conditions are a major burden on individuals as well as health and social care systems, with significant indirect costs.

1.3 Incidence and prevalence

- Literature is limited on the incidence and prevalence of OA because of the problems of defining it and determining its onset. Worldwide estimates indicate that 9.6% of men and 18% of women ≥ 60 years have symptomatic OA.
- OA is a major cause of impaired mobility. In 1990, OA was estimated to be the eighth leading non-fatal burden of disease, accounting for 2.8% of total years of living with disability.
- OA is the highest-ranking disease among the musculoskeletal diseases and contributes to approximately 50% of the disease burden in this disease group.
- Overall disease burden ranking according to this compiled data shows a ranking of 12 for combined 25 EU countries; 15^{th} ranked for old EU and 9^{th} rank for the 10 EU accession countries.
- Knee OA is likely to become the fourth most important global cause of disability in women and eighth most important in men.

- OA contributes to a higher disease burden in men below the age of 50 and in women over the age of 50.
- According to expert opinions presented in the EULAR committee report, radiographic evidence of knee OA in men and women over 65 is found in 30% of patients.
- The prevalence of OA of the knee by age group, sex and region. In general OA is more prevalent in Europe and USA than in other parts of the world.

1.4 Country Impact

Aggregate numbers on the overall impact of OA are not available. Therefore, statistical highlights and the impact of arthritis from individual countries that have reported information are presented.

1.4.1 UK

- In England and Wales between 1.3 and 1.75 million people have symptomatic OA. In 2000 more than 80,000 hip or knee replacements were performed at a cost of £405 million.
- As a cause of disability (such as walking and climbing stairs) in the elderly OA is second to cardiovascular disease.
- Altogether 10% to 15% of adults over 60 have some degree of OA.

1.4.2 Germany

- Four million people out of 82 million people suffer from some form of autoimmune conditions affecting joints.
- Most people participate in a universal medical health insurance system.
- The key issues in the fight against arthritis include access to medications, access to specialty care, uncoordinated treatment, and diminished state budgets.

1.4.3 Canada

- The direct and indirect costs of arthritis in Canada equates to approximately $18 billion per year.
- Over four million Canadians out of 31,014,000 people have arthritis.

- Currently there are approximately 270 rheumatologists in Canada; however, 150 of them are close to retirement leaving 120 rheumatologists to care for 4 million suffering arthritis patients.
- There are approximately 37,000 hip and knee replacement surgeries every year in Canada.
- The key issues in the fight against arthritis facing Canada include: access to medications, access to rheumatology care, access to orthopaedic care, funding for research and illness disability.

1.4.4 Japan

- Population of 127 million people.
- 17% of population is over 65 (this percentage is expected to grow by 25% in the next three decades).
- 5% of the population has some form of arthritis.
- The key issues in the fight against arthritis facing Japan include access to medications, access to specialty care.

1.4.5 USA

- It is estimated that over 41 million people out of 285 million people in the United States have arthritis.
- In the United States about 6 percent of adults over 30 have OA of the knee and about 3 percent have OA of the hip.
- The occurrence of the OA increases with age, rising 2- to 10-fold in people from 30 to 65 years of age.
- An estimated 50 million people will be diagnosed with arthritis by 2013.
- The current economic burden of arthritis in its various forms is approximately $82.4 billion.
- Direct costs are $34.6 billion (hospitals, doctors, transportation, nursing homes)
- Only 3% of the cost is for drugs.
- Indirect costs are $47.8 billion (primarily lost wages and lost productivity).
- Arthritis is a greater factor in limiting activity than heart disease, hypertension, blindness, or diabetes. Figure 3 shows the levels of physical activity reported by

women with arthritis in the US. Only 24% of people with arthritis report and achieve levels of physical activity that are recommended for health. The remainder are essentially inactive or insufficiently active.

1.4.6 Bangladesh

One statistics give a general indication to the prevalence of osteoarthritis and that is 10,392,681 people are affected by osteoarthritis in 2004 (Statistics by Country Osteoarthritis, 2005).

1.5 The Economic Burden of Osteoarthritis

The costs of the management of OA are very high since it is a chronic condition that is very prevalent and incurable. The costs per individuals who suffer from OA are small. However, the costs at the population level are large because of the joint disease's high prevalence. The cost of arthritis in 1998 was estimated at 4.4 billion dollars which accounted for over one-quarter of the total costs of musculoskeletal diseases, and 10.3% of the total economic burden of all illnesses. More recently, in 2004, it was estimated that the total societal costs associated with OA specifically were approximately 3.26 billion dollars. A study which measured the economic burden of OA among individuals revealed that the average total annual costs, both health care and non-health care costs, incurred by these individuals were $12 200.

Evidence shows that non-health care costs such as time lost from employment, time unable to perform household chores and unpaid caregiver time spent on household chores also plays a major role in the economic burden of individuals with OA. It appears as though health care costs exceed non-health care costs as the majority of individuals who suffer from OA are retired or no longer participate in labor market activities which results in fewer non-health care costs related to employment. Contrary to this, Gupta et al. found that non-health care costs are the main cause of the economic burden of OA after considering that non-health care costs are not only incurred by individuals with OA, but are split between those attributable to their caregivers as well. It is evident that as health status declines and OA severity increases, individuals are more inclined to incur higher costs. A study conducted by Gabriel et al. concluded that individuals with OA spent more on medical costs (US

$2044) than the controls who did not have OA (US $1592). Maetzel et al, 2004 revealed that 7.9% of individuals with OA purchased adaptive aids and 82.9% had at least one investigative test during the 6 month study period.

To estimate the magnitude, burden of illness and help-seeking behavior of patients with osteoarthritis in a rural community of Bangladesh. The study was conducted in a few villages near Dhaka city which were considered to be a fairly representative sample of Bangladeshi rural population. During the 18 months study period, 297 adults (45 years and above) were included (M=197, F=100). The incidence rates were 10.9/100 person-years (PY) for the whole population, 8.2/100 PY for males and 13.6/100 PY for females.

Osteoarthritis (OA) most commonly affects the knee joint. Knee OA is defined as a clinical syndrome of joint pain accompanied by varying degrees of functional limitation and reduced quality of life (The Royal Australian College of General Practitioners. The prevalence of symptomatic knee OA in developed countries is estimated at five per cent for adults between the ages of 26 and 45 years; 17% for adults above the age of 45 years; and 12.1% for adults over the age of 60 years (American Academy of Orthopedic Surgeons (AAOS, 2008). In the United States (US), 9.3 million adults suffer from symptomatic knee OA (National Collaborating Centre for Chronic Conditions (NCCCC, 2008).

In Bangladesh, knee osteoarthritis is one of the familiar disabling diseases affecting both elderly male and female (Rashid *et al.,* 1997). Osteoarthritis has a significant impact on our society because it is the most prevalent musculoskeletal disorder. The knee joint is most frequently affected by osteoarthritis and the number of patients with disabling osteoarthritis of the knee is rapidly increasing day by day. Most of the available literature shows that there is no effective treatment for osteoarthritis, and individuals with this disease have little benefit from prescribed medications (Holman and Lorig, 2004). It is known that knee joint probably is the most complicated joint in the human body (Cailliet, 1992). Functionally, the knee joint is a condyler and modified hinge joint (Datta, 2000). In Bangladesh, there is no real statistics that how many patients are affected by osteoarthritis. But, one statistics give a general indication to the prevalence of osteoarthritis and that is 10,392,681 people are affected by osteoarthritis in 2004 (Statistics by Country Osteoarthritis, 2005).

Knee OA has a significant impact on function and quality of life. Recurrent knee pain is the primary symptom affecting crucial functional activities, including walking (Zhang and Jordan, 2010). Other knee OA-associated symptoms such as stiffness and muscle weakness further impairs function and has an impact on societal, recreational and occupation-related activities (Walsh and Hurley, 2008). Management of chronic knee OA symptoms primarily includes pharmacological, physiotherapeutic and surgical interventions (Sharma *et al.*, 2009).

Musculoskeletal diseases are the most common chronic disorders and a huge burden to society affecting more than half of the adult Danish population within any given two-week period (Altman *et al.*, 2009). Osteoarthritis (OA) is one of these musculoskeletal diseases. It is a slowly developing degenerative disease causing local destruction of the involved joint and the surrounding structures. The knee is the most frequently affected joint by OA (Martin, 1998) resulting in pain, functional disability and reduced quality of life (Felson *et al.*, 2009). A review from the UK estimated that about 25% of adults above 55 years self-report knee pain with half of them displaying radiographic changes of OA (Peat *et al.,* 2001).

The structural changes observed in patients with Tibiofemoral knee OA are characterized by a degradation of the cartilage on the tibial and femoral articular surfaces together with degenerative changes such as joint space narrowing, osteophytes, sclerosis and bone marrow lesions (Hunter *et al.,* 2010, Ding *et al.,* 2010). These changes are believed to origin from changes to the mechanical environment causing altered knee joint load (Andriacchi and Mundermann, 2006) and can be detected by radiography or Magnetic Resonance Imaging (MRI). Traditionally, knee OA has been diagnosed by radiography using different classification systems such as the Kellgren & Lawrence scale (Kellgren and Lawrence, 2008) which is one of the most commonly used. Radiography is still considered the diagnostic ‘gold standard’.

However, the most frequent symptoms experienced by the patients such as knee pain, stiffness and functional decline are poorly associated with structural changes (Dieppe *et al.,* 1998). In fact, it may take decades for structural changes to appear on radiographs even though symptoms are evident. Therefore, much research is presently conducted in using MRI as an alternative and more sensitive measure than radiography to detect OA onset (Hunter *et al.,* 2009). Relying only on radiographs and not including patient reported pain and symptoms in the diagnosis of knee OA is problematic. The American College of Rheumatology (ACR) has developed a set of criteria for clinical diagnosis of knee OA. These criteria include age >38, knee pain, morning stiffness and joint Crepitus (Altman *et al.,* 1996). As a consequence of this, knee OA is frequently referred to as either radiographic or symptomatic knee OA depending on the criteria of diagnosis.

1.6 The role of neuromuscular function in knee OA development

Knee OA is considered a mechanically driven disease due to increased and/or altered load. Particularly increased knee adduction movement (KAM), which is indicative of medial compartment knee joint loading (Schipplein and Andriacchi, 1991), have been associated with incidence (Baliunasa *et al.,* 2002), severity (Sharma *et al.,* 2007) and progression (Miyazaki *et al.,* 2002) of medial Tibiofemoral knee OA. Impaired muscle strength reduces the capacity for shock absorption and joint protection. Several studies have demonstrated that patients with knee OA have reduced lower extremity muscle strength compared to healthy controls (Jan *et al.,* 2009 and Slemenda *et al.,* 1997). Particularly maximal quadriceps strength seems to be compromised (Bennell *et al.,* 2008). Furthermore, studies have reported reduced risk of knee OA in women with moderate and high quadriceps strength (Hootman *et al.,* 2004), a protective effect of high quadriceps strength on incident symptomatic knee OA (Segal *et al.,* 2001) and that reduced functional capacity predict knee OA development in patients with knee pain (Thorstensson *et al.,* 2004). Training induced changes in quadriceps strength have been shown to reduce the rate of loading in women indicating a possible role for muscle strength and training in knee OA prevention (Mikesky *et al.,* 2000).

Alterations in neuromuscular activity are another aspect of neuromuscular function which is thought to affect knee joint kinematics and kinetics during walking gait and stair ascent/descent. Observed kinematic alterations in knee OA patients include decreased range of motion (ROM) and reduced movement speed during walking gait (Chen, 2007) thought to reflect a movement strategy to protect the knee joint and minimize pain. Changes in neuromuscular activity in knee OA patients involve increased muscle co activation (Kozeyab and Chery, 2013) and altered medial vs. lateral muscle activity (Hubley-Kozey *et al.*, 2006, Heiden *et al.,* 2009, Hubley-Kozey *et al.*, 2009). As with impaired muscle strength changes in prime mover thigh neuromuscular activity/control could potentially affect the focal concentration of bone-on-bone contact forces in the knee joint during locomotion.

The causes of degenerative changes to the knee joint are complex and likely involve different pathways incorporating various combinations of risk factors for different sub groups of patients (Radin *et al.*, 2004). Impaired neuromuscular function is considered one of the modifiable risk factors for knee OA but the exact role still remains to be determined. Knee injury can affect neuromuscular function through mechanical instability, pain and disuse atrophy. Furthermore, few patients are ever fully rehabilitated after knee injury. De conditioning of the neuromuscular system may also stem from a sedentary lifestyle which can lead to obesity that can affect loading of the knee joint directly due to increased mass (Messier *et al.*, 2005) or indirectly through decreased neuromuscular function.

1.7 Sustainable management of Knee Osteoarthritis by using Swimming Exercise

1.7.1 Introduction

Osteoarthritis (OA) is the leading cause of disability in older adults and is associated with muscle weakness. Aerobic exercise is widely recommended for patients with OA, but OA and its associated joint pain act as a significant barrier for performing a variety of basic daily activity such as walking. Swimming can be an ideal form of exercise for patients with OA as it includes minimum weight-bearing stress. However, no study has investigated if swimming exercise improves muscle strength in patients with OA. We compared the effects of swimming exercise and cycling exercise on upper and lower body strength using a standard grip strength dynamometer and isokinetic knee flexor and extensor strengths at an angular velocity of 60 degrees/sec using a Biodex isokinetic dynamometer. Cardoso *et al.,* 2017 reported that forty-eight patients with OA were randomly assigned to swimming (n=24, age=59±8 yr) or cycling (n=24, age=61±4 yr) training groups. Supervised exercise was performed for 45 min/day for 3 days/week at 60-70% heart rate reserve for 12 weeks. After 12-weeks of exercise training, average left and right arms body strength increased significantly after both swimming (20.4±1 vs. 21.0±1 kg) and cycling (22.3±1 vs. 23.8±1 kg) training.

Since the earliest recorded history, water has always been believed to promote healing and has therefore been widely used in the management of medical ailments. Through observation and centuries of trial and error, and scientific methodology, traditions of healing through aquatic treatments have evolved. This review will detail the current scientific understanding of the many physiologic changes that occur during aquatic immersion. Aquatic immersion has profound biological effects, extending across essentially all homeostatic systems. These effects are both immediate and delayed and allow water to be used with therapeutic efficacy for a great variety of rehabilitative problems. Aquatic therapies are beneficial in the management of patients with musculoskeletal problems, neurologic problems, cardiopulmonary pathology, and other conditions. In addition, the margin of therapeutic safety is wider than that of almost any other treatment milieu. Knowledge of these biological effects can aid the skilled rehabilitative clinician to create an optimal treatment plan, through appropriate modification of aquatic activities, immersion temperatures, and treatment duration.

1.7.2 Rehabilitation History

Historically, the field of Physical Medicine viewed hydrotherapy as a central treatment methodology. Lowman, 1937 began using therapeutic tubs to treat spastic patients and those with cerebral palsy after a visit to the Spaulding School for Crippled Children in Chicago, where he observed paralyzed patients exercising in a wooden tank. On returning to California, he transformed the hospital's lily pond into 2 therapeutic pools. At Warm Springs, he developed his famous tank, and in 1924, Warm Springs received its most famous aquatic patient (Becker, 2009). A wealth of information, research, and articles on spa therapy and pool treatments appeared in professional journals during the 1930s. At Hot Springs, Arkansas, a warm swimming pool was installed for special underwater physical therapy exercises and pool therapy treatments with chronic arthritic patients. Lowman, 1937 published his *Technique of Underwater Gymnastics: A Study in Practical Application,* in which he detailed aquatic therapy methods for specific underwater exercises that "carefully regulated dosage, character, frequency, and duration for remedying bodily deformities and restoring muscle function". During the 1950s, the National Foundation for Infantile Paralysis supported the corrective swimming pools, and hydro gymnastics of Charles L. Lowman and the therapeutic use of pools and tanks for the treatment of poliomyelitis. Licht *et al.,* (1962) organized the American Society of Medical Hydrology and Climatology, which historically met at the annual meeting of the American Academy of Physical Medicine and Rehabilitation.

1.8 Sustainable management of Knee Osteoarthritis by using Quadriceps Stretching Exercise and Hot Pack

1.8.1 Introduction

Osteoarthritis (OA) is regarded a major public health problem, as reported by the World Health Organization. It is one of the major causes of impaired function that reduces quality of life (QOL) worldwide. Osteoarthritis (OA) is the most common musculoskeletal condition affecting the quality of life of older adults. A recent survey in India reported that the prevalence of OA in older adults more than 65 years of age was 32.6% in the rural population and 60.3% in the urban population. Knee OA is likely to become the eighth most important cause of disability in men and the fourth most important cause of disability in women according to the World Health Organization report on global burden of disease. Three major physical impairments, such as knee pain, stiffness, and decreased quadriceps strength, are highly associated with knee OA and are believed to contribute to physical disability and progression of the disease.

Strength of the quadriceps musculature is one of the intrinsic factors that has been shown to affect the knee joint functions. It is evident that lower extremity strength has a major role in knee joint shock attenuation during weight bearing activities; however, research is still ongoing regarding investigation of the role of strengthening in the treatment of OA of the knee. There is increased risk of development or progression of disease due to greater or uncontrolled loading on the joint; therefore, quadriceps strength needs to be considered in the study of knee OA. A reduced quadriceps strength has been shown to be associated with the presence of OA in the knee.

Muscle weakness, especially of the quadriceps muscle, is one of the major musculoskeletal repercussions of knee OA. The strength deficit in the population with OA is 15%-18% at the beginning of the disease, 24% in individuals with grade II knee OA (according to the Kellgren & Lawrence grading scale for knee OA), and 38% in individuals with grade IV knee OA. Hurley et al. have suggested that degenerative changes in the OA knee structure might result in altered sensory input to joint mechanoreceptors, thus decreasing quadriceps activation. Thus, the quadriceps weakness of patients with OA is worth noting.

Because the quadriceps muscle acts as a shock absorber in the knee joint, its weakness is believed to reduce functional capacity, predisposing the knee to structural damage. The origin of the quadriceps weakness in patients with OA is not clear. Hurley et al. have shown that some patients with OA cannot completely activate the quadriceps muscle, a condition that can be called quadriceps activation failure (QAF).

Exercises are considered one of the major interventions in the conservative treatment of patients with knee OA. The major objectives are as follows: pain reduction; function improvement; and improvement in social and occupational aspects. Doi et al. have compared the effect of home-based exercises for quadriceps strengthening and the use of non-steroidal anti-inflammatory drugs (NSAIDs) for eight weeks. No improvement difference between the two groups was observed according to the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The authors have concluded that home-based exercise for quadriceps strengthening improves knee OA no less than the use of NSAIDs. Moderate exercise may be a good treatment not only to improve joint symptoms and function, but also to improve knee cartilage glycosaminoglycan in patients at high risk of developing OA.

Reduction of pain and disability is the main aim of any treatment approach in the management of knee OA. Combinations of treatment approaches including both pharmacological and non-pharmacological methods are often preferred. The Osteoarthritis Research Society International (OARSI) recommended non-pharmacological methods including patient education programs, weight reduction, coping strategies, and exercise programs for treatment of knee OA.

There are three types of basic therapeutic exercise: isotonic, isokinetic, and isometric exercise. Of these three, isometric exercise might be the most appropriate and easy to understand by the patients and can be easily and safely performed at home because it requires no or minimal apparatus. Further, isometric exercise causes the least intra-articular inflammation, pressure, and bone destruction. Norden, Leventhal, and Schumacher reported that "isometric exercises" are simple and inexpensive to perform and that they rapidly improve strength. Hence, the purpose of this study was to investigate whether isometric quadriceps exercise has a beneficial effect in patients with knee osteoarthritis.

1.9 Sustainable management of Knee Osteoarthritis by using Knee Mobilization Exercise and Hot Pack

1.9.1 Introduction

Osteoarthritis (OA) is the most common form of degenerative joint disease affecting 15 to 40% of people aged 40 and above (Corti and Rigon, 2003). One hundred fifty one million people worldwide experienced OA in 2004 which was ranked sixth as a leading cause of moderate and severe disability (World Health Organization, 2008). The knee is the joint most frequently affected by osteoarthritis. OA knee is two times more prevalent than OA hips in people aged over 60 years (Scott *et al.*, 2007), and is a significant contributor of pain and mobility impairment in community-dwelling adults (Corti and Rigon 2003). In a general practice setting in Britain, 1% of people aged over 45 years have a currently – recorded clinical diagnosis of knee osteoarthritis, and 5% will have had the clinical diagnosis made at some point (Bedson *et al.* 2005). Clinically, OA knee is characterized by pain during weight bearing, tenderness, limitation of knee movement, crepitus, occasional effusion, and variable degrees of local inflammation (Symmons et al. 2000). Pain is the most frequent reason for patients with OA knee to seek medical attention and rehabilitation (Symmons *et al.* 2000). If left untreated, pain and stiffness will result in a loss of physical function and self-independence. The presence of OA-related knee pain has also been associated with increase in the risks of physical disability in the community (Van Baar *et al.*, 1998).

Management of pain in OA knee is a multidisciplinary approach. Physiotherapy, as a mainstay of conservative treatment for OA knee involves the use of various modalities such as manual therapy, exercises, patellar taping, thermal modalities and electrical stimulations as a direct or an indirect pain reduction measure. Manual therapy includes soft tissue manipulation, massage, manual traction, joint manipulation and joint mobilization (Crossley, K.M. and Vicenzino, 2015). Joint mobilization which involves low-velocity passive movements within or at the limit of joint range of motion reduces pain by modulating the nervous tissues and increases joint motion (Crossley, K.M. and Vicenzino, 2015). The use of joint mobilization is recommended in many guidelines for the management of OA knee, yet the evidence underlying its use is limited (Moss *et al.,* 2007) in a study of 38 subjects with mild and moderate OA knee examined the effects of accessory joint mobilization on pain and function of the knee. In the study, a 9-minutes mobilization of the tibio-femoral joint was compared with manual contact and non-contact interventions. They concluded that the technique significantly reduced pain and improve functional ability, measured with pressure pain threshold and 3-metre ‘up and go’ test than the other two techniques. The change in stairs ascending-descending ability and its association with pain was not investigated. This study aimed to evaluate the effects of knee joint mobilization in addition to conventional physiotherapy compared to conventional physiotherapy alone in adult patients with OA knee. Specifically, this study aimed to compare changes in knee pain and stair ascending descending ability, and assess correlation between knee pain and stairs ascending-descending ability.

The Physical therapy management aim to control pain, stiffness, instability, deformity and functional performance of the patient. Different types of therapeutic exercises, such as stretching, strengthening (isotonic, isokinetic, and isometric) and aerobic exercise, and electrotherapy are frequently used for the treatment of different musculoskeletal disorders. Regular physical activity and lower limb strengthening exercises are key components of knee osteoarthritis (OA) management (Zhang *et al.,* 2017). Exercise has shown to have beneficial effects on decreasing symptoms of pain and improving physical function in knee OA patients.

1.10 Sustainable management of Knee Osteoarthritis by using Deep Transverse Friction Massage and Hot Pack

1.10.1 Introduction

Osteoarthritis (OA) affects million of people in Bangladesh and the knee is one of the most common joints affected. Knee OA is the leading cause of disability and its prevalence is growing among the general population. Seventy percent of the population over the age of 65 will demonstrate radiographic evidence of knee OA and 12.1% will have clinical symptoms. An adequate understanding of the non-surgical options and early diagnosis and management is essential to optimally treating knee OA patients. Knee OA is a degenerative disorder that involves cartilage breakdown, subchondral bony sclerosis, osteophytes formation, abnormal synovial fluid hyaluronate, and an increase concentration of inflammatory mediators. Risk factors include obesity, female gender, genetic predisposition, African American race, and weak quadriceps. Obesity is the most important modify able risk factor for the development of knee OA. When evaluating the history, physical examination and radiologic findings, the American College of Rheumatology includes the following criteria for knee OA: pain in the knee, and either morning stiffness less than 30 minutes, age greater than 50 or Crepitus on active range of motion (ROM), and x-ray evidence of osteophytes. The Kellgren-Lawrence scale can be used to grade radiologic findings of knee OA. Grading is based on osteophytes, deformity of bone contour and joint space narrowing. X-rays done are usually weight-bearing anterior-posterior radiographs of the knee in full extension. It has also been suggested that x-rays may be done in 40° of flexion, as this view demonstrates different weight bearing areas of the femur and tibia and may be more sensitive in identifying arthritic changes. Other x-ray views include the tunnel view, also called the inter condylar notch view, which helps identify osteochondral loose bodies and the sunrise or merchant view, useful in identifying arthritis at the patello femoral compartment.

Key elements of the physical examination include inspection, palpation, evaluation of range of motion, neuromuscular examination, and knee-specific examination including medial joint line tenderness, Crepitus with passive ROM, supra patellar effusion, painful knee flexion, and possibly quad weakness. Ligamentous laxity and concomitant meniscal pathology should also be assessed. Differential diagnoses of patients with supra patellar effusions should also include infection and inflammatory conditions. If there is a high clinical suspicion for these, further workup such as blood tests and knee aspiration with synovial fluid analysis should be performed (9). Once the diagnosis has been made, treatment should include educating the patients on risk factors such as obesity and the importance of compliance with a home exercise program (HEP), a comprehensive rehabilitation program with emphasis on quad strengthening, and identification of other components that may help them improve their quality of life including: activities of daily living (ADL) evaluation, assistive devices, and bracing.

1.10.2 The Rehabilitation Program

A comprehensive rehabilitation program should include the five phases of rehabilitation with controlling pain and inflammation using the PRICE principal, restoration of ROM, strengthening, proprioceptive training, and functional recovery including aerobic conditioning. Modalities, HEP, weight loss, and bracing also play an important role and should be considered for integration into the rehabilitation program. The main treatment goals include pain reduction, improved ROM, and identifying and then correcting modifiable risk factors. Each patient should have an individualized rehabilitation program to target their respective rehabilitation needs. All exercises should be done without aggravating the signs and symptoms of the underlying OA. Although previously controversial, it is now clear that joint loading and movement are essential for cartilage nutrition. A multidisciplinary approach should also include evaluation of assistive devices, in-office trial of a knee un loader brace, and consideration for lateral wedged insoles for genuvarum knee deformities. Education and incorporation of a proper HEP is essential. Having the patient demonstrate the exercises at the follow up physician visits is important in helping to assess compliance with the HEP and to help correct any errors in exercise performance.

Chapter Two
Literature Review

2.1 Systematic Literature Search

A systematic search of the literature review between 2001 to 2016 were published in different journal, book, periodical and thesis.

The aim of this study was to review the research literature on pain and quality of life (QoL) and the relationship between these variables among people with osteoarthritis. This literature review is to evaluate current research articles pertinent to physical therapy treatment of osteoarthritis (OA) of the knee. Osteoarthritis of the knee is an increasingly common diagnosis, with a prognosis that can lead to loss in an individual's functional abilities. Literature on the subject of OA and its physical therapy treatment is vast and current, however, obtaining and analyzing it can be time consuming and costly to a Physical Therapist. The primary aim of this paper is to review current trends for treatment of OA of the knee, and to compare each intervention for effectiveness. This article provides a systematic categorization as well as recommendations for physical therapists based on current literature.

Osteoarthritis (OA) is a disease characterized by the breakdown of articular joint cartilage, and often causes severe pain and disability. In particular the knee joint is most commonly affected, with more than 30% of adults over 60 years of age experiencing functional limitations, such as inability to perform Activities of Daily Living (ADL) or Instrumental Activities of Daily Living (IADL) due to OA of the knee. There are multiple interventions to treat OA of the knee. Current popular methods of treatment include, but are not limited to physical therapy based on practice pattern as well as non-steroidal anti-inflammatory drugs (NSAIDS), surgery and knee capsule injections, which are commonly followed by physical therapy. It should be noted, however, that NSAIDs though frequently prescribed, often have significant side effects. Arthroscopic surgery has not been shown to have a major role in the management of OA of the knee. Similarly, knee capsule injections have been shown to be equal to arthroscopy in effective management of the disorder. Exercise-based interventions are extensive, and include pool-based strengthening exercise, muscular strengthening, stretching, cardiovascular programs, and mechanical unloading. Modalities include, but are not limited to, knee bracing, heat, ice massage, cold packs, ultrasound, acupuncture, and taping.

Several common databases and search engines that the authors were familiar with were used for this review, including PubMed, EBSCO, The Cochrane Library, and Google Scholar. All articles included were written in English, peer-reviewed, and published from 2001 to 2016. Key search words and phrases for the physical therapy treatment of knee osteoarthritis included "physical therapy or physiotherapy," "Sustainable management of osteoarthritis", "Environmental Impacts on Osteoarthritis and Its sustainable Management", "knee osteoarthritis," and "non pharmacological management or treatment of Osteoarthritis." Only studies that included a control group or presented a case report of physical therapy management of knee osteoarthritis were included. Some are controlled by manual therapy. Previously conducted review articles on the subject of physical therapy management of knee osteoarthritis were excluded.

The scientific rigor of each study was evaluated using the following 6 criteria developed by Megens and Harris: (1) inclusion and exclusion criteria noted for the subjects and an operational definition of the clinical condition provided (2) treatment methodology described adequately enough to allow replication (3) outcome measures assessed for reliability (4) validity of outcome measure's assessed (5) blind assessment of outcome and (6) accounting for attrition.

More than sixty articles were found pertaining to physical therapy management of osteoarthritis of the knee. Fifteen of these articles met the inclusion criteria and were reviewed and evaluated according to Sackett's levels of evidence. A summary of the articles evaluated can be found. Studies included in this review either evaluated or described procedures or tools used in PT procedural interventions of OA of the knee. Four studies dealt with analysis or development of a tool to treat knee OA. Ten studies evaluated the effects of exercise programs. Seventeen articles were identified that met the requirements for methodological quality and inclusion criteria. Two studies evaluated the use of acupuncture. A variety of techniques in physical therapy management of knee osteoarthritis were included in the articles presented in this study. Studies differed in research design, level of evidence, and type of intervention. The research design distribution of the articles consisted of the following: Thirteen studies were randomized, controlled clinical trials, Two studies were case studies and one was a nonrandomized convenience sample trial. Four article are found that they use non pharmacological management of osteoarthritis. Two additional articles evaluating acupuncture were also included, because they had sufficient scientific rigor, level of evidence, and close connection with rehabilitation.

All of these article there is no any relation to my research. Because the risk of disability due to OA of the knee is greater than that due to any other medical condition in aging adults it is essential for physical therapists to have a thorough understanding of different treatment methods, if they wish to make an impact in the reduction of this risk. Due to a lack of systematic reviews on the effectiveness of physical therapy management of OA of the knee, as well as the conflicting evidence about modalities, the primary aim of this paper is to review current trends for treatment of OA of the knee, and to compare the effectiveness of each intervention. This article will explores various methods of treating OA of the knee and makes recommendations for physical therapy management of the disorder.

Ravaud *et al.,* 2000 was published an article and the title was "Management of osteoarthritis (OA) with an unsupervised home based exercise programme and/or patient administered assessment tools. A cluster randomized controlled trial with a 2×2 factorial design" published in *Ann. Rheum. Dis.* Research method was the study was a 24 week, open cluster randomized controlled trial with a factorial design. Outcome measure was a home based exercise programme was performed daily at least four times per week with the aid of videotape and booklet and result was after 24 weeks, both pain and function improved in the ST, EX, ST+EX, and usual care groups.

Coggon *et al.,* 2001 was published an article and the title was "Knee osteoarthritis and obesity" in *International Journal of Obesity***.** Research method was Population-based case control study in three health districts of England (Southampton, Portsmouth and North Staffordshire). Outcome measure was a total of 525 male and female aged 45 year and over, consecutively listed for surgical treatment of primary knee OA, and result was Overweight and obese people reduced their weight by 5 kg or until their BMI was within the recommended normal range, 24% of surgical cases of knee OA might be avoided.

Campbell *et al.,* 2001 was published an article and entitle as “Why don’t patients do their exercises? Understanding non-compliance with physiotherapy in patients with osteoarthritis of the knee” published in *J. Epidemiol. Community Health.* Research method was a qualitative study, nested within a randomised controlled trial. Outcome measure was twenty participants in the intervention examining the effectiveness of physiotherapy in reducing pain and increasing mobility in knee OA and result was a necessary precondition for continued compliance was the perception that the physiotherapy was effective in ameliorating unpleasant symptoms.

Hassan *et al.,* 2002 was published an article and the title was “Influence of elastic bandage on knee pain, proprioception, and postural sway in subjects with knee osteoarthritis” in *Ann. Rheum. Dis.* Research method was symptomatic and radiographic knee OA were randomly assigned to either an S-bandage or an L-bandage. Outcome measure was In a cross over, within-subject study, 68 subjects (49 female, 19 male; mean age 67.1, range 36–87) and result was knee OA application of an elastic bandage around the knee can reduce knee pain and improve static postural sway.

Brian *et al.,* 2003 was published an article and the title was “Physiotherapy, including quadriceps exercises and patellar taping, for knee osteoarthritis with predominant patello-femoral joint involvement: randomized controlled trial” and published on *The Journal of Rheumatology.* Research method was the study design was a controlled trial using pre randomization and a blind observer, comparing the intervention package with standard non physiotherapy treatment. Outcome measure was pain in the worse knee by 100 mm visual analog scale score, the disability domain of the Western Ontario and McMaster University OA index (WOMAC) and result was the treatment package produced small improvements in knee pain scores and quadriceps muscle strength 10 weeks after the end of the treatment period.

Hinman *et al.,* 2003 was published an article and the title was “Efficacy of knee tape in the management of osteoarthritis of the knee: blinded randomised controlled trial” in *BMJ Mu*. Research method was randomised single blind controlled trial with three intervention arms of three weeks' duration and three week follow up. Outcome measure was primary outcome measure was pain as measured by visual analogue scale and participant perceived rating of change. Secondary measures of pain and disability and result was therapeutic knee taping is an efficacious treatment for the management of pain and disability in patients with knee osteoarthritis.

Rossignol and Leclerc, 2003 was published a article and the title was “Primary osteoarthritis and occupations: a national cross sectional survey of 412 symptomatic patients” in Research method was Cases in the survey were compared with their expected counterpart by age, Gender, and occupational groupings using data from the 1998 French National Survey on Health Impairment and Disability. Outcome measure was to describe the age standardized prevalence of symptomatic osteoarthritis (OA) in a nationwide cross sectional survey of 412 patients in France, and their functional and work limitations and result was results contribute to the mounting evidence that OA is potentially etiologically linked to occupation in a sizeable segment of the population and that OA can no longer be considered an inevitable disease of ageing.

Jong *et al.,* 2004 was published an article and the title was “An implementation study of two evidence-based exercise and health education programmes for older adults with osteoarthritis of the knee and hip” in *Health Education Research.* Research method was implementation studies are recommended to assess the feasibility and effectiveness in real life of programmes which have been tested in randomized controlled trials (RCTs). Outcome measure was the outcome measures were pain and mobility. Pain and self-efficacy in the Knee programme (n = 157), and for pain in the Hip programme (n = 132) and result was in particular, the decrease of pain is a noticeable effect. Pain is an indicator of perceived quality of life.

Ravaud and Giraudeau 2004 was published an article and the title was “Management of osteoarthritis (OA) with an unsupervised home based exercise programme and patient administered assessment tools. A cluster randomized controlled trial with a 262 factorial design” in *Ann Rheum. Dis.* Research method was the study was a 24 week, open cluster randomized controlled trial with a factorial design. Outcome measure was a home based exercise programme was performed daily at least four times per week with the aid of videotape and booklet and result was the exercise programme, results from this study failed to demonstrate a short term symptomatic effect of the two non-pharmacological treatments in patients with OA.

Bennell and Hinman 2005 was published an article and entitle was "Efficacy of physiotherapy management of knee joint osteoarthritis: a randomized, double blind, placebo controlled trial" in *Ann. Rheum. Dis.* Research method was randomised, double blind, placebo controlled trial. Outcome measure was primary outcomes were pain measured by visual analogue scale and patient global change. Secondary measures included WOMAC, knee pain scale and result was the physiotherapy programme tested in this trial was no more effective than regular contact with a therapist at reducing pain and disability.

Roddy *et al.,* 2005 was published a article and the title was "Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee-the MOVE consensus" in *Rheumatology (Oxford).* Research method was a multidisciplinary guideline development group was formed from representatives of professional bodies to which OA is of relevance and other interested parties. Outcome measure was abstracted and effect sizes calculated. The evidence for each recommendation was assessed and expert consensus highlighted by the allocation of two categories: (1) strength of evidence and (2) strength of recommendation and result was these are the first recommendations for exercise in hip and knee OA to clearly differentiate research evidence and expert opinion.

Giuseppina and Anna 2005 was published an article and the title was "Subjective impact of osteoarthritis flare-ups on patients' quality of life" in *Health and Quality of Life Outcomes.* Method was an observational study on prospective data collected from the Evaluation of Quality of life in OA clinical trial was conducted; outpatients from 70 participating centers. Outcome measure was among the 1323 patients, 1138 (86%) were prescribed one drug/treatment of osteoarthritis, 169 (13%) 2 drugs/treatments, and 16 (1%) 3 drugs/treatments and result was follow-up visits were performed after 29.0 days on average. For all SF-36 domains, all SAT-P items and factors, the differences between baseline and follow up scores resulted statistically significant.

Roddy and Zhang, 2005 was published an article and the title was "Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee-the MOVE consensus" in *Rheumatology (Oxford)*. Research method was a multidisciplinary guideline development group was formed from representatives of professional bodies to which OA is of relevance and other interested parties. Outcome measure was abstracted and effect sizes calculated. The evidence for each recommendation was assessed and expert consensus highlighted by the allocation of two categories: (1) strength of evidence and (2) strength of recommendation and result was these are the first recommendations for exercise in hip and knee OA to clearly differentiate research evidence and expert opinion.

Paul and Van den, 2006 was published an article and the title was "Six sessions of manual therapy increase knee flexion and improve activity in people with anterior knee pain: a randomized controlled trial" in *Australian Journal of Physiotherapy.* Research method was Randomized controlled trial. Outcome measure was active knee flexion and extension was measured from photographs. Activity was measured by having the participants step up and down a 15 cm step, leading with the painful leg as many times as they could in a 60 second period and the result was decrease pain by –8 mm and pain on stairs by –10 mm compared with the control group. They increased their active knee flexion by 10 deg and the number of steps in 60 seconds by 5 compared with the control group.

Cindy and Timon, 2006 was published an article and the title was "Active involvement and long-term goals influence long term adherence to behavioral graded activity in patients with osteoarthritis: a qualitative study" in *Australian Journal of Physiotherapy.* Research method was Qualitative study. Outcome measure was data from 12 interviews were coded and analyzed using the methods developed in grounded theory and result was initial long-term goals rather than short-term goals seem to relate to greater adherence to performing activities in the long term & active involvement by participants in the intervention process seems to relate to greater adherence to performing activities in the long term.

Delaruea and Brancheb 2007 published a research work and entitle as "Physical exercise supervised or not by a physiotherapist in the treatment of lower-limb osteoarthritis. Elaboration of French clinical practice guidelines" in *Annales de*

Réadaptation et de Médecine Physique. His research method is The SOFMER (French Physical Medicine and Rehabilitation Society) methodology, associating systematic literature review, collection of everyday clinical practice, and external review by a multidisciplinary expert panel, was used to develop guidelines. Outcome measure was Exercises that were “directed exercise therapy” by a physiotherapist, in either an individual program or a group session, during at least eight sessions or at least more than 4 h. Functional criteria based on validated questionnaires, physical performance, or deficiencies in, for example, muscular strength or speed of walking. Result was Program directed by a physiotherapist, associated or not with a program at home, versus a non-directed program; all four were graded level 1 by the ANAES scale. Ten RCTs evaluated the effectiveness of a program of non-directed exercise; seven were level 1 and, 3 level.

Tiffreaua *et al.*, 2007 published a research work and entitle as “The value of individual or collective group exercise programs for knee or hip osteoarthritis. Elaboration of French clinical practice guidelines” and reference is *Annales de Réadaptation et de Médecine Physique*. The research method is SOFMER (French Physical Medicine and Rehabilitation Society) methodology, combining systematic literature Review. Outcome measure is to develop clinical practice guidelines concerning individual and group exercise therapy for knee and/or hip osteoarthritis (OA) and result is benefit of individual exercises is low to moderate for pain, strength and ability to walk. The benefit of group exercise is also low to moderate for pain, strength, balance and ability to walk.

Foster *et al.,* 2007 was published an article and title was “Acupuncture as an adjunct to exercise based physiotherapy for osteoarthritis of the knee: Randomized controlled trial” in *BMJ*;. Research method was multi centre, Randomized controlled trial. Outcome measure was Western Ontario and McMaster Universities osteoarthritis index pain subscale at six Months & function, pain intensity, and unpleasantness of pain at two weeks, six weeks, six months, and 12 months and result was acupuncture to a course of advice and exercise for osteoarthritis of the knee delivered by physiotherapists provided no additional improvement in pain scores. Small benefits in pain intensity and unpleasantness were observed in both acupuncture groups, making it unlikely that this was due to acupuncture needling effects.

Hinman *et al.*, 2007 was published an article and the title was “Aquatic Physical Therapy for Hip and Knee Osteoarthritis: Results of a Single-Blind Randomized Controlled Trial” in *Physical Therapy*. Research method was the study was designed as a randomized controlled trial in which participants randomly received 6 weeks of aquatic physical therapy or no aquatic physical therapy. Outcome measure was a total of 71 volunteers with symptomatic hip OA or knee OA participated in this study and result was a 6-week program of aquatic physical therapy resulted in significantly less pain and improved physical function, strength, and quality of life.

Christensen and Bartels 2007 was published an article and the title was “Effect of weight reduction in obese patients diagnosed with knee osteoarthritis: a systematic review and meta-analysis” in *Ann. Rheum. Dis.* Research method was a systematic literature search was carried out to identify and locate all controlled and preferably randomized trials dealing with the effects of weight loss on symptoms associated with knee OA. Outcome measure was among 35 potential trials identified, four RCTs including five intervention/control groups met our inclusion criteria and provided data from 454 patients and result was clinical efficacy on pain reduction was present, although not predictable after weight loss. Meta regression analysis indicated that physical disability of patients with knee OA and overweight diminished after a moderate weight reduction regime.

Keenan *et al.,* 2007 was published a research work and the title is “The development of a quality of life instrument for osteoarthritis” and reference is Keenan, Anne-Maree *The development of a quality of life instrument for osteoarthritis.* PhD thesis, University of Leeds. Research method is Analysis was undertaken of a large, community based survey to examine the prevalence and impact of joint problems on everyday activities. Study, in depth, semi-structured interviews was undertaken. Outcome measure was 44 people with OA to explore the issues associated with living with OA. From these interviews, a disease specific, needs-based, quality of life instrument, the OA QoL, was developed and tested for appropriate psychometric properties and the results was Effect of physical and psychosocial influences on quality of life was explored. Structured equation modeling was used to construct a model explaining the relationship between pain, function, depression, anxiety, disease characteristics and demographics on quality of life.

Yip *et al.,* 2007 was published an article and the title was “Effects of a self-management arthritis programme with an added exercise component for osteoarthritic knee” and reference was *TOC.* Research method was Randomized controlled trial. Outcome measure was Patients with knee OA (n=182) were randomized to a control group or to an arthritis self-management program (2- hour classes a week for 6 weeks). In these classes, patients were taught how to manage pain and other circumstances associated with OA and result was significant improvement from baseline in self-management skills, such as using hot and cold compresses and joint protective methods and could perform light exercise for significantly longer.

Williamson and Wyatt, 2007 was published an article and the title was “Severe knee osteoarthritis: a randomized controlled trial of acupuncture, physiotherapy (supervised exercise) and standard management for patients awaiting knee replacement” in *Rheumatology (Oxford).* Research method was three-arm, assessor-blind, randomized controlled trial. Outcome measure was 181 patients awaiting knee arthroplasty and result was however, we failed to demonstrate any other clinically or statically significant effects between the groups. Both interventions can be delivered effectively in an out-patient group setting at a district general hospital.

Marlene and Lillias, 2007 was published an article and the title was “Physical activity for osteoarthritis management: A randomized controlled clinical trial evaluating hydrotherapy or Tai Chi classes” in *TOC.* Method was a randomized controlled trial was conducted among 152 older persons with chronic symptomatic hip or knee OA. Outcome measure was assessed 12 and 24 weeks after randomization and included pain and physical function (Western Ontario and McMaster Universities Osteoarthritis Index), general health status and result was access to either hydrotherapy or Tai Chi classes can provide large and sustained improvements in physical function for many older, sedentary individuals with chronic hip or knee OA.

Yin-Bing Yip *et al.,* 2008 was published an article and the title was “A 1-year follow-up of an experimental study of a self-management arthritis programme with an added exercise component of clients with osteoarthritis of the knee” and reference was *Psychology, Health & Medicine.* Research method was an experimental study with 95 participants assigned randomly to the intervention (n=45) or control group (n=50).

Seventy-seven (81.1%) participants joined at least one out of three follow-ups in the 12 month period. Outcome measure was arthritis self-efficacy (ASE) and health outcomes including pain and fatigue rating, self-rated health, daily activities limitation and number of unplanned arthritis-related medical consultations and result was our findings add to the evidence that the modified arthritis empowering programme improved perception of control of osteoarthritis and three health outcomes after 12 months of treatment.

Coleman *et al.,* 2008 published a research work and the title was "Effects of self-management, education and specific exercises, delivered by health professionals, in patients with osteoarthritis of the knee" in *BMC Musculoskeletal Disorders.* Research method was the effects of standard medical management will be compared with the effects of the OAK program in a single-blind randomized study. Outcome measure was 146 male and female participants with established OA knee will be recruited. Volunteers with coexistent inflammatory joint disease or serious co-morbidities will be excluded and result was evidence to guide clinicians and funding bodies seeking to establish priorities regarding the provision of this disease specific program.

Luciana and Valeria, 2008 was published an article and the title was "Hydrotherapy Versus Conventional Land-Based Exercise for the Management of Patients with Osteoarthritis of the Knee: A Randomized Clinical Trial" in *PHYS THER.* Research method was a water-based exercise group and a land-based exercise group. Outcome measure was sixty-four subjects with OA of the knee included a visual analog scale (VAS) for pain in the previous week, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and result was both water-based and land-based exercises reduced knee pain and increased knee function in participants with OA of the knee. Hydrotherapy was superior to land based exercise in relieving pain before and after walking during the last follow-up.

Nicola *et al.,* 2008 was published an article and the title was "Evidence based guidelines and current practice for physiotherapy management of knee osteoarthritis" and reference was *TOC* **7**: 45–56. Research method was questionnaire survey of chartered physiotherapists. Outcome measure was 300 postal questionnaires were distributed to Physiotherapy Departments requesting information regarding source of referrals, treatment aims, preferred methods of treatment and service delivery and result was exercise was utilized by 100% of practitioners, often supplemented with electrotherapeutic modalities (66%), manual therapy (64%) and acupuncture (60%). The majority of patients received individual treatment for a total contact time of 1–2 hours, whilst most group interventions lasted 5-6 hours.

Coleman *et al.,* 2008 was published a article and the title was “Effects of Self-Management, Education and Specific Exercises, Delivered By Health Professionals, Using Behavior Modification In Patients With Osteoarthritis of The Knee” in *Ann Rheum Dis.* Research method was randomized to control or intervention groups. Coexistent inflammatory joint disease or serious co-morbidities excluded participation. Outcome measure was the intervention group completed the 8-week self-management behavior modification programme that included specific exercises tailored for knee OA and result was improvements did occur in the intervention group consistent with those in the pilot study, the control group also experienced improvements in some outcomes.

Haxby *et al.,* 2008 was published an article and the title was “Exercise therapy, manual therapy, or both, for osteoarthritis of the hip or knee: a factorial randomized controlled trial protocol” in *Bio Med Central.* Research method was this is a 2 × 2 factorial randomized controlled trial. Outcome measure was 224 participants with hip or knee OA. The primary outcome will be disability at one-year follow up using the WOMAC. Outcome measures recommended by OMERACT-OARSI guidelines and result was The MOA Trial will be among the first randomized trials to investigate the effectiveness and cost-utility of manual therapy interventions and/or individually tailored, supervised multi-modal exercise therapy programmes for patients with hip or knee OA.

Jensen, 2008 was published an article and the title was “Knee osteoarthritis: influence of work involving heavy lifting, kneeling, climbing stairs or ladders, or kneeling/squatting combined with heavy lifting” in *Occup Environ Med.* Research method was the relevant studies were identified through searches in the following literature databases: Medline, NIOSH-tic, Embase and HSE-line. Outcome measure was limitations of the studies include few participants, use of different diagnostic criteria and a poor description of the exposure and result was in the studies on the association between knee OA and climbing stairs or ladders, there was an increased risk for knee OA, but only a few studies were found and no dose–response relationship.

Kanda and Orapin*,* 2009 was published an article and the title was "No difference between home based strength training and home based balance training on pain in patients with knee osteoarthritis: a randomized trial" in *Australian Journal of Physiotherapy.* Research method was randomized trial with concealed allocation and assessor blinding. Outcome measure was 48 community volunteer with knee injury used to evaluate pain and result was there was no difference in pain between home based strength training and home based balance training.

Marlene and Sara*,* 2009 was published an article and the title was "Land-based Exercise for Osteoarthritis of the Knee: A Meta-analysis of Randomized Controlled Trials" and reference was *The Journal of Rheumatology June.* Research method was conducted a meta-analysis of RCT comparing some form of land-based therapeutic exercise with a non-exercise group using pain and self-reported physical function outcomes. Outcome measure was the 32 included studies provided data on almost 3800 participants. Meta-analysis revealed a beneficial treatment effect and result was there is evidence that land-based therapeutic exercise has at least short-term benefit in terms of reduced knee pain and physical disability for people with knee OA.

Thomas *et al.,* 2009 was published an article and the title was "Recommendations for the Treatment of Knee Osteoarthritis, Using Various Therapy Techniques, Based on Categorizations of a Literature Review" in *Journal of Geriatric Physical Therapy.* Method was twenty-two articles were located using various online databases, critically analyzed, and categorized using Sackett's levels of evidence. Outcome measure was this article contains recommendations outside the scope of a therapist's practice, which a physical therapist could consider when treating a patient with knee osteoarthritis and result was recommendations outside the scope of a therapist's practice, which a physical therapist could consider when treating a patient with knee osteoarthritis.

Ming and Chia, 2009 was published an article and the title was "Effects of Different Stretching Techniques on the Outcomes of Isokinetic Exercise in Patients with Knee Osteoarthritis" in *The Kaohsiung Journal of Medical Sciences.* Research method was patients were randomly divided into four groups (I–IV). The patients in Group I received isokinetic muscular strengthening exercises, Group II received bilateral knee static stretching and isokinetic exercises, Group III received proprioceptive neuromuscular facilitation (PNF) stretching and isokinetic exercises, and Group IV acted as controls. Outcome measure was we recruited 132 subjects with bilateral knee osteoarthritis (Altman Grade II) to compare the effects of different stretching techniques on the outcomes of isokinetic muscle strengthening exercises and result was stretching therapy could increase the effectiveness of isokinetic exercise in terms of functional improvement in patients with knee osteoarthritis. PNF techniques were more effective than static stretching.

Nicola and Walsh, 2009 was published an article and the title was "Evidence based guidelines and current practice for physiotherapy management of knee osteoarthritis" in *Musculo skeletal care.* Research method was 300 postal questionnaires were distributed to Physiotherapy departments requesting information regarding source of referrals, treatment aims, preferred methods of treatment and service delivery. Outcome measure was responses were received from 83 physiotherapists (28 %), predominantly working in the UK National Health Service. Approximately equal numbers of referrals came from primary and secondary care and result was patient education and self-management is observed by physiotherapists, but other modalities are often used despite poor or no research evidence supporting their efficacy.

Ken and Hiroshi, 2010 published an research work and the title was "Exercise Focused on Multi articular Movement to Improve Muscle Activity during Gait and Single-leg Standing for Participants with Hip Osteoarthritis by Using Electromyogram and Three-dimensional Motion Analysis" in *Journal of Physical Therapy Science.* Research method was two types of exercise affect walking and single-leg standing in people with hip osteoarthritis (OA) using surface Electromyogram (EMG) and three dimensional (3D) motion analysis system. The outcome measure was Participants were 18 female diagnosed as having knee OA and the result was in Multi group, GMax and GMed were significantly increased during the stance phase, whereas GMax was significantly decreased during the swing phase.

Martin *et al.,* 2010 was published an article and the title was “Behavioral graded activity results in better exercise adherence and more physical activity than usual care in people with osteoarthritis: a cluster-randomized trial” in *Journal of Physiotherapy.* Research method was analysis of secondary outcomes of a cluster-Randomised trial with concealed allocation, assessor blinding, and intention-to-treat analysis. Outcome measure was two hundred patients with hip and/or knee osteoarthritis. Experimental group received 18 sessions of behavioral graded activity over 12 weeks and up to 7 booster sessions and result was behavioral graded activity results in better exercise adherence and more physical activity than usual care in people with osteoarthritis of the hip or knee, both in the short- and long-term.

Mariette and Wolfgang, 2011 was published an article and the title was “Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilization each reduce pain and disability in people with knee osteoarthritis: a systematic review” and reference was *Journal of Physiotherapy* Method was a meta-analysis of randomized controlled trials. Outcome measure was the primary outcomes were pain and physical function. Typical measures of these outcomes include the Western Ontario McMaster Universities Index (WOMAC) and result was exercise therapy plus manual mobilization showed a moderate effect size on pain compared to the small effect sizes for strength training or exercise therapy alone.

Duncan, *et al.,* 2011 was published an article and the title was “Effects of a six week lower limb stretching programme on range of motion, peak passive torque and stiffness in people with and without osteoarthritis of the knee” in *New Zealand Journal of Physiotherapy.* Method was a randomized controlled trial design was utilized. Outcome measure was twenty two females and seventeen males aged between 60 and 78 years participated and result was arthritis of the knee are able to demonstrate sustained improvements in joint range of motion with stretching interventions. Study demonstrated that simple stretching exercises are effective as part of the long term management of knee osteoarthritis.

Frencha and Brennanb, 2011 was published an article and the title was “Manual therapy for osteoarthritis of the hip or knee - A systematic review” in *Manual Therapy.* Research method was eight databases were searched for randomised controlled trials (RCTs). Outcome measure was four RCTs were eligible for inclusion (280 subjects), three of which studied people with knee OA and one studied those with hip OA and result was manual therapy is more effective than exercise for those with hip OA in the short and long-term.

Husam *et al.,* 2011 published a research work and the title is Evidence-based physiotherapeutic management for knee osteoarthritis: A knowledge translation study in *Thesis MSc Physio Stellenbosch University.* His research method is a three-month retrospective audit (initial audit) of knee OA patients' physiotherapy records kept by the participating physiotherapists was conducted to establish current management patterns. Outcome measure was A systematic review (SR) into EB clinical guidelines was conducted to describe and synthesize the available evidence and formulate composite recommendations for knee OA and the result was a statistically significant increase the implementation of weight-loss and self-management strategies in the management of knee OA was noted. Conversely, a statistically significant decrease was noticed in using patellar taping.

Mariette and Jansen*,* 2011 was published an article and the title was "Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilization each reduce pain and disability in people with knee osteoarthritis: a systematic review" in *Journal of* Physiotherapy. Research method was a meta-analysis of randomized controlled trials. Outcome measure was the primary outcome measures were pain and physical function. 12 trials compared one of the interventions against control and result was exercise therapy plus manual mobilization showed a moderate effect size on pain compared to the small effect sizes for strength training or exercise therapy alone.

Heuts *et al.,* 2017 was published an article and the title was "Self-management in osteoarthritis of hip or knee: a randomized clinical trial in a primary healthcare setting" in *The Journal of Rheumatology.* Research method was this was a 2-group randomized controlled trial, with 273 patients aged 40 to 60 years with OA of the hip(s) and/or knee(s). Outcome measure was pain severity in hips and knees, other significant complaints, and functional limitations and result was the self-management program positively influenced knee pain.

Foley *et al.,* 2003 was published an article and the title was "Does hydrotherapy improve strength and physical function in patients with osteoarthritis-a randomized controlled trial comparing a gym based and a hydrotherapy based strengthening programme" in *Ann. Rheum. Dis.* Research method was single blind, three arm, randomized controlled trial, WOMAC OA Index. Outcome measure was 105 community living participants aged 50 years and over with clinical OA of the hip or knee and result was both exercise (84% of hydrotherapy and 75% of gym sessions) programmes compared with the control group.

Nathaly and Gaudreaulta, 2011 was published an article and the title was "Effects of physiotherapy treatment on knee osteoarthritis gait data using principal component analysis" and reference was *Clinical Biomechanics*. Research method was three-dimensional (3D) knee kinematic and kinetic data were recorded during the gait of 29 participants diagnosed with knee OA before and after they received 12 weeks of physiotherapy treatment. Outcome measure was principal component analysis was applied to extract groups of knee flexion/extension, adduction/abduction and internal/external rotation angle and moment data and result was when pre- and post-treatment comparisons were performed without grouping, the data showed no treatment effect.

Jaramillo *et al.,* 2012 was published an article and the title was "Prevention and self-management interventions are top priorities for osteoarthritis systematic reviews" in *Journal of Clinical Epidemiology.* Research method was we consulted with experts and conducted a literature search to identify a priority-setting method that could be adapted to address the health equity and SDH. Outcome measure was developing an evidence map of the existing systematic reviews on osteoarthritis; conducting one face-to-face workshop with patients and another one with clinicians, researchers, and patients; and conducting an online survey of patients to rank the top 10 research questions and result was there were marked gaps: no high-priority topics were identified for access to care until patients had advanced disease–lifestyle changes once the disease was diagnosed.

Kim *et al.,* 2012 was published an article and the title was "A physiotherapist-delivered integrated exercise and pain coping skills training intervention for individuals with knee osteoarthritis: a randomized controlled trial protocol" and reference was *BMC Musculo skeletal Disorders.* Method of research was this will be an assessor-blinded, 3-arm randomized controlled trial of a 12-week intervention involving 10 physiotherapy visits together with home practice. Outcome measure was primary outcomes are overall average pain in the past week measured by a Visual Analogue Scale and physical function measured by the Western Ontario and McMaster Universities Osteoarthritis Index subscale. Secondary outcomes include global rating of change, muscle strength, functional performance, physical activity levels, health related quality of life and psychological factors and result was efficacy of an integrated exercise and PCST program delivered by physiotherapists in improving pain and physical function in those with knee OA compared with exercise or PCST alone. The novel findings will enable evidence-based recommendations as to the efficacy of this conservative option for the management of patients with knee OA.

Moody *et al.,* 2012 was published an article and the title was "Perceptions of a water-based exercise programme to improve physical function and falls risk in older adults with lower extremity osteoarthritis: barriers, motivators and sustainability" in *New Zealand Journal of Physiotherapy.* Research method was mixed methods study that investigated the effects of a twelve week aqua-aerobics programme on falls risk and physical function in older adults with lower extremity osteoarthritis. Outcome measure was 17 participants with an average age of 78 years attended focus group interviews and result was Strong positive feedback as well as constructive criticism from participants provided the basis of recommendations which may be used to create an optimal programme to promote long-term participation.

Laurianne and Lucie 2012 was published an article and the title was "Ottawa Panel Evidence-Based Clinical Practice Guidelines for Aerobic Walking Programs in the Management of Osteoarthritis" in *Arch Phys Med Rehabil.* Research method was a literature search was conducted using the electronic databases MEDLINE, PubMed, and the Cochrane Library for all studies related to aerobic walking programs for OA. Outcome measure was Ottawa Methods Group established the inclusion and exclusion criteria regarding the characteristics of the population, by selecting adults of 40 years old and older who were diagnosed with OA of the knee and result was the greatest improvements were found in pain, quality of life, and functional status (grades A, B, or C).

Roos and Juhl 2012 was published an article and the title was "Osteoarthritis 2012 year in review: rehabilitation and outcomes" and reference was *Osteoarthritis and Cartilage*. Research method was a systematic literature search was performed in Medline from July 2011 to 10 April 2012 using the terms 'osteoarthritis, knee', 'osteoarthritis, hip' rehabilitation, physical therapy, exercise therapy and preoperative intervention. Outcome measure was included if they contributed methodologically to advancing outcome measurement and result was exercise and weight loss are supported by both research evidence and expert opinion as preferred first-line treatments, and as adjunctive treatments prior to surgery.

Pinto *et al.,* 2013 was published an article and the title was "Manual therapy, exercise therapy, or both, in addition to usual care, for osteoarthritis of the hip or knee. economic evaluation alongside a randomized controlled trial" in *Osteoarthritis and Cartilage.* Research method was resource use was collected using the Osteoarthritis Costs and Consequences Questionnaire. Quality-adjusted life years (QALYs) were calculated using the Short Form 6D. Outcome measure was 206 Adults who met the American College of Rheumatology criteria for hip or knee osteoarthritis were included in an economic evaluation from the perspectives of the New Zealand health system and result was in this study, exercise therapy and manual therapy were more cost effective than usual care at policy relevant values of willingness-to-pay from both the perspective of the health system and society.

Martin, 2013 was published an article and the title was "A comparison of Knee pain hydrotherapy with conventional physiotherapy in the treatment of osteoarthritis: a pilot trial" in *Journal of Integrative Medicine.* Research method was the study design is a prospective randomized controlled three-arm clinical pilot trial, carried out at a specialist clinic for integrative medicine. Outcome measure was pain intensity of the affected joint in the course of inpatient treatment; health-related quality of life, joint-specific pain and mobility in the course of the study and result was the results of this pilot study demonstrate beneficial effects of hydrotherapy.

Knoop and Dekker 2013 was published an article and the title was "Knee joint stabilization therapy in patients with osteoarthritis of the knee: a randomized, controlled trial" and reference was *Osteoarthritis and Cartilage*. Research method was a single-blind, randomized, controlled trial involving 159 knee OA patients with self-reported and/or bio mechanically assessed knee instability, randomly assigned to two treatment groups. Outcome measures included activity limitations WOMAC Index – physical function, pain, global perceived effect and knee stability and result was both exercise programs were highly effective in reducing activity limitations and pain and restoring knee stability in knee OA patients with instability of the knee.

Michael and Hunta 2013 was published an article and the title was "A physiotherapist-delivered, combined exercise and pain coping skills training intervention for individuals with knee osteoarthritis: A pilot study" in *The Knee.* Research method was OA were randomized to receive either 10 weeks of physiotherapist supervised exercises. Outcome measure was ten participants were randomized to each group and both groups exhibited significant improvements in isometric knee strength, self-reported knee pain and physical function and result was combines exercise and PCST within the same treatment session and delivered by specially-trained physiotherapists is feasible and can improve both physical and psychological outcomes.

Zacharias and Green, 2014 was published an article and the title was "Efficacy of rehabilitation programs for improving muscle strength in people with hip or knee osteoarthritis: a systematic review with meta-analysis" and reference was *Osteoarthritis and Cartilage.* Research method was seven databases (MEDLINE, CINAHL, SPORT Discus, Embase, AUSPORT, COCHRANE and PEDro) were searched systematically. Outcome measure was exercise-based interventions for participants with hip or knee OA. All studies were screened for eligibility and methodological quality and result was high-intensity resistance exercise demonstrated moderate quality of evidence for large and sustained improvements for knee muscle strength in knee OA patients.

Rana, 2015 was published an article and the title was "Manual physiotherapy or exercise leads to sustained reductions in pain and physical disability in people with hip and knee osteoarthritis" in *Journal of Physiotherapy.* Research method was randomised, controlled trial with concealed allocation and blinded outcome assessment. Outcome measure, the primary outcome was the change in the WOMAC index at 1 year. Secondary outcome measures included measures of pain, and physical function and result was manual therapy and exercise therapy supervised by physiotherapists can lead to reduced pain and improved physical function for up to one year.

Crossley and Vicenzino, 2015 published a research work and the title was "Exercise, education, manual-therapy and taping compared to education for patello femoral osteoarthritis: a blinded, randomized clinical trial" in *Osteoarthritis and Cartilage.* Research method was a randomized, participant-blinded and assessor-blinded clinical trial was conducted in primary-care physiotherapy. Outcome measure was 92 people aged 40 years with symptomatic and radiographic PFJ OA participated. Physiotherapists delivered the PFJ-targeted exercise, education, manual-therapy and taping program, or the OA-education (control condition) in eight sessions over 12 weeks and result was exercise, education, manual-therapy and taping can be recommended to improve short-term patient rating of change and pain severity.

Fitzgerald, 2016 was published an article and the title was "Exercise, manual therapy, and use of booster sessions in physical therapy for knee osteoarthritis: a multi-center, factorial randomized clinical trial" in *Osteoarthritis and Cartilage.* Researcher method was multi-center, 2×2 factorial randomized clinical trial. Outcome measure was 300 participants with knee OA were randomized to four groups: exercise-no boosters (Ex), exercise-with boosters (Ex+B), manual therapy+exercise-no boosters (MT+Ex), manual therapy+exercise-with boosters (MT+Ex+B) and result was interaction analysis suggested knee pain decreases for participants receiving boosters and increases for participants not receiving boosters from 9 weeks to 1 year.

Tan 2016 was published an article and the title was "Cost-utility of exercise therapy in patients with hip osteoarthritis in primary care" in *Osteoarthritis and Cartilage.* Research method was data on direct medical costs, productivity costs and quality of life (QoL) was collected using standardized questionnaires. Outcome measure was a total of 203 patients were included and result was exercise therapy is probably cost saving, without the risk of noteworthy negative health effects.

Many researchers have done work on the knee OA in the world. From the literature review it is mentionable that most of the research worked on traditional research. No research work on the issue of OA in Bangladesh especially in sustainable management using therapeutic agents. From the above literature reviewed it can be said that the present study has been conducted for those people who are socially and economically disadvantaged and has been suffering due to food and environment related knee OA.

Chapter Three
Materials and Methods

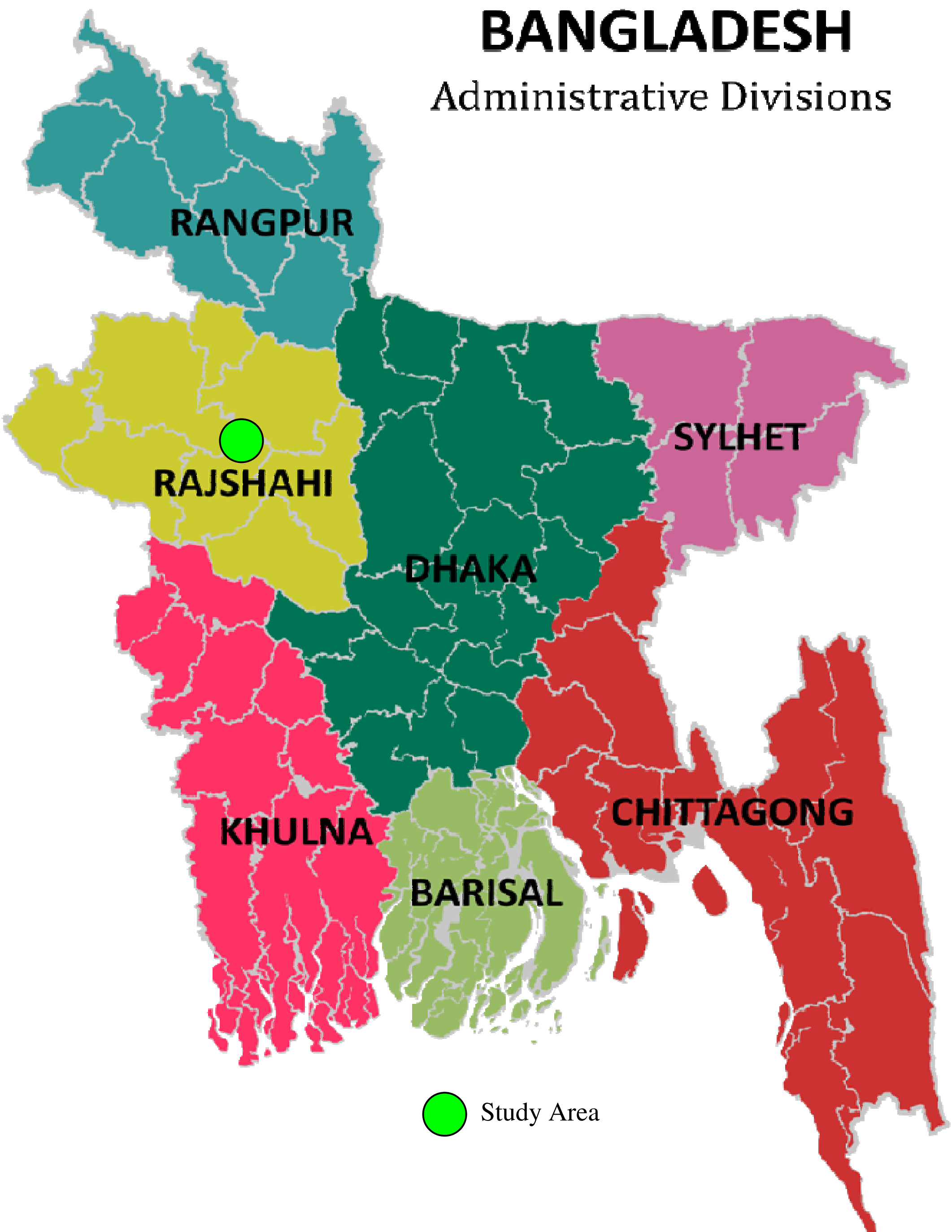
3.1 Study Area

The study area was situated in Rajshahi, Chapai Nawabgonj and Pabna district of north western region of Bangladesh where large number of arthritis patient found. Shibgonj under Chapai Nawabgonj district, Mohonpur, Mundumala and Bagmara under Rajshahi district, Tebunia under Pabna district were selected prospectively. The principal cover of the study site was health areas. The remaining parts of the site were hospital and thana health complex with rural community.

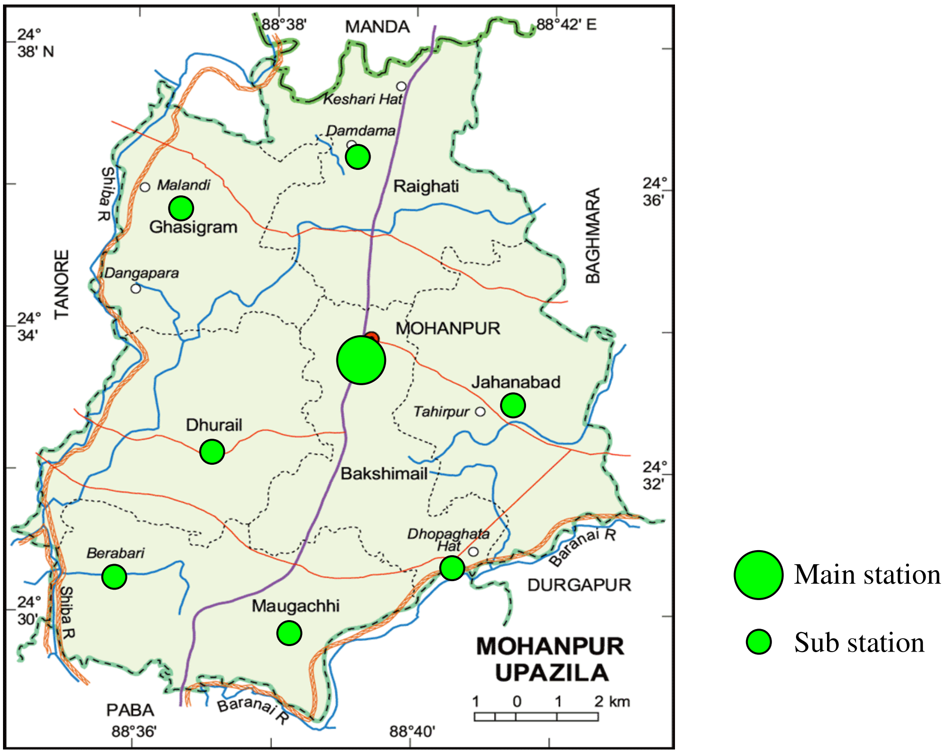
The study area was mapped on the basis of rectified aerial photographs and field surveys in 2012-2016. The area was then digitized in the geographical information system Arc View.

The study area is especially known as North Bengal which is situated north side of Bangladesh. It is a largest Pleistocene physiographic unit of the Bengal Basin covering an area of about 7,770sq. km. Geographically this area lies roughly between latitude 24°20’N and 25°35’N and longitudes 88°20’E and 89°30’E. The Kortoya to the east, Mohanonda to the west and the northern bank of the Ganga to the South and Punarbhaba rivers are the main of this area.

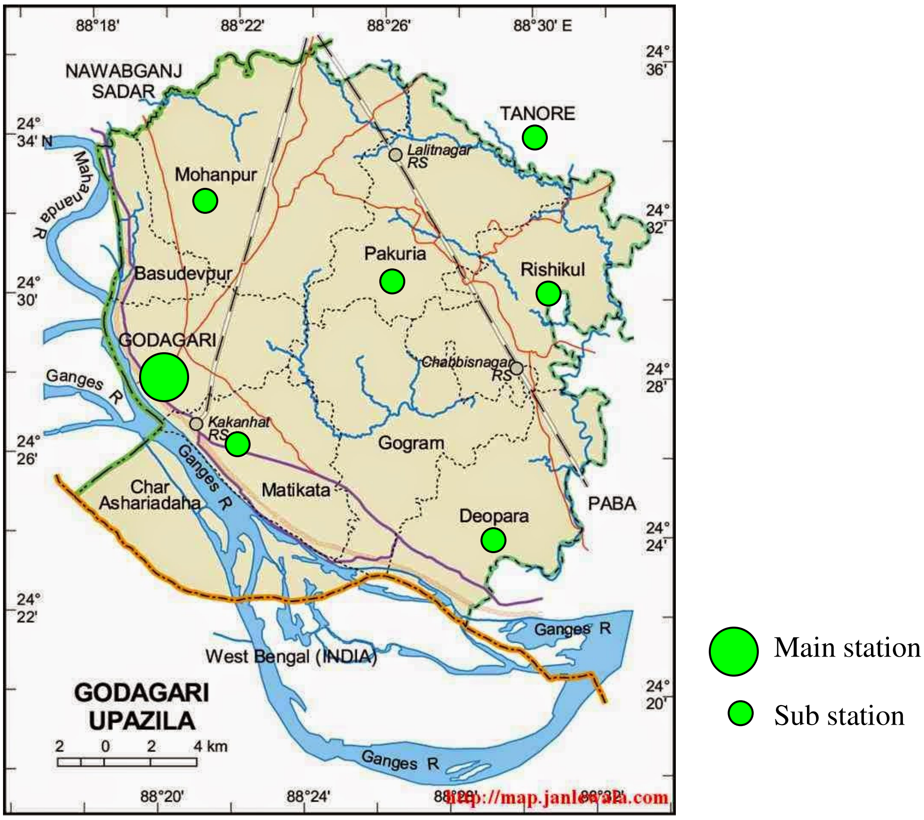
Figure 3.1: Maps of Study Area



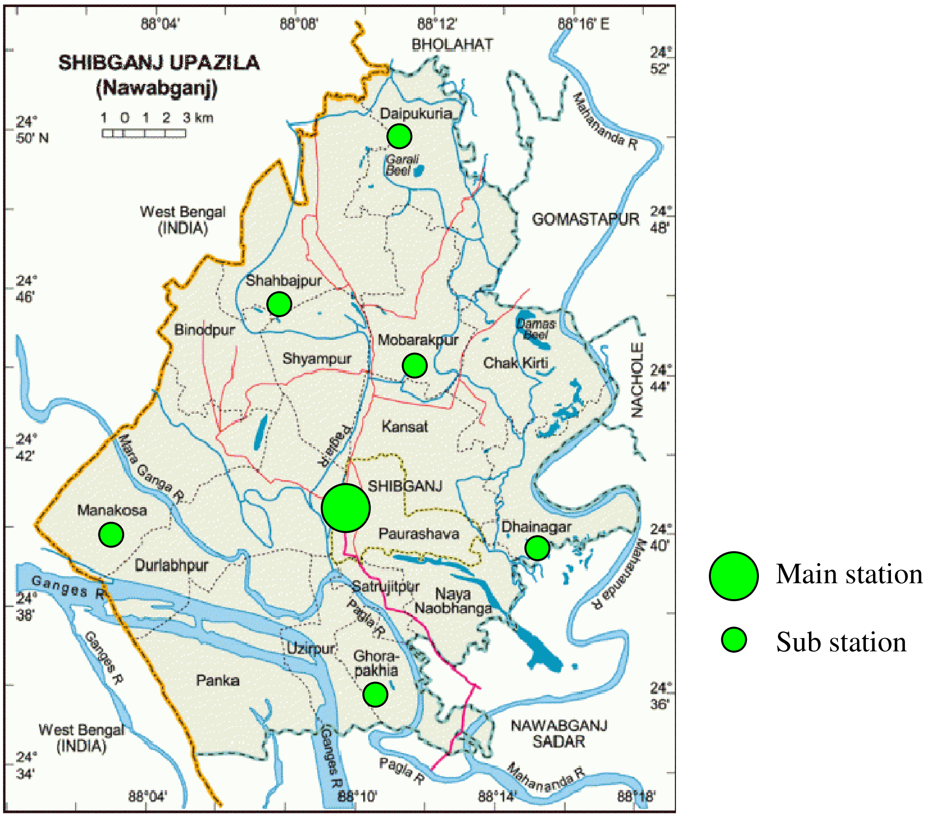
Map of Bangladesh and the study area is Rajshahi division



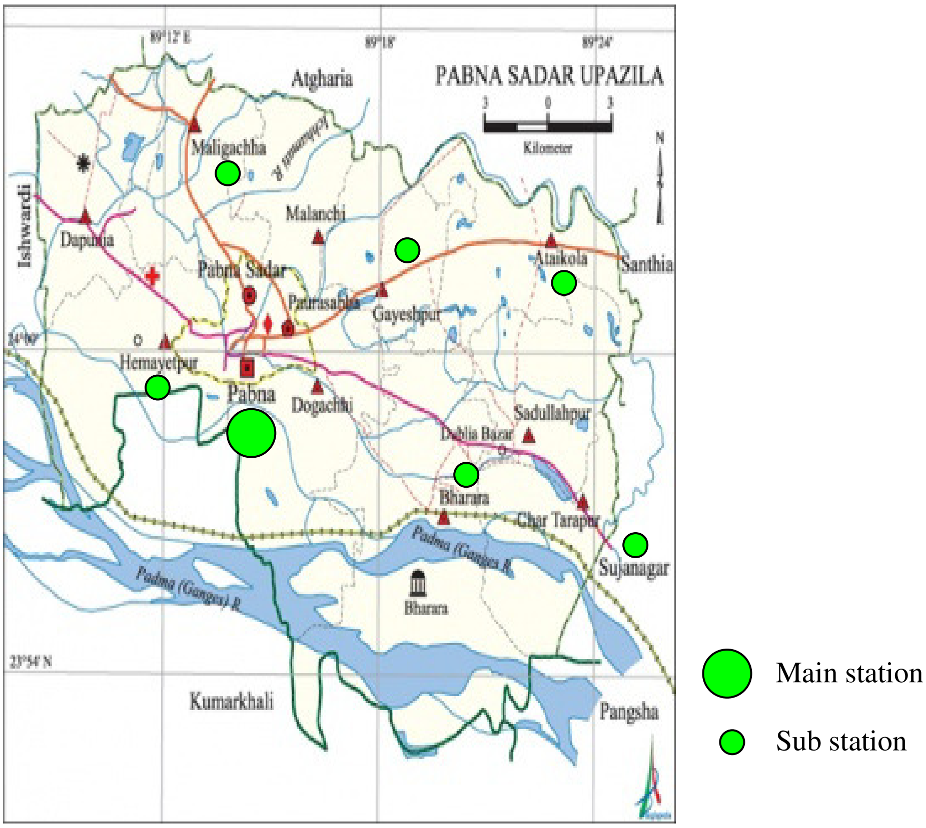
Map of Mohonpur upazila under the district of Rajshahi division. Main station is upazila health complex and seven substation around the upazila.



Map of Godagari upazila under the district of Rajshahi division. Main station is upazila health complex and seven substation around the upazila



Map of Shibgonj upazila under Chapai Nawabgonj district of Rajshahi division. Main station is upazila health complex and six sub station around the upazila



Map of Pabna sadar upazila under Pabna district of Rajshahi division. Main station is upazila health complex and six sub station around the upazila

Figure 3.2: Pictures of Study Area


সু-খবর!
সু-খবর!!
সু-খবর!!!
বাত, ব্যাথা, প্যারালাইসিস ও হাটু ব্যথা চিকিৎসা ক্যাম্প
হাটু ব্যথা, পায়ের গোড়ালীর ব্যাথা, গিরা শক্ত হয়ে যাওয়া, মাজার ব্যথা, ঘাড়ের ব্যথা,
পিঠ ব্যথা, আঘাত জনিত ব্যথা, বিকলাঙ্গতা, শিশুদের জন্মগত বিকলাঙ্গতা, গর্ভবতী
মহিলাদের কোমর ব্যথা, সিজার পরবর্তী কোমর ব্যথা, স্ট্রোক, প্যারালাইসিস, মুখ
একদিকে বাকা হয়ে যাওয়া ও খেলাধুলার আঘাত জনিত ব্যথা সহ শরীরের
যে কোন ব্যথার রুগীদের জন্য সুখবর ।
বিশিষ্ট বাত, ব্যথা ও প্যারালাইসিস বিশেষজ্ঞ
ডাঃ মোঃ শাহাদৎ হোসেন "মনি"
স্থান ঃ মৌপাড়া সরকারি প্রাথমিক বিদ্যালয়
তারিখঃ ৩০-১১-২০১২ ইং
সময়ঃ - সকাল ৯.০০ টা হইতে বিকাল ৩.০০ টা পর্যন্ত
আপনাদের এলাকায় চিকিৎসা প্রদান করবেন ।

3.2 Weather and Climate of the Study Area

3.2.1 Rajshahi

Rajshahi's climate is classified as tropical. The summers are much rainier than the winters in Rajshahi. This climate is considered to be Aw according to the Köppen-Geiger climate classification. The average annual temperature in Rajshahi is 25.8 °C. About 1419 mm of precipitation falls annually (Weather office).

Between the driest and wettest months, the difference in precipitation is 299 mm. The variation in temperatures throughout the year is 10.9 °C. Useful hints about reading the climate table: For every month, you will find data about precipitation (mm), average, maximum and minimum temperature (degrees Celcius and Fahrenheit). Meaning of the first line: (1) January, (2) February, (3) March, (4) April, (5) May, (6) June, (7) July, (8) August, (9) September, (10) October, (11) November, (12) December.

3.2.2 Chapai Nawabgonj

Chapai Nawabgonj is the most western district of Bangladesh. Rajshahi and Naogaon is on the east, Malda of West Bengal, India is on the north. Western side is surrounded by the river Padma and Malda district and Murshidabad of West Bengal, India is on the southern side. Chapai Nawabgonj is situated between the latitude 24'22 to 24'57 and longitude 87'23 to 88'23. Chapai Nawabgonj District (Rajshahi division) has an area of 1702.55 km2. Many rivers flows over this area. The main rivers are the Ganges, and Mahananda.

Chapai Nawabgonj is very close to the big city of Rajshahi and the climate of both districts are very close. Under Köppen climate classification, Rajshahi has a tropical wet and dry climate. The climate of Rajshahi is generally marked with monsoons, high temperature, considerable humidity and moderate rainfall. The hot season commences early in March and continues till the middle of July. The maximum mean temperature observed is about during the months of April, May, June and July and the minimum temperature recorded in January is about 7 to 16 °C (45 to 61 °F). The highest rainfall is observed during the months of monsoon. The annual rainfall in the district is about 1,448 millimeters (57.0 in).

3.2.3 Pabna

Pabna forms the south-east boundary of Rajshahi Division. Sirajganj District is on the north-east, while the Padma River, main stream of the holy river Ganges, in the south separates it from Rajbari District and Kushtia District. The Jamuna River runs along its eastern border separating it from Manikgonj District; and on the north-west it has a common boundary with the Natore District. Average maximum temperature 36.8°C, minimum 9.6°C; annual rainfall 1872 mm. Characteristically the soil of the district is divided into four, viz flood plains of the Ganges, Karatoya, Jamuna and Barind Tract. Main rivers are Ganges, Ichamati, Gumani, Baral and Hurasagar.

Pabna's climate is classified as tropical. In winter, there is much less rainfall than in summer. According to Köppen and Geiger, this climate is classified as Aw. In Pabna, the average annual temperature is 26.0°C. Precipitation here averages 1603 mm. Precipitation is the lowest in December, with an average of 3 mm. Most precipitation falls in June, with an average of 300 mm.

At an average temperature of 29.9°C, May is the hottest month of the year. In January, the average temperature is 18.4°C. It is the lowest average temperature of the whole year.

Between the driest and wettest months, the difference in precipitation is 297 mm. The average temperatures vary during the year by 11.5 °C. Useful hints about reading the climate table: For every month, you will find data about precipitation (mm), average, maximum and minimum temperature (degrees Celcius and Fahrenheit). Meaning of the first line: (1) January, (2) February, (3) March, (4) April, (5) May, (6) June, (7) July, (8) August, (9) September, (10) October, (11) November, (12) December.

3.2.4 Settings

The clinical trial was conducted in primary care physiotherapy practices. Volunteers from the greater Rajshahi, Pabna and Chapai Nawabgonj district area responded to advertisements in print media, posters, health and medical practices and referrals from practitioners. Potential participants underwent telephone screening, followed by a physical screening by an experienced physiotherapist and standardized weight-bearing semi-flexed, standing, postero anterior and skyline radiographs to assess the severity of knee OA.

To be included, volunteers were required to be aged at least 40 years; have anterior or retro-patellar pain that was aggravated by two or more knee- loaded activities (e.g., stair ambulation, rising from sitting or squatting); have an average pain score of at least 3 on an 11-point scale (0 ¼ no pain; 10 ¼ worst pain possible) during aggravating activities and on most days during the past month; and have evidence of lateral knee osteophytes on weight-bearing skyline radiographs. Participants were excluded if they had pain from other lower-limb sites; predominantly knee joint symptoms on clinical examination (*e.g.,* location of pain, tenderness on palpation); current or previous physiotherapy for knee pain; recent knee injections; previous or planned knee surgery; physical inability to undertake testing; other medical conditions; inability to understand written and spoken English; and a body mass index (BMI) greater than 34 kgm². Additionally, individuals with medial >lateral knee osteophytes or moderate-to-severe concomitant knee OA were excluded.

3.2.5 Protocol

The trial comprised a 12 week intervention and a 12 week follow up. Participants were assessed immediately before treatment (baseline), immediately after treatment (final), and at 24 weeks (follow up).

3.2.6 Sample Size

Based on RCT of knee-targeted physiotherapy for knee pain, we required 20 people per group to detect 49% of people in the physiotherapy group reporting much improvement on the global rating of change, compared with 19% of people in the education group, with 80% power (a ¼ 0.05). A sample size of approximately 200 also enabled detection of the minimal clinically important improvements of 19.9 (21.5) mm on a 100 mm pain VAS and 9.1 (13.9) normalized units on the WOMAC physical function subscale with 90% power (a ¼ 0.05) and accounting for approximately 10% drop outs.

3.3 Selection Procedure of Programme

3.3.1 Participants

The recommended selection procedure, including the inclusion and exclusion criteria, was described in the implementation guidelines. The programme participants were recruited by providers by means of announcements in local newspapers, in monthly magazines of the home-care organizations and through recommendations of GPs. Adults aged 50 years or older with OA of knee were eligible for participation. The physiotherapist used an assessment protocol, including a decision tree, to assess eligibility. The protocol was based on the criteria of the American College of Rheumatology, which are also applied by Dutch general practitioners. All applicants whose OA of the knee was diagnosed by a GP were included. Applicants with self-reported OA of the knee were only included if they reported pain at endow rotation of the knee and morning stiffness, but no other major health problems. Applicants with self-reported OA of the knee were included if they reported crepitation, swelling and stiffness of one or both knee joints, but no other major health problems.

Applicants with symptoms of OA of knee and could participate in one of the programmes, depending on the severity of the symptoms of knee. Applicants on a waiting list for knee replacement and/or with self-reported severe mobility problems were excluded from participation.

Between October 2012 and April 2013, 297 participants were screened. Of these participants, 71 fulfilled the selection criteria and were enrolled in the study. Thirty-six participants were randomly assigned to an aquatic physical therapy group (intervention group), and 35 participants were randomly assigned to a control group. One aquatic physical therapy participant withdrew after randomization, did not undergo the intervention as allocated, and did not return for reassessment. Four control participants withdrew prior to re- assessment; however, 2 of them completed reassessment questionnaires only. All participants provided written informed consent.

3.3.2 Diagnostic Procedure

While no single test can definitively diagnose osteoarthritis of the knee, physicians use a comprehensive approach that is verified by diagnostic imaging to arrive at a clinical diagnosis.

It is important to clarify that most individuals over age 50 will have signs of osteoarthritis in their major joints that can be seen on an x-ray, but most will have no symptoms, so the medical provider will not rely on diagnostic studies (such as an x-ray) alone. An accurate diagnosis will come following a comprehensive medical history and physical examination by the health care provider.

3.3.3 Patient Interview

A doctor will ask a patient about family history and to describe the onset of his or her knee symptoms, the pattern of pain and knee swelling and how symptoms affect lifestyle, as well as what makes the pain better or worse. A patient's reported symptoms are important for diagnosis and treatment.

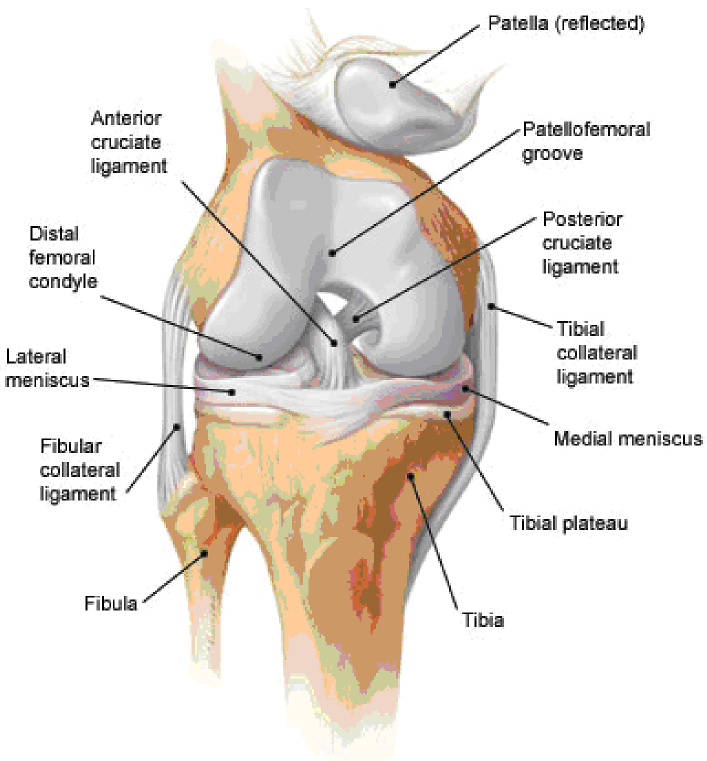
3.4 Physical Examination of Knee

Doctor will physically examine the patient's knee, noting any signs of swelling, pain points, stiffness and range of motion. The examination should extend above and below the knee, since knee pain may be referred from a remote source.

3.4.1 Testing

After the patient consultation and physical exam, doctor will usually have a pretty solid determination if the patient's symptoms are caused by arthritis or not. Follow up tests may be included as part of the diagnostic process both to gain further information about the extent of the knee arthritis and/or to rule out other possible causes of the patient's pain.

Figure 3.3: Diagrammatic Presentation of Knee Joint



3.4.2 Approach

- Adequately expose both lower limbs

1. Look –

- Walking aids
- Alignment - varus / valgus
- Quadriceps wasting
- Scars - arthroscopic ports, meniscectomy, midline longitudinal incisions
- Swellings

2. Gait –

- Antalgic -
- "Stiff knee" gait - pelvis rises to allow leg clearance during swing phase.
- Instability "thrust" gait - mechanical or neuropathic

3. Measure –

- Quadriceps wasting - measure thigh circumference at set distance (15cm above superior pole of patella, compare with opposite side)

4. Feel –

- Temperature- use back of hand
- Effusion test
- Swipe test
- patellar tap
- Tenderness - feel around joint margin, patella
- Grind test: move patella up and down while pressing gently against the femur - painful grating indicative of patello-femoral osteoarthritis
- Clarke's test: Feel behind knee for any poplitial fossa swellings

5. Move –

- Active (block to extension implies meniscal or cruciate injury) –

  Extension / hyperextension

- Passive –

  Extension / hyperextension

  Flexion - normally flexes until calf meets hamstring: 140'

Component	Test	Significance
Cruciates	• Flex knees to 90' (keep feet flat on couch), Look for sag sign. • Anterior draw test: flex knee to 90', sit on foot to stabilize (ensure foot is not tender) an pull forwards. • Posterior draw test: flex knee to 90', sit on foot to stabilize and push backwards. • Lachman test for ACL injury. • Flex knee to 20' and hold distal thigh firmly with hand. • Press down on distal thigh of patient and lift proximal tibia forwards.	Grading of draw tests: 1+: 0 -5mm 2+: 6 -10mm 3+: 11-15mm 4+: >15mm
Collateral ligaments	• Tuck patient's foot under arm and flex knee to 20-30'. • Apply varus / valgus force. • Repeat test with knee in full extension (instability signifies a combined collateral and cruciate ligament injury).	
Menisci	• McMurray's test: differentiate between medial and lateral meniscal tears. • Medial meniscus: flex knee, palpate medial joint line, externally rotate, extend knee. • Lateral meniscus: flex knee, palpate lateral joint line, internally rotate, extend knee. • Positive if: click or pain.	

Figure 3.4: Diagrammatic Presentation of Lachman Test

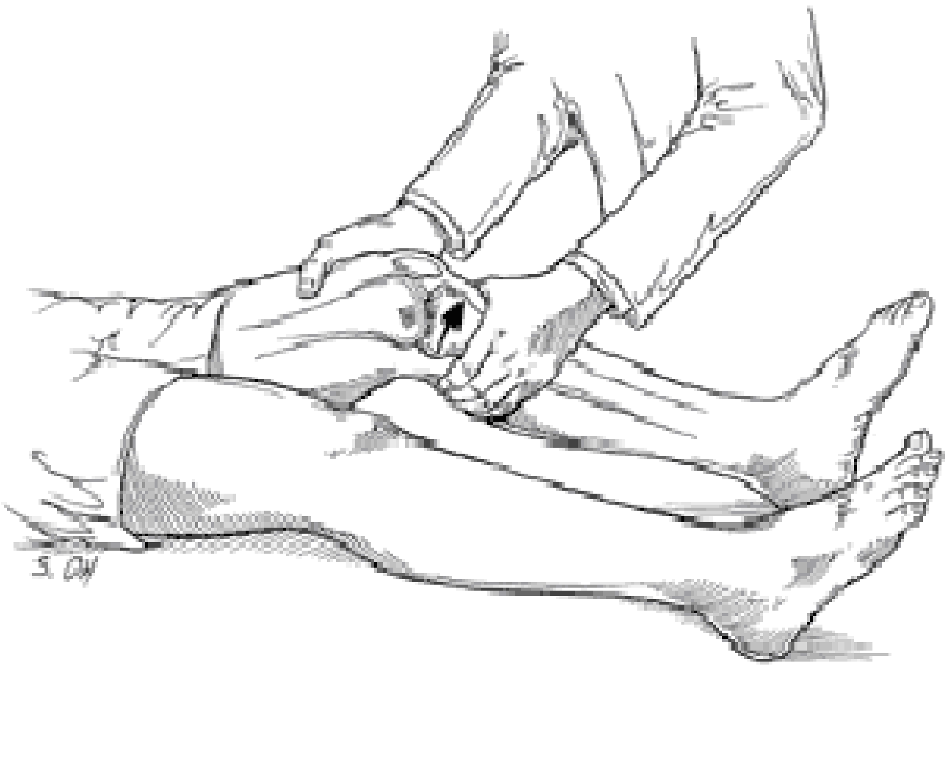
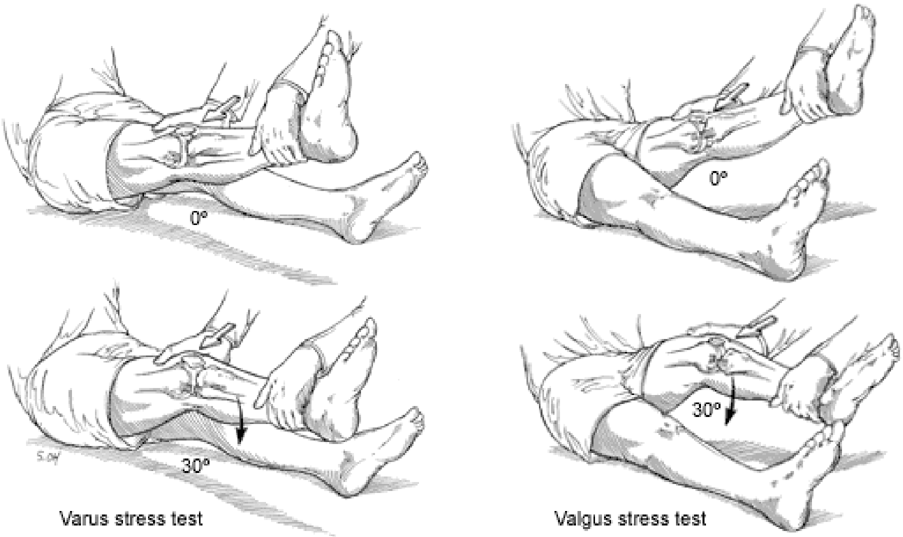
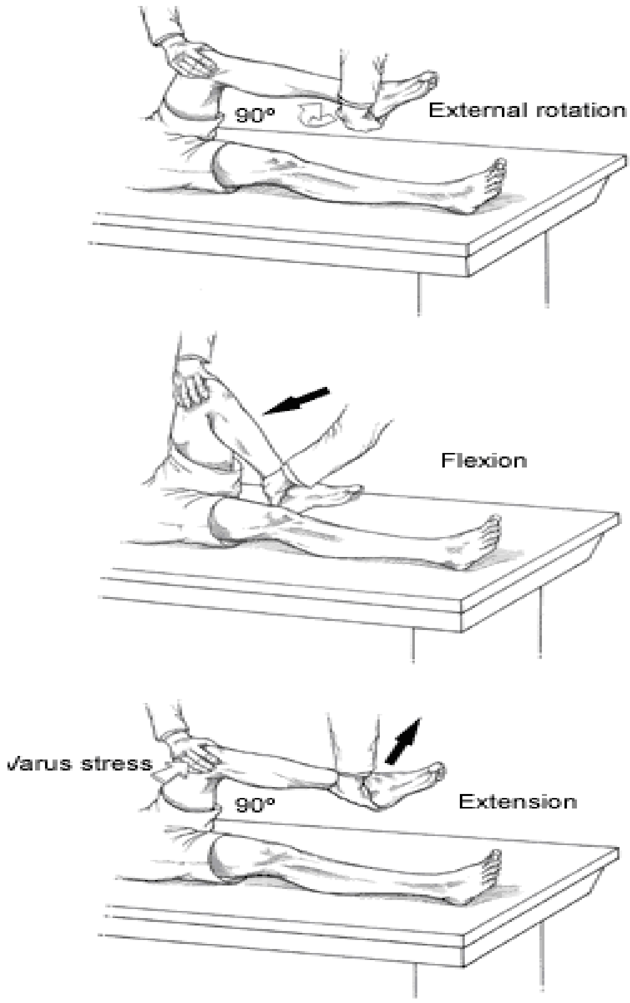


Figure 3.5: Diagrammatic Presentation of Varus and Valgus Stress Test



The maneuvers should be performed with the knee un flexed and at 30 degrees of flexion

Figure 3.6: Diagrammatic Presentation of McMurray Test



The test is performed with the patient supine and the knee flexed to 90 degrees. To test the medial meniscus, the examiner grasps the patient's heel with one hand to hold the tibia in external rotation, with the thumb at the lateral joint line, the fingers at the medial joint line. (Middle) The examiner flexes the patient's knee maximally to impinge the posterior horn of the meniscus against the medial femoral condyle. (Bottom) A varus stress is applied as the examiner extends the knee.

3.4.3 Radiological Examination

The diagnosis of osteoarthritis is often suggested on physical examination. Plain film radiographs are usually adequate for initial radiographic evaluation to confirm the diagnosis or assess the severity of disease if surgical intervention is being considered. Two views of the involved joint should be obtained, with the possible exception of the sacroiliac joints and the pelvis. The two views should be obtained in orthogonal planes to one another (i.e., antero posterior [AP] and lateral). Additional views of weight-bearing joints (knees, hips) may be necessary. Correlation of radiographic evidence of degenerative joint changes and symptoms described by patients vary by joint. Abnormalities detected in the knees correlate with pain in 85% of patients, the fingers and carpo metacarpal joints in approximately 80% and the hips in 75%.

The radiographic hallmarks of primary osteoarthritis include non-uniform joint space loss, osteophytes formation, cyst formation and subchondral sclerosis. The initial radiographs may not show all of the findings. At first, only minimal, non-uniform joint space narrowing may be present. The involved joint spaces have an asymmetric distribution. As the disease progresses, subluxations may occur and osteophytes may form. Subchondral cystic changes can occur. These cysts may or may not communicate with the joint space, can occur before cartilage loss and have a sclerotic border. Subchondral sclerosis or subchondral bone formation occurs as cartilage loss increases and appears as an area of increased density on the radiograph. In the advanced stage of the disease, a collapse of the joint may occur; however, ankylosis does not usually occur in patients with primary osteoarthritis.

Table 3.1: Clinical findings differentiating Osteoarthritis from other causes of painful joints

Condition	History	Physical
Primary osteoarthritis	Gradual progression of pain Morning stiffness of one hour or more Pain increasing with weight bearing Night pain No systemic symptoms	Bony enlargement of joints: DIP, PIP, first carpo metacarpal, hips, knees, feet Usually no wrist, elbow, ankle or involvement of MCP
Bursitis/tendonitis	Pain increased with movement Pain worse at night. No systemic symptoms Pain on some maneuvers, not others	No joint abnormality or swelling Certain passive maneuvers produce pain. Pain on resisted active range of motion of affected muscles
Mechanical intra-articular conditions	Recurrent joint swelling Joint locks Joint "gives way" Intermittent pain with pain-free intervals	Pain and limitation at certain points of flexion or extension Pain on combined rotation and extension of the knee
Rheumatoid arthritis	Often insidious onset Morning stiffness of one hour or more Systemic symptoms Associated symptoms (e.g., Raynaud's syndrome, skin rash)	Involvement of MCP, wrist, elbows, ankles Synovial thickening Classic deformities: Swan neck Boutonniere Ulnar deviation Loss of range of motion of wrist, elbows

DIP = distal inter phalangeal joint; PIP = posterior inter phalangeal joint; MCP = metacarpal phalangeal joint.

When evaluating patients with osteoarthritis of the knee, AP and lateral radiographs allow an adequate evaluation of the medial and lateral joint spaces. To adequately assess the joint space, the AP view should be obtained with the patient in a standing position. The lateral view also allows evaluation of the patello femoral joint; however, an additional view, known as the sunrise view, can offer even more information about this joint space.

Radiographic findings in patients with osteoarthritis include medial tibio femoral and patello femoral joint space narrowing, as well as subchondral new bone formation. Next, lateral subluxations of the tibia occurs, and osteophytes formation is most prominent medially. Lateral joint space narrowing can also occur but not as prominently as the medial narrowing. Cartilage is lost, and subchondral bone formation occurs. Marked osteophytes formation also occurs, and osteophytes are seen anteriorly and medially at the distal femur and proximal tibia, and posteriorly at the patella and the tibia.

Figure 3.7: X-ray Diagnostic film of Osteoarthritic Knee
(Appendix 10: Diagnostic Reports (X-Ray) on Knee OA Patients)

Osteoarthritis of the knees. (A) Antero posterior view of the left knee of patient 1 shows medial joint space narrowing (arrow). (B) Lateral view of the left knee shows sclerosis with marked osteophytes formation (arrows). The osteophytes are best seen in this view. (C) Patient 2 has marked osteoarthritic changes with medial joint space narrowing (white arrow) causing a varus deformity of the knee and collapse of the joint space with destruction of the medial cartilage and the subchondral cortex (open arrowheads). (D) Subchondral cysts (solid arrowhead) are noted.

Differential considerations are based, in part, on which joint is being examined. In general, the major differential diagnosis includes rheumatoid arthritis, psoriatic arthritis, calcium pyrophosphate deposition disease, ankylosing spondylitis and diffuse idiopathic skeletal hyperostosis.

Table 3.2: Radiographic Findings Differentiating Osteoarthritis from Other Causes of Painful Joints

Condition	Bone density	Erosions	Cysts	Joint space loss	Distribution	Bone production
Osteo-arthritis	Normal overall	No, unless erosive osteoarthritis	Yes, subchondral	Non uniform	Unilateral and/or bilateral; asymmetric	Yes; osteophytes; subchondral sclerosis
Rheuma-toid arthritis	Decreased	Yes	Yes, synovial	Uniform	Bilateral; symmetric	No
Psoriatic arthritis	Normal	Yes	No	Yes	Bilateral; asymmetric	Yes
CPPD	Normal	No	Yes	Uniform	Bilateral	Yes; osteophytes; chondrocalcinosis; subchondral
Ankylosing spondylitis	Early—normal Late—decreased	Yes	No	Yes	Bilateral; symmetric	Yes
DISH	Normal	No	No	No	Sporadic	Flowing osteophytes; ossification of tendon, ligaments

3.4.4 MRI

Magnetic Resonance Imaging (MRI) may be ordered to provide additional detail, as this test provides images of the soft tissue (ligaments, tendons and muscle) as well as bone. This more detailed image of the knee joint can be helpful if x-rays of the knee are inconclusive or if the doctor suspects symptoms are due to something other than osteoarthritis, such as damage to the knee's meniscus, tendons or ligaments. However, an MRI is more time consuming - requiring the patient to remain perfectly still for about 30 minutes - and is much more expensive than an x-ray. An MRI is not necessary in most cases.

3.4.5 Treatment Techniques

1. Swimming exercise 20 minute for every day for 12 week. Patient can perform this technique independently without the help of others.
2. Quadriceps stretching exercise and apply hot pack for 15min for two time every day for 12 week. Patient can perform this techniques independently.
3. Self-knee mobilization technique and apply hot pack for 15 minute for two time every day for 12week.
4. Deep Transverse Friction Massage (DTFM) and apply hot pack for 15 minute for two time per day for 12 week.

3.4.6 Measurements

All participants completed questionnaires before the programme. This pre-test design was thought to be adequate, given the objective to identify the effects of the programmes in real-life conditions after the initial RCTs. Outcome measures were pain, mobility, self-efficacy and OA knowledge for the Knee programme, and pain and mobility for the knee programme. Self-efficacy and OA knowledge were not evaluated, because the knee programme is a muscle-strengthening training programme. The patients with combined OA of the knee were evaluated according to the programme they followed. Questions on background variables were asked about sex, age, civil status, education, income and the number of other chronic conditions. OA knowledge in the Knee programme was assessed by means of 68 statements (range 0±10). A higher score indicates more correctly answered questions.

Self-reported pain was assessed with five items of the Impact of Rheumatic Diseases on General Health and Lifestyle (IRGL) pain scale. The IRGL is based on the Arthritis Impact Measurement Scales I, but adapted to the Dutch situation. Measured parameters were severity, tolerance and frequency of pain (range 5±25; Cronbach's a 0.86). A higher score indicates more pain. Furthermore, tolerance and severity of pain were measured over the past month with a Visual Analogue Scale (VAS; range 0±100). A higher score indicates less tolerance and more severe pain. Mobility in both programme was measured with seven items of the IRGL mobility scale (range 7±28; Cronbach's a 0.92). A higher score means better mobility. Self-efficacy, one's belief that one can perform a specific task or behavior in the future, was measured with the

Dutch version of Lorig's efficacy scale for controlling the OA symptoms of pain, daily functioning and other symptoms (range 0±5 each; Cronbach's a 0.76±0.89). A higher score reacts better self-efficacy.

3.4.7 Primary Outcomes

- Health status; measured using the WOMAC Osteoarthritis Index for OA of the knee (WOMAC LK3.0). Also self-administered, the WOMAC assesses pain, stiffness and physical function and can be completed in less than 5 minutes. Two major studies have shown WOMAC pain, stiffness and physical function subscales are valid and the questionnaire is reliable and sensitive enough to detect changes in health status following a variety of interventions.
- Quality of life; measured using the Short Form questionnaire. This 68 item questionnaire is self-administered, and can be completed in about 20 minutes. Scores for 8 sub components reflecting both physical and mental status can be generated. Reliability and validity have been established in numerous studies.

3.4.8 Secondary Outcomes

- Active range of motion of the knee joints; measured using a long armed Goniometer. The reliability and validity of the goniometer to measure range of motion has been widely documented for knee flexion and extension.
- Strength of the hamstrings and quadriceps muscles will be measured using a Mecmesin Force Gauge Dynamometer. The dynamometer will be fixed via an adjustable arm to a portable steel frame and stool. Subjects will sit on the stool with hips and knees flexed to 90 degrees. Isometric strength in flexion and extension will be measured in this position. Each knee will be measured 3 times. The first measurement will be a practice and will be excluded from analysis. The two subsequent measures will be averaged for analysis.
- Pain will be assessed at weekly intervals from baseline to the 8-week follow-up assessment. A 10 cm Visual Analog Scale (VAS) anchored at the left with "no pain" and at the right "worst pain imaginable" will be used for this assessment. The VAS is well established in clinical practice and research for measuring pain levels in arthritis populations.
- Functional mobility, using a Functional Knee Assessment Test (FKAT) will be assessed using a modification of the "Timed Up and Go" test (TUG). TUG is widely used to assess basic functional mobility in the elderly. The test measures

the time taken to stand from a chair and walk 6 m, turn around, return to the chair and sit down. For this study the addition of ascending and descending a 15 cm step will be added to the outward walk.

3.4.9 Data Extraction and Analyses

Data from the trials were extracted by two reviewers (RC and EMB). A standard data extraction form was developed to use for data collection. The following information was systematically extracted for each of the k randomized trials: characteristics of the study population: age, number of participating females/(males + females)6100% (%F), treatment period (duration time), primary endpoint, intention-to-treat (yes/no), quality score (0–5; as presented above), and body mass index at baseline (inclusion). From each of the k trials (and sub studies, if any study reported mutually independent two-group comparisons within the same article), we extracted the following numbers and estimates by group (T, treatment and C, control, respectively): number of patients in the group (n); change in the outcome measure of interest within the treatment group (the mean change, D); SDD in the outcome measure of interest within each group (corresponding to the mean change within the group). Change scores were used, as some of the studies were small and showed baseline differences in outcome scores between the allocation groups. When the required data in the studies were not presented clearly, a standardized extraction recalculation technique was used, as recommended by The Cochrane Statistical Methods Group.16 To enable the use of meta regression analyses, the simultaneous mean changes in body weight (%) in each of the two groups per its sub study (D Weight Ti and D Weight Ci, respectively) were extracted, together with the SDs of the changes (or calculated assuming the same data distribution as the absolute change, in kg).

As the studies used a variety of continuous data scales to evaluate clinical outcomes, a unit-less measure of treatment effect size (ES) was applied to pool the results across the multiple controlled trials. As recommended by the Cochrane Collaboration,16 we used the standardized mean difference (SMD) as summary measure, which is applicable for interpretation as the ES originally proposed by Cohen.17 Clinically, an ES of 0.2 is considered small, 0.5 as moderate (and would be recognized clinically) and .0.8 as large.8 Accordingly, the ES (SMD) that we used was Hedges' adjusted g value, which is very similar to Cohen's d value, although with an adjustment for small sample bias.18 To pool the mean different weight reduction of individual study group, the weighted mean difference was applied.19 Random effects meta-analysis20 was used if the studies were heterogeneous, for which the Cochran Q test was used to assess the degree of heterogeneity21; the a risk for this analysis is set to 0.1 (p,10%).16 22 Quantification of the effect of heterogeneity was assessed by means of I2, which ranges from 0% to 100%; I2 shows the percentage of total variation across studies due to heterogeneity, and may be used to assess the consistency of evidence.23 These analyses were carried out using the software provided by the Cochrane Collaboration, Review Manager (Rev Man V.4.2).18 For further illumination of the quality (ie, magnitude and intensity) of the intervention,12 we applied dose–response efficacy estimates following meta-regression analyses, with two subsequent a priori defined weight change differences (% point weight change as magnitude and % point weight change per week as intensity, respectively) as independent variables. Meta regression analyses should be weighted to take account of both within-trial variances of treatment effects and the residual between-trial heterogeneity (ie, heterogeneity not explained by the covariates in the regression). We therefore applied the random effects meta-regression,24 using the individual study weight (based on the inverse variance) following the random effects model presented by Der Simonian and Laird.20 All meta regression analyses were calculated using SAS statistical package.

3.4.10 Sample Size

Sample size calculations were predicted on a 10 point reduction in the primary outcome measure (for instance, absolute change in pain VAS), regardless of the intervention and the type of knee OA and it was assumed that there would be no intervention interaction. We therefore based our sample size calculations on the comparison of two means. The statistical analysis consisted of an overall analysis and two subgroup analyses. We expected to have at least 80% power for the overall analysis and 70% power for the subgroup analyses.

I calculated that a study involving 299 patients with OA of the knee per group would have the 70% required power to detect a 10 point difference, with a two sided alpha level of 5%. Because each physician was to recruit three patients with knee OA. The power calculation for 299 patients with knee OA established that the study had a power estimated at 78.6% to detect the postulated difference, after adjustment for an intra-cluster correlation (assumed to be 0.05). 10 11 For the overall analysis the estimated power was 92.3%. We therefore planned to randomize physicians, each recruiting for patients.

3.5 Swimming Exercise 20 minute per day for 12 Week

3.6 Methods

Swimming Exercise

Swimming exercise is particularly helpful for osteoarthritis, because body is supported and the resistance provided by moving through water boosts muscle strength and endurance.

Swimming exercise involves exercising in a pool, usually heated, and may also be called ‘hydrotherapy’ or a pod or a river. There are several ways for swimming exercise. The most suitable type of swimming exercise is depends on a number of factors including the severity of condition, how it affects, fitness level, physical ability and interests.

Swimming is very good for people with osteoarthritis because the water supports your weight, so you won’t put a lot of strain on your joints. Hydrotherapy (exercises in warm water) can help get muscles and joints working, and it can be very relaxing. Swimming and aquatic exercise in particular have great rehabilitative value for individuals of all ages and health conditions.

When people begin swimming or any other aquatic activity their body temperatures increase. Because the whole body is immersed in it, the temperature of the water can dramatically affect the body’s ability to cool down or maintain heat. This is why the temperature of pool water for most aquatic activities should be between 83 to 86 degrees Fahrenheit (28 to 30 degrees Celsius). Water in this temperature range allows the body to adjust naturally to physical demands of exercise without overheating or needing to conserve heat.

Swimming can enhance overall physical fitness. Swimming improves and maintains cardiovascular endurance (the ability of the heart and lungs to sustain vigorous activity), muscular strength, endurance and flexibility. It can also help with weight management. Swimming also may help to improve motor function (the brain's ability to direct reflexive and voluntary movement activities). Motor function includes the following components: n Speed—The ability to act or move with different velocities n Agility—The ability to change direction during locomotion n Perceptual motor function—The ability to integrate perception with action; to develop balance, control and visual and auditory discrimination; and to improve spatial orientation (the understanding of one's location in space and position with reference to other objects).

3.6.1 Types of Swimming Exercise Include

- Hydrotherapy – a type of exercise therapy offered by physiotherapists as a group session or as one-on-one training, which is useful if you are new to water exercise or your osteoarthritis is limiting your ability to exercise.
- Gentle water exercise classes – some fitness or recreation centers offer gentle water exercise programs suitable for older adults or people with health conditions such as osteoarthritis.
- Swimming laps at your local pool can also help.

3.6.2 Procedure of Swimming Exercise

Arms are whirring round like windmills, and your shoulders are flat in the water. That's creating resistance. This is why you find it difficult to swim crawl (Figure 3.8).

Osteoarthritis of knees, it is a painful, incurable, and degenerative disease in which the cartilage in the joints gradually erodes. It was such a shock, as I am in my forties. Osteoarthritis usually affects older people or those who've done a lot of high-impact exercise.

I advised that if continue swimming, would have to switch to crawl, as the breaststroke leg-kick would further damage joints. But just one length of crawl had me gasping for breath.

There is an ease and grace to good swimmers, body is like a see-saw, and if your head and neck are in alignment, it affects the way you move. It's poetry in motion.

Face down in the water, letting our weight be supported, and kicking our feet to a slow, steady rhythm. This explains, is part of "smart swimming" – knowing when to work and when not to work. Before every propulsive movement is a non-propulsive movement. You have to get ready to apply the power. It's about using your energy economically and maximizing the distance per stroke.

In crawl, only 20% of the propulsion comes from the legs. It's a front-wheel-drive stroke. The legs are primarily for balance and stability. Those swimmers who thrash up and down pumping their legs like pistons are simply wasting their energy.

The stroke down into component parts, following a series of exercises on land and in the water. It's a gentle, hands-on approach that focuses on "redirecting" the body to move in a different way, slowing everything down, so that you are aware of every movement you make.

The walk-through exercises on land are crucial. Need to walk before crawl, need to get the rhythm and the pace of the stroke without worrying about breathing in water.

This is much harder than it seems – a kind of choreography in which the timing of every movement in relation to the next is crucial. Keeping the heads totally still, we learn to rotate our bodies, streamlining our passage through the water. There is a moment, midway through the afternoon when suddenly feel I've got it right. I'm gliding along with the minimum of effort.

3.6.3 Thermodynamics

Water's heat capacity is 1,000 times greater than an equivalent volume of air. The therapeutic utility of water depends greatly on both its ability to retain heat and its ability to transfer heat energy. Water is an efficient conductor, transferring heat 25 times faster than air. This thermal conductive property, in combination with the high specific heat of water, makes the use of water in rehabilitation very versatile because water retains heat or cold while delivering it easily to the immersed body part. Water may be used therapeutically over a wide range of temperatures. Cold plunge tanks are often used in athletic training at temperatures of 10–15°C to produce a decrease in muscle pain and speed recovery from overuse injury, although there are some contradictory studies regarding this. Most public and competitive pools operate in the range of 27–29°C, which is often too cool for general rehabilitative populations, because these populations are usually less active in the water. Typical therapy pools operate in the range of 33.5–35.5°C, temperatures that permit lengthy immersion durations and exercise activities sufficient to produce therapeutic effects without chilling or overheating. Hot tubs are usually maintained at 37.5–41°C, although the latter temperature is rarely comfortable for more than a few minutes, and even the lower typical temperature does not allow for active exercise. Heat transfer begins immediately on immersion, and as the heat capacity of the human body is less than that of water (0.83 versus 1.00), the body equilibrates faster than water does.

3.6.4 Getting started with water-based exercises and relieving joint pain

Do you want to learn how exercise can reduce arthritis and joint pain? Water exercise for arthritis relief is a good place to start. It can be a simple exercise, such as water walking. Water is thought to provide 12 times the resistance of air. In other words, as you walk you are building and strengthening your muscles. Water walking as therapy helps relieve osteoarthritis pain and joint damage. The water's buoyancy can also decrease the impact on your joints. There are a few key points to keep in mind when you are getting started with water-based exercises to treat joint pain:

- It is important to start slow if you have arthritis but currently don't exercise.
- Use a flotation belt to stay upright when doing deep-water walking.
- Avoid water exercises if you are experiencing a severe rheumatoid arthritis flare-up. Some downtime may be needed until the pain eases up. If your joint pain, stiffness, or swelling continues to increase, consult doctor.
- It is advised that people who experience heavy swelling related to knee osteoarthritis wait to attempt swimming or any other water exercise that would put the joints through a lot of movement.
- An aquatic center or community center with pools will have programs geared toward people with arthritis.
- Heated pools with temperatures that reach between 82 to 88 degrees Fahrenheit will help relieve arthritis pain.

3.7 Examples of Warm Water Exercises

It is important to relax and enjoy the soothing warm water from the pool when conducting the exercises, just make sure to choose a warm water exercise that best suits your capabilities and fitness level. The following are examples of warm water exercises that can reduce arthritis and joint pain:

3.7.1 Pool walking exercise or jogging

The water exercise eases arthritis and joint pain as well. You can try it for yourself. A good place to start is in chest high water. Walk about 10 to 20 steps forward and then about the same amount of steps backward. Eventually you will increase you speed and your difficulty level. Jogging will also increase your intensity. It is good practice to alternate between water walking and jogging for 30-second intervals for at least a five-minute period.

3.7.2 Water Aerobics

Water aerobics (also known as waterobics, aquafit, or aquatic fitness) includes water yoga, aqua aerobics, or aqua Zumba. Water aerobics tend to be strenuous by nature. Examples of water aerobic exercises include strengthening or resistance exercises and range of motion workouts that prevent joint stress.

3.7.3 Hydrotherapy

Hydrotherapy is part of physiotherapy, occupational therapy, and naturopathic medicine. It is used to treat rheumatoid arthritis and osteoarthritis. This therapy is different from swimming since it involves water exercises in a warm water pool. The temperatures are usually warmer than a normal swimming pool at 33 to 36 degrees Celsius. The exercises tend to focus on slow and controlled movements and relaxation.

3.7.4 Side and Forward Lunges

Side and forward lunges are among the most effective pool exercises for joint pain. It is a great way to strengthen the muscles and improve the range of motion of joints. To perform the exercise, stand near the pool wall for support and take a large lunge forward; however, avoid letting the knee go past your toes. Return your leg to the starting position and then repeat on the other side. Side lunges are a little different.

Face the pool wall and take a large step to your side with your toes facing forward. Repeat on the other side. Try doing three sets of 10 lunges and side steps.

Figure 3.8: Techniques of Swimming Exercise in a pond.

3.7.5 Precautions to take with Water Exercises

Water exercise is a great option for arthritis pain relief; however, there are a few precautions you should take before you perform water exercises for arthritis pain relief:

- Consult with a doctor before participating in water-based exercises to make sure they are safe for you, especially if you have certain medical conditions such as diabetes, multiple sclerosis, thyroid disease, heart or lung disease, circulatory problems, low or high blood pressure, skin problems, or any other serious health condition.
- Everyone reacts differently to heat. People who feel nauseous or lightheaded should get out of the pool immediately.
- Avoid using pools or spas after drug or alcohol use. They may increase or reduce blood pressure or cause drowsiness or sleepiness.
- A good way to warm up is to swim gently or go for a walk through the water – be guided by your physiotherapist.
- If you feel light-headed, sick or dizzy at any stage, get out of the water.
- Take care when moving in wet areas around the pool, including in change rooms, to avoid slipping and falls.
- Perform each movement as gracefully and smoothly as you can.
- Keep the body part you are exercising under the water. This may require you to squat or bob down at times.

3.8 Quadriceps Stretching Exercise and hot pack for 15 min for two time per day for 12 weeks

3.8.1 Methods

Quadriceps Stretching Exercise (Figure 3.9 and 3.10)

This study included all of the patients diagnosed with grade 2 or 3 OA of the knee(s), according to the Kellgren-Lawrence scale, and patients with light or moderate arthrosis who were referred to physical therapy in a private hospital. Both males and females (> 45 years old) were recruited for this study. The patients must have been referred to the rehabilitation service by physicians during the period of 2012 to 2015, and all were evaluated by radiographs. Patients with grade 1 or 4 in the Kellgren-Lawrence scale were excluded. In addition, we also excluded patients who had undergone any kind of orthopedic surgery of the lower limb during the last two years and/or other concomitant therapies, except for the use of analgesic and non-steroidal anti-inflammatory drugs (according to medical guidelines). During the study period, 299 patients were included in the study.

The subjects in the experimental group performed the following sets of exercise for 12 weeks (7 days/week). All exercises were performed in sets of 10 repetitions; 1 set of all exercises was performed twice a day for the 1st week, and this progressed to 2 sets twice a day until the 3rd week and then 3 sets twice a day until the 12th week.

3.8.2 Isometric quadriceps exercise

Patients lay in a supine position. A rolled up towel was put beneath the knee. They were instructed to maximally activate their thigh muscles in order to straighten their knee and hold the contraction for 5 seconds.

3.8.3 Straight leg raising (SLR) exercise

Patients lay in a supine position. They were instructed to perform a maximum isometric quadriceps contraction prior to the lifting phase of the exercise. Then they were instructed to lift the leg up to 10 cm above the plinth and hold the contraction during the lifting phase for 10 seconds.

3.8.4 Isometric hip adduction exercise

Patients lay in a supine position. A small pillow was put between the knees. They were instructed to perform isometric hip adduction exercise while pressing the pillow between the knees and to maintain the adduction with contraction for 5 seconds.

The control group received ultrasound therapy as per the patient's requirement with an intensity of 1.5 watts/cm^2 for 7 minutes in continuous mode at the tender point around the knee joint. They were told to continue their normal daily activities, and no extra exercises were applied.

The outcome measures or dependent variables selected for this study were pain intensity, knee function, and isometric quadriceps strength. These variables were measured using the Numerical Rating Scale (NRS), a reduced WOMAC index, and a strength gauge device, respectively. All the measurements were taken at baseline (week 0) and at the end of the trial at week 12.

3.8.5 Compliance

In the first 3 months of treatment, when the patients were administered by telephone or in-person visits once a week, compliance of sports treatment in exercise therapy group was 67.73%. Of 28 participants in this group, 19 performed the sports exercises completely based on the trained pattern. Also 25 received acupuncture and 26 received physical modalities completely, and their compliance percentage was 89.28 and 92.85, respectively. In without exercise therapy group, the compliance rate was 90.9% and of 22 patients, 20 performed suggested treatment. During 3-12 months, when there was no supervision on recommended treatment methods in exercise therapy group, compliance of patients from sports exercises was 14.2%. During this time that any exercise was allowed for the without exercise therapy group, only two individuals irregularly received hydrotherapy in pool.

3.8.6 Exercise Group (EXG)

The patients from the ExG group took part in group sessions lasting from 30 to 40 minutes, with a weekly frequency of twice a week. The load used for muscle strengthening was based on the 10 maximum repetitions test. After estimating 100% of the load, 30-400% of this load was established for use in the strengthening of the patients from the study. In the ExG, the intervention was performed twice a week for a period of eight weeks. The exercise protocol included the following: warm up for 10 minutes with a stationary bike; stretching of the hamstring muscle with the aid of an elastic band (three sets of 30 seconds); and three sets of 15 repetitions of knee extension exercises, with 30-45-second intervals between the sets. The exercise was performed at the sitting position, with the hip and knees flexed at 90º.

The load to be used for the strengthening exercise was defined based on the ten-repetition maximum test rather than on the one-repetition maximum test, to prevent damage caused by an excessive muscle contraction. Fifty to sixty percent of the estimated maximum load was used.

The exercise protocol used by us consisted of 10 minutes of warm-up on a stationary bicycle, ischiotibial stretching exercises and three series of 15 repetitions of knee extension exercises, aiming to strengthen the quadriceps muscle. The interval between series was from 30 to 45 seconds. The load used in the exercise was increased according to tolerance. The patient's positioning for the exercise was: seated in a chair, with 90 degrees of knee and hip flexion. The patients from the ExG also received the orientation manual given to the OG group.

3.8.7 Instruction Group (IG)

The IG patients followed the instruction manual. Around the second and sixth weeks, they were phoned and encouraged to follow the instructions. The instruction manual was explained to patients in a simple and easy way to improve its understanding.

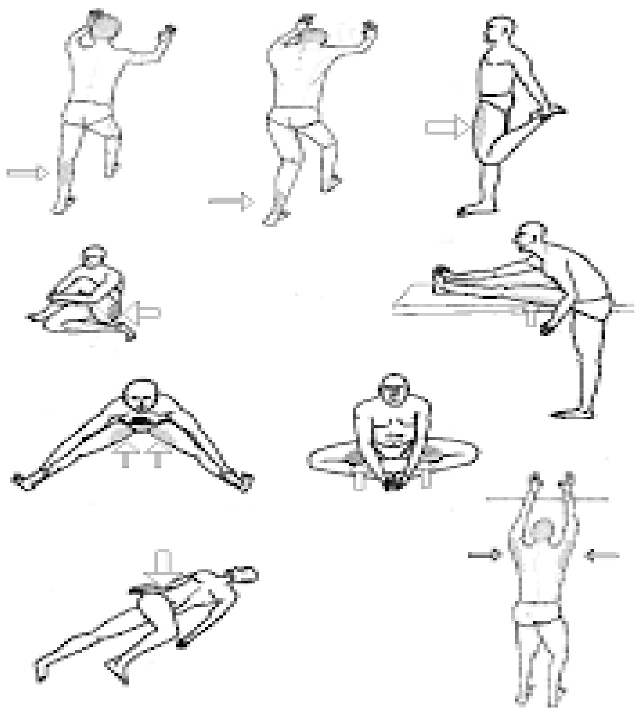
The pre- and post-intervention assessments were performed by a physiotherapist masked to the information regarding the patients' groups. The primary endpoints were the TUG test and the self-reported WOMAC aspects of functionality, pain, and stiffness (validated and recommended by the Osteoarthritis Research Society, and chosen to assess adults with knee OA). The Lequesne Index was defined as secondary outcome. In their study, Faucher et al. have reported that the Lequesne Index has good reproducibility. It is worth emphasizing that versions of the WOMAC and Lequesne Index translated into Brazilian Portuguese and validated were used.

3.8.8 Timed Up And Go Test (TUG)

The TUG is a simple and low-cost test developed to assess the functional mobility of patients during daily activities. The test comprises the following sequence of movements: to stand up from a standard chair, walk a distance of 3 meters, turn, walk back to the chair and sit down again. The time taken by patients to perform the sequence of movement is recorded and compared before and after treatment.15 In our study, patients got acquainted with the test before their performance was timed. The best time of three attempts was used.

Figure 3.9: Presentation of Technique of Quadriceps Stretching Exercise

Figure 3.10: Diagrammatic Presentation of Self Quadriceps stretching exercise



3.8.9 Hot Pack

Hot pack are used for heat or cold applications and are the bags filled with the silicate gel. The use and preparation of hot pack varies according to the manufacturing company. Therefore, the preparation of the pack and the application time must done as specified in the user guide. The pack should be prepared by waiting in hot water or microwave if it will be used for the purpose of heat application. When disposable quick hot pack is pressurized, the chemical mixture in the package and the heat are released and warming / cooling begins. These packages cannot be used again. These packages should not be tightened, and should be protected from kneaded and shock until the time of use. (Figure 3.11 to 3.14)

Hot packs are used for the purpose of dry heat applications; however there are some varieties that are used for wet heat applications. These packages are made of impermeable fabric, and there are special heating units to heat. Silica gel in the fabric bag swells by absorbing large amounts of heat and water. Therefore, the extra water must be filtered; dry towel should be wrapped to the package, and the package should not be placed under the patients, but should be placed over the patients. Hot pack are also utilized by wrapping in a wet towel. Water-resistant treatment cloth or plastic wrap should be used during application to prevent the loss of temperature as in the compressed application.

Hot pack applications for the purpose of treatment are applied to a part or whole of the body and cause local or systemic effects. In general, the physiological effects of heat are vasodilatation, increased capillary permeability, acceleration of cell metabolism, muscle relaxation, acceleration of inflammation, pain reduction by relaxing muscles, sedative effect, and reducing the viscosity of the synovial fluid to decrease joint stiffness.

Heat may be used for treatment of knee OA pain depending on the particular treatment goal. An understanding of the physiologic effects of each is essential to using them as effectively as possible. Physiologic effects of cryotherapy include analgesia, edema reduction, decreased tissue elasticity, and localized vasoconstriction. Ice modalities should work best in patients with inflammation and pain, but should be avoided before exercise. Cold will promote increased stiffness of collagen, which leads to decreased flexibility and can predispose to injury. Heat also promotes analgesia, but has opposite effects on collagen stiffness and arterial blood flow. Heat modalities may be most effective before exercise to help facilitate stretching and ROM. For example, the application of ultrasound to a contracted knee capsule could promote better ROM if stretching is performed immediately after the ultrasound application. Although either therapeutic cold or heat can be used, it is unclear which is the most effective in treating knee OA pain. A Cochrane database review evaluated three randomized controlled clinical trials involving 179 patients with clinical and radiographic evidence of knee OA. The studies evaluated the effectiveness of heat and cold versus placebo. The conclusions of the review include the following: ice massage compared to control had a statistically beneficial effect on ROM, function, quad strength, and swelling. However, ice packs did not have significant effects on pain when compared to control. Hot packs had beneficial effect on edema.

Table 3.3: Effects of Heat Application

Heat Application Effects	Therapeutic Benefits
Vasodilatation.	Accelerates the transport of nutrients and the removal of the residuum by increasing blood flow to the injured area of the body. It reduces the accumulation of venous blood in the region.
Decrease in blood viscosity.	Accelerates the transport of leucocytes and antibody to the injured area.
Decrease in blood spasm.	Reduces the pain caused by muscle relaxation, muscle spasm or stiffness.
Increase in tissue metabolism.	Blood flow increases due to the increased local temperature.
Increase in capillary permeability.	Transition of nutrients and residuum increases.

The use of hot applications in medicine history goes back to the ancient times. For example, Hippocrates, in his book titled “Management of Acute Disease", recommended the application of the hot water -filled caps made of clay or metal for the pain in the costal joints, and to place a soft material between skin and cap to prevent the burns. In addition, he mentioned the dry and heat applications that consisted of a heated corn in the blanket made of wool. Different types of materials related to general and local heat and cold applications have been produced by the medical technology since Hippocrates.

Patients should be considered before performing heat applications. The application area should be checked for the tolerance of application, skin integrity of the patient, bleeding, and circulatory disorder, and the information about the application to the patient should be provided. The conditions in which heat application must be avoided.

3.8.10 The Conditions in which hot Applications must be avoided

- Within the first 24 hours after traumatic injury. Temperature increases bleeding and edema.
- In active bleedings. Temperature causes vasodilatation and increases bleeding.
- Edema not caused by inflammation. Temperature increases capillary permeability and edema.
- In localized malignant tumors. Temperature increases the risk of metastasis by accelerating the cell metabolic rate, cell growth and circulation.
- In the skin problems characterized by redness and blistering. Temperature can cause severe damage or skin burns.

3.9 Knee Mobilization exercise and hot pack for 15 min for two time per day for 12 week

3.9.1 Methods

Knee Mobilization Exercise (Figure 3.11 – 3.14)

Knee mobilizations may be beneficial for individuals with a variety of conditions, including knee osteoarthritis (OA). Several studies have used knee mobilizations for treatment of knee osteoarthritis.

Subjects in the intervention group received passive joint mobilization in addition to conventional physiotherapy. Joint mobilization includes antero-posterior (AP) glide of tibia on femur, and patella glides in all directions. Techniques of application were based on guidelines developed by Maitland. Conventional physiotherapy consisted of a set of exercises followed by a 20-minutes thermal therapy with hot pack. The exercise components were chosen based on previous studies and comprised of stretches of lower limb muscles (gastrocnemius, soleus and hamstring), isometric quadriceps work, closed-kinetic chain exercise (seated leg press or partial squat or step-up) and static bicycling. The control group received conventional therapy alone.

Both groups were treated twice a week for a total of 4 weeks. Subjects were also advised to continue the given exercise daily at home. An exercise instruction sheet and home program adherence log were provided to facilitate self practice of the exercise programme. All subjects continued their normal medications for the duration of the study.

3.9.2 Tibiofemoral Distraction

Patient is positioned in prone with thigh fixated to table via use of a stabilizing belt. The therapist grasps the involved leg just proximal to the malleoli and provides a distraction force by leaning backward along the line of the tibia. This technique is particularly effective for pain control; other positions may be more beneficial for higher-grade mobs to increase general joint play and flexion. An alternative position is performed with the patient sitting with leg hanging off a table.

3.9.3 Anterior Glide

Anterior tibial glides can be performed several ways but are often (and most functionally) performed with the patient supine and lower leg propped, reaching maximal or near-maximal extension. The proximal tibia is stabilized with one hand and the mobilizing hand is placed on the distal femur. A posteriorly-directed force is applied directly downward through the distal femur. This mobilization is useful for helping to gain joint play necessary for obtaining terminal extension of the knee, particularly when a patient only lacks a few degrees to reach full extension.

3.9.4 Posterior Glide

Patient is positioned in supine with the knee slightly flexed and a prop placed under the distal femur. The stabilizing hand is used to prop the distal femur and the mobilizing hand is placed over the proximal tibia just below the tibial tuberosity. The mobilization itself is performed by a force perpendicular to the line of the tibia. This technique is useful for obtaining joint play necessary for knee flexion. Although this technique is often used in the closed-packed position, it can also be performed with the knee flexed near the level of restriction, similar in position to the posterior drawer test for the PCL.

3.9.5 Rotational Glide

Internal and external rotation glides are useful for gaining joint play for knee flexion and extension, respectively. These glides can be performed at various points in the normal ROM of the knee with the patient positioned in supine. The stabilizing hand grasps the distal femur and the mobilizing hand grasps the heel of the patient's foot. The ankle is maximally dorsi flexed so that rotational motion is applied to the rotating tibia and not at other joints more distally. The foot is either rotated medially or laterally, depending on the mobilization preferred (internal or external rotation) and at the range where restriction may be apparent.

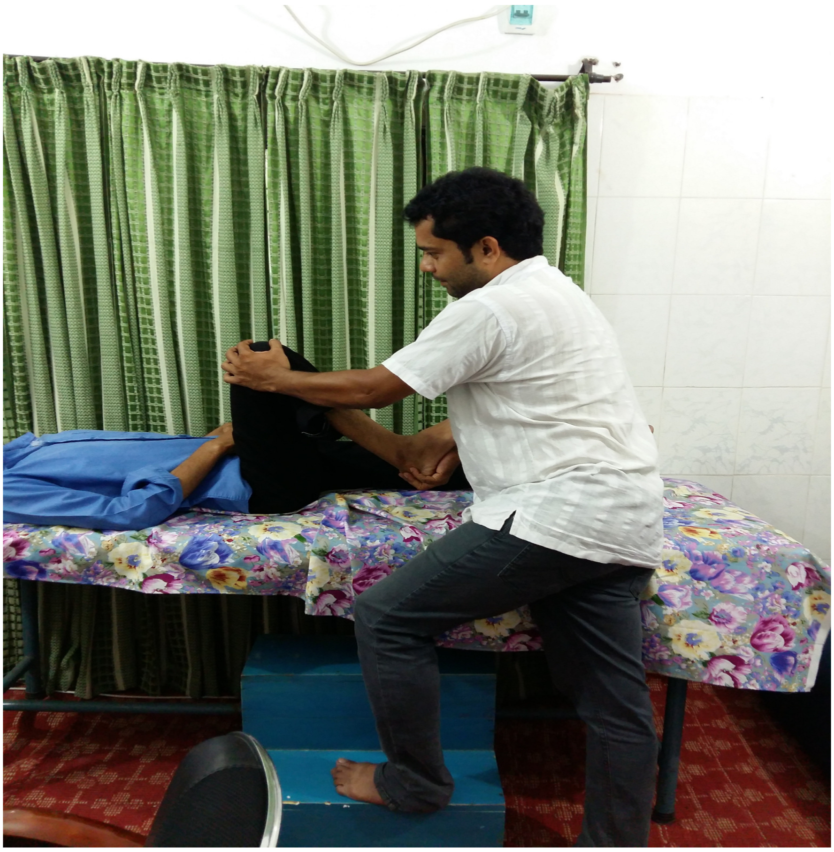
The benefit from the comprehensive clinically instructed home exercise program in the current study is consistent with the highest levels of benefit from exercise reported in the previously cited studies. This benefit accrued to patients in the current study with only 2 clinic visits, whereas previously reported home regimens required a range of 1 to 12 clinical visits for instruction and reinforcement to yield similar or lesser benefits. The success of the home program may be attributable to any or all of the features designed into the program: careful instruction, minimal exercise performance time, an adherence log, a high-quality exercise folder, and a comprehensive set of exercises addressing muscle tightness, limitations in joint movement, muscle weakness, and general fitness. Although the exercises of the subjects in the clinic treatment group were observed and corrected as necessary, subjects in the home exercise group exercised without the supposed benefits of frequent supervision; they received one-to-one supervision only initially and at the 12-week follow-up visit.

Figure 3.11: Self Gliding Movement by using hot pack.

Figure 3.12: Self Gliding Movement of knee joint.

Figure 3.13: Self Gliding Movement by mobilizing belt.

Figure 3.14: Self Gliding Movement of knee joint.



The following quadriceps strengthening exercises are designed to improve strength of the quadriceps muscle (figure 3.15). The quadriceps comprises of four muscle bellies, one of which is the VMO (Vastus Medialis Obliquus). The VMO is very important in quadriceps and knee rehabilitation exercises. You should discuss the suitability of these exercises with your physiotherapist prior to beginning them. Generally, they should only be performed provided they do not cause or increase pain.

Figure 3.15: Diagrammatic Presentation of Quadriceps Muscle

To begin with, the following basic quadriceps strengthening exercises should be performed approximately 10 times, 3 times daily. As your quadriceps strength improves, the exercises can be progressed by gradually increasing the repetitions and strength of contraction provided they do not cause or increase pain.

Tighten the muscle at the front of your thigh (quadriceps) by pushing your knee down into a towel (figure 3.16). Put your fingers on your inner quadriceps (VMO – figure 3.15) to feel the muscle tighten during contraction. Hold for 5 seconds and repeat 10 times as hard as possible pain free.

Figure 3.16: Presentation of self knee Mobilization Exercise

Begin this exercise lying on your back with a rolled towel or foam roll under your knee and your knee relaxed. Slowly straighten your knee as far as possible tightening the front of your thigh (quadriceps) (figure 3.16). Hold for 5 seconds then slowly lower back down. Repeat 10 times as hard as possible pain free.

Figure 3.17: Self Knee Mobilization by using towel role.

The following intermediate quadriceps strengthening exercises should generally be performed 1–3 times per week provided they do not cause or increase pain. Ideally they should not be performed on consecutive days, to allow muscle recovery. As your quadriceps strength improves, the exercises can be progressed by gradually increasing the repetitions or resistance of the exercises provided they do not cause or increase pain.

Begin this exercise in sitting with your knee bent and a resistance band tied around your ankle as shown (figure 3.18). Keeping your back straight, slowly straighten your knee tightening the front of your thigh (quadriceps). Then slowly return back to the starting position. Perform 3 sets of 10 repetitions provided the exercise is pain free.

Figure 3.18: Self knee mobilization exercise by using belt

Hot Pack – Same as previous Hot Pack method

3.10 Deep Transverse Friction Massage and Hot Pack for 15 Minute for two time per day for 12 week

3.10.1 Methods

Deep Transverse Friction Massage (Figure 3.19 – 3.21)

Deep friction massage is a specific connective tissue massage that was developed by Cyrix. The purpose of deep friction massage is to maintain the mobility within the soft tissue structures of ligament, tendon, and muscle and prevent adherent scars from forming. The massage is deep and must be applied transversely to the specific tissue involved unlike the superficial massage given in the longitudinal direction parallel to the vessels which enhances circulation and return of fluids. Before friction massage can be performed successfully, the correct structure must be found through proper evaluation procedures. The distinction must be made between contractile structures such as the muscle belly, musculotendinous junction, tendon, and tendon-periosteal junction and non-contractile structures such as the joint capsule, bursa, fascia, dura mater, and ligament.

Deep Massage uses a variety of techniques to work on the deeper layers of muscles that are commonly involved in chronic pain conditions, scar tissue and myofascial adhesions. So often deep tissue massage is thought to be a lot of pressure but it is more rightly associated to appropriate pressure on deeper tissues. Deep pressure has it's value however not all deep tissue work requires painful pressure. A good session of deep tissue work should be accompanied by warming strokes to allow the deeper tissues to be accessed without damage, allowing for greater functional recovery with less pain. Commonly a therapist utilizing deep tissue techniques will use thumbs, knuckles, forearms and elbows to release the deeper tissues. It is possible for everyone to have deep tissue work accomplished but only by a therapist with proper training, healing intention and compassion towards a client's results. Sessions can be intense but should not leave residual discomfort except for general soreness, similar to what a regular work out at the gym creates. Deep tissue work releases stored toxins and lactic acid into the blood stream and these are omitted from the body through the kidneys and finally the urine. It is so important for client's success to drink half their body weight in ounces during treatment sessions. Drinking pure H2O is a key to balanced health and wellness in general and should be taken very seriously in any wellness plan.

When considering the treatment of pain, I combine these techniques so I will define them as one. Trigger points develop in the myofascial system of the body that surrounds all of the muscles of the entire body. It (myofascia) is described as a web, though I think of it as a protective layer that allows the muscles to work independently and in harmony at the same time. Trigger points are the result of the fascia becoming adhered to itself between muscle tissues, kind of like Saran Wrap sticks to itself. When we have injuries or stress related to trauma, our body may turn that into scar tissue and that can become a real pain problem. These traumas can be as simple as poor posture over a long period of time. Trigger points are most effectively released by addressing both the point that seems to be causing the pain and the myofascial system itself. Most people have some myofascial adhesions that will lead to pain or limitations, especially when dealing with neuro-traumas, chronic pain, Osteoarthritis and sports injury. Myofascial and trigger point work requires a nice warming up of the tissues and some nice deep stretching of the layers of the tissues as well. It is usually deeply relaxing but can create some discomfort, though can relieve pain very quickly and for long periods of time. This treatment is commonly done on one or two parts of the body in a session and is rarely a full body session.

In addition to finding the right spot, the massage must also be given the most effective way by following these basic principles:

1) The proper location must be found through proper evaluation procedures and palpation of the specific tendon, ligament, or muscle.
2) Friction massage must be given across the affected fibers. The thicker and stronger a normal structure, the more important friction is given strictly across the grain.
3) The therapist's fingers and patient's skin must move as one, otherwise moving subcutaneous fascia against muscle or ligament could lead to blister formation or subcutaneous bruising.
4) The friction massage must have sufficient sweep and be deep enough.
5) The patient must be in a comfortable position.

The frequency and duration of treatment varies with the severity and type of the injury. In a recent injury, i.e., ligament sprain, start daily with gentle massage to keep mobility. It is important for the therapist to distinguish between tenderness and pain. Tenderness can be due to deep friction and can persist long after the pain disappears. Pain is elicited by clinical assessment and reassessment. Deep friction massage may be given every other day or when the excess tenderness has worn off. The duration of the treatment varies; for example, with an acute ligamentous injury, the gentle massage performed may last only 1-2 minutes. However, it may well take several minutes to be able to get your fingers on the structure depending on the severity of pain. With deep friction massage, the treatment will last 10-15 minutes.

Massage therapy is generally a safe intervention. Patients may experience minor discomfort. A small number of serious adverse events have been reported, however the risk is low if the therapy is performed by a trained practitioner. Massage is the use of manual techniques such as stroking, friction and compression to apply traction and pressure to the soft tissues, including skin and underlying muscle tissue. The therapy aims to relieve pain and promote function through reduction of muscle tension and spasm, increase in circulation of blood and lymph, and promotion of mental relaxation. Massage may also contribute to positive outcomes for to the patient through the therapeutic benefit of touch. A wide variation of massage types are available including conventional muscular massage (Swedish massage), deep tissue massage, and Shiatsu, however there is limited research on their use in osteoarthritis and no research comparing the effective various massage forms. There was only one low quality study on massage therapy, hence the recommendation that there is weak evidence to support massage therapy in the treatment of OA of the knee or hip.

3.10.2 Massage for Osteoarthritic Patients

The massage therapist will use long strokes, kneading and friction to the surrounding muscle tissue depending on the joint that is affected.

- This technique focuses on improving flexibility and mobility of the joint.
- Using his/her finger tips, the massage therapist will try to feel and decrease the spasm and stiffness of the muscles.

- Other than this, the massage therapist will also concentrate on the myofascial trigger points. These trigger points reveal the source of the radiating pain.
- The massage session usually lasts for about 10-15 minutes.
- Massage oil, cream or lotion can be applied to the skin in order to reduce friction and for smoother strokes to aid in easy massage.

Figure 3.19: Presentation of DTFM Techniques of Meniscus

Figure 3.20: Presentation of DTFM of Ligament

Figure 3.21a and b: Presentation of Self DTFM Techniques

(Figure 3.21a)

(Figure 3.21b)

Hot Pack – Same as previous Hot Pack method

Chapter Four
Results

4.1 Environmental Impacts on Osteoarthritis

4.1.1 Weather

The relationship that weather may share with pain was a secondary Clearwater Exercise Study (CES). CES inclusion criteria consisted of men and women aged 40 yr or older with radiological evidence of OA, grades 2+, as defined by the Kellgren and Lawrence criteria. Blinded to the current hypothesis, all CES participants were included in our study. A visual analogue scale measured pain severity, where 0=no pain and 10=severe pain. The total number of pain recordings varied by knee. Pain levels assumed values from 0–10, with mean scores spanning from 1.2–2.5 and corresponding standard deviations ranging from 2.1–2.7. The mean temperature was 23°C with a low of 0°C and a high of 36°C. Precipitation levels ranged from 0.00–21.08 cm, with a mean of 0.36 cm. Barometric pressure direction (rising, falling and steady) was analyzed with the corresponding days' pain scores.

The relationship between OA pain and barometric pressure on days when the barometric pressure direction had been the same for 3 consecutive days was evaluated. For example, when the barometric pressure had been rising on Wednesday, Thursday and Friday, Friday's pain score was assessed for a relationship with barometric pressure direction. Consecutive days of rising barometric pressure indicated a significant relationship with the aggregate pain level ($P<0.0008$). Precipitation status, analyzed with the corresponding days' pain scores, indicated no association as indicated by P values ranging from 0.02–0.71. Sample data, limited by the lack of consecutive days of precipitation, focused on the effect of no precipitation. Non-significant findings were noted for the relationship between OA pain and 3 consecutive days of no rain. Site-specific correlation analyses of aggregate mean pain scores with the weather indices produced rho values ranging from −0.07 to +0.15 (Table 4.1). Largely, no discernable patterns were noted. A significant, albeit modest, association was reflected between 1-day lagged precipitation and OA pain (rho=0.15; $P<0.001$).

Table 4.1: Meteorological Indices' Association with Site-specific OA pain pear man Correlation Coefficients

Weather Index	Knee	Aggregate
Mean temperature	0.06	0.08
Minimum temperature	0.07	0.07
Maximum temperature	0.05	0.08
Mean temperature 1 day lagging	0.06	0.07
Mean temperature 1 day leading	0.05	0.07
Barometric pressure	0.04	0.02
Barometric pressure 1 day lagging	0.06	0.04
Barometric pressure 1 day leading	0.07	0.10
Precipitation level	0.00	0.06
Precipitation level 1 day lagging	0.01	0.00
Precipitation level 1 day leading	0.02	0.02

*P value < 0.001.

Each plotted point represented a date. x-axis = weather data; y-axis = patients' aggregate site-specific pain score.

1-day lagging/leading = weather index value 1 day prior/subsequent to the pain assessment.

The range and variability of the meteorological exposures are described in table 4.1. Three of these, change in barometric pressure, ambient temperature, and ambient dew point, were associated with pain severity in the multivariate models (Table 4.2, 4.3). With adjustment for age, gender, body mass index, nonste-roidal anti-inflammatory drug use, opiate use, and prior pain score, the coefficient was 1.0 (P .04) for change in baro-metric pressure, 0.01 (P .004) for ambient temperature, and 0.01 (P .02) for ambient dew point. In mutually adjusted models there were persistent significant effects from ambient temperature (coefficient 0.010, 95% confidence limits 0.017 to 0.003, P .004) and change in barometric pressure (coefficient 1.14, 95% confidence limits 0.15 to 2.13, P .02), but not dew point (which was highly correlated with temperature). Both change in barometric pressure and ambient temperature had similar standardized regression coefficients (0.16 and 0.18, respectively).

Table 4.2: Distribution of Meteorological Exposures in the Study Sample

	Mean	SD	Range
Ambient Weather*			
Temperature (degrees Fahrenheit)	56.9	15.4	7.3 to 95.7
Barometric pressure (inches mercury)	29.1	1.0	24.6 to 30.4
Dew point (degrees Fahrenheit)	46.2	14.3	6.6 to 76.4
Precipitation (inches)	0.09	0.12	0 to 1.92
Relative humidity (%) Weather change	68.2	14.3	18.2 to 98.6
Temperature (degrees Fahrenheit)	0.13	3.0	22 to 28
Barometric pressure (inches mercury)	0.008	0.06	0.58 to 0.51
Dew point (degrees Fahrenheit)	0.37	3.4	29.0 to 24.0
Precipitation (inches)	0.004	0.15	3.1 to 2.4
Relative humidity (%)	0.7	12.3	48.1 to 47.0

SD – Standard Deviation.

Conversion formulas: Centigrade to Fahrenheit: C (F 32)

5/9. Barometric pressure: 1 inch mercury 3.386 kPa.

* Average of within-participant means over the 3-day period before each pain report.

Change between the day before each pain report and the day of the pain report.

Table 4.3: Meteorological Exposures and Knee Pain: Multivariable Analyses

	Ambient Weather*		Weather Change	
	Coefficient	P Value	Coefficient	P Value
Temperature (degrees Fahrenheit)	0.01	.004	0.01	.3
Barometric pressure (inches mercury)	0.03	.7	1.0	.04
Dew point (degrees Fahrenheit)	0.01	.02	0.004	.7
Precipitation (inches)	0.5	.2	0.1	.7
Relative humidity (%)	0.001	.8	0.003	.6

Conversion formulas: Centigrade to Fahrenheit: C (F 32) 5/9. Barometric pressure: 1 inch mercury 3.386 kPa.

*Average of within-participant means over the 3-day period before each pain report.

Change between the day before each pain report and the day of the pain report.

Adjusted for regression to the mean, prior pain score, age, sex, body mass index, non-steroidal anti-inflammatory drug use, and opiate use.

The coefficient indicates the magnitude of change in pain severity score expected from a 1-unit change in the independent variable (e.g., the coefficient of 1.0 for change in barometric pressure is commensurate with an increase in knee pain score of 1.0 for each 1 inch of mercury change in barometric pressure).

women experience an enhanced relationship between pain and weather compared with their male counterparts. Various approaches were used to evaluate the relationship between OA pain and weather. Numerous unadjusted relationships were highly statistically significant. For analyses testing barometric pressure direction, consideration of the absolute value of barometric pressure produced dramatically different results. Among women with knee OA, days of rising barometric pressure suggested higher pain levels ($P<0.001$). Temperature variation during the study period, there were relatively fewer days experiencing cold weather. Approximately 19% of the dates recorded temperatures<19°C. This may have contributed to finding no association in the correlation analyses. (Table 4.3)

4.1.2 Pain Exacerbation (Detailed in Appendix 4)

At study entry, participants reported their usual pain intensity was on average 4.9 (SD: 2.1; 0–10 NRS); that increased to 8.3 (SD: 1.5) when at its worst, and reduced to 2.9 (SD: 1.9) when at its mildest (Table 4.4). The average pain intensity reported during exacerbation episode was 5.9 (SD: 2.3) on a 10-point numerical scale.

Table 4.4: Demographic Characteristics of Study Participants (n = 299)

Characteristics	
Female (%)	180 (64.3%)
Male (%)	119 (55.4%)
Age (years)	61.7 (SD: 8.7)
Height (cm)	168.3 (SD: 10.1)
Weight (Kg)	85.5 (SD: 19.8)
BMI (kg/m2)	30.2 (SD: 6.7)
Number of years with OA	10.5 (SD: 10.3)
Symptomatic knee (right)	104 (60.8%)
Educational level	
Primary School	1 (0.6%)
Some High School	27 (15.8%)
Completed High School	34 (19.9%)
Some University	24 (14.0%)
Completed Tertiary	85 (49.7%)
Occupation	
Farmer	51 (29.8%)
Technical/Sales	9 (5.3%)
Business	12 (7.0%)
Service	8 (4.7%)
Tradesman	5 (2.9%)
Operator	2 (1.2%)
Retired	64 (37.4%)
Unemployed	8 (4.7%)
Other	10 (5.9%)

4.1.3 Risk Associated with Weather Conditions

As shown in Table 4.5, high maximum temperature over the three days before the index date was associated with increased risk of knee pain exacerbation. Compared to the temperature 10–20°, the odds of knee pain exacerbation for maximum temperature above 30°C increased by 2-fold (OR = 2.18, 95% CI: 1.01 to 4.74); nevertheless, tests for trend did not reach statistically significant for observed (OR: 0.99; 95% CI: 0.96 to 1.02) or median values (OR: 1.02; 95% CI: 0.97 to 1.07). No apparent association was observed between other weather factors (i.e., relative air humidity, precipitation or barometric pressure) and the risk of knee pain exacerbation (Table 4.5).

Table 4.5: Frequency of exposure to weather in hazard and control periods (across 72 h prior to index date) and risk of pain exacerbation

Weather factor	Hazard periods	Control periods	Odds ratio (95% CI)
Maximum temperature, °C			
<10	2	6	0.58 (0.03–10.25)
10–20	148	383	Referent
20–30	200	554	0.96 (0.68–1.36)
>30	21	33	2.18 (1.01–4.74)*
Minimum temperature, °C			
<10	169	419	1.01 (0.78–1.54)
10–20	200	539	Referent
20–30	10	17	1.91 (0.73–4.95)
Relative humidity, %			
<59	121	326	1.02 (0.73–1.42)
59–79	146	392	Referent
79–100	28	68	1.25 (0.72–2.19)
Precipitation (mm)			
0–5	320	842	1.16 (0.73–1.82)
5–10	29	85	Referent
>10	19	42	1.35 (0.66–2.78)
Barometric pressure (hPa)			
<1010	24	86	0.89 (0.51–1.54)
1010–1014	82	175	1.38 (0.93–2.06)
1014–1019	83	255	Referent
1019–1024	64	141	1.41 (0.94–2.12)
>1024	17	52	0.83 (0.44–1.58)

*P < 0.05.

Post hoc analyses – Post hoc interaction analyses have not shown any effect of pain intensity at its mildest measured at baseline and risk of pain exacerbation associated with any of the weather factors included in the study (P > 0.05). Likewise, the combined effect of change in temperature and barometric pressure on knee pain exacerbation was not statistically significant (P > 0.05).

4.1.4 Occupation, Posture and Age

(Detailed data in Appendix 4)

The Framingham study found the risk of developing OA of the knee was doubled for men with a large amount of knee bending and at least medium physical demands in their occupation (OR 2.2, 95% CI 1.4-3.6). A "dose-response" relation was also found in this group. A population based case-control study including 299 men and women with osteoarthritis of the knee and 218 healthy controls (Table 4.6). Analysis found increased odds ratios with greater than 30 minutes of squatting (OR 6.9, 95% CI 1.8-26.4), greater than 30 minutes of kneeling (OR 3.4, 95% CI 1.3-9.1), and climbing more than 10 flights of stairs per day (OR 2.7, 95% CI 1.2-6.1). These results suggest that prolonged knee bending is a risk factor for osteoarthritis via mechanical loading. In a larger case-control study to assess the risk of knee osteoarthritis associated with kneeling, squatting, and other occupational activities.

Table 4.6: Occupation and Knee OA Study Characteristics

	Cohort	Cross-sectional	Case control	All studies
No. studies	78	25	18	51
No. subjects	47	34	13	52
Mean age (range)	49 (38–68)	59 (47–79)	66 (52–75)	60 (38–79)
Female (%)	21	34	57	39
Mean BMI	N/A	25.5	25.8	25.6
Hospital based (%)	0	8	22	12
Knee OA measured				
Symptomatic	8	10	18	36
Asymptomatic	0	15	0	15
Main occupational activity				
Job title	2	6	2	10
Heavy work	2	3	3	8
Elite sport	2	9	0	11
Knee strain	1	1	2	4
Multiple exposures	1	6	11	18
Occupation as				
Primary exposure	7	20	15	42
Secondary exposure	1	5	3	9

* Body mass index (BMI) could only be derived in one study from the cohort group.

The synthesis of all studies of occupational risks for knee OA yielded an OR of 1.61 (95% CI 1.45–1.78), and a forest plot of the studies is presented.

Figure 4.1: Funnel Plot of Occupation Risk for Knee OA

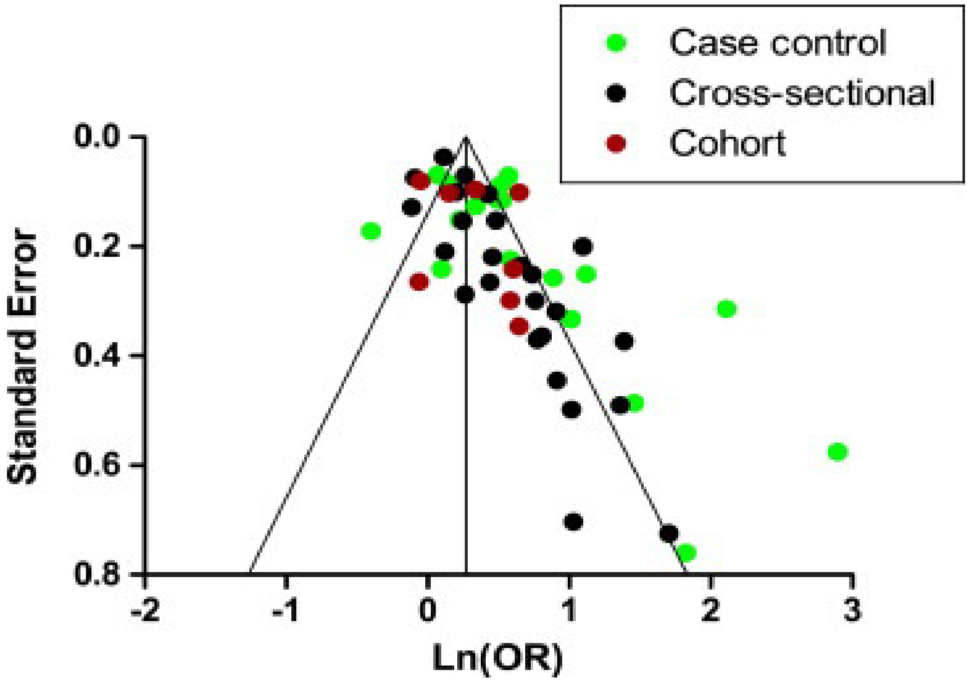


Figure 4.1 Funnel plot of occupational risks for knee OA. Funnel plot showing all studies of knee OA and occupation. Asymmetry suggests publication bias. Egger test for bias = 2.39, P < 0.0001.

Subgroup analyses are summarized in Table 4.7. We observed that case control studies gave higher estimated risks than cross-sectional and cohort studies, and the hospital-based studies gave higher risk estimates than the community-based studies. Subgroup analysis of standing work suggested that it was not a significant risk for knee OA, whereas the other subgroups associated with a positive risk.

Table 4.7: Subgroup analyses for occupation and knee OA

Subgroups	No. subjects	Heterogeneity % (Cochran Q, P value)	Summary meta-analysis
Study design			
Cohort	47	81.3 (<0.0001)	1.38 (1.10–1.74)
Cross-sectional	34	77.7 (<0.0001)	1.57 (1.37–1.81)
Case control	13	87.8 (<0.0001)	1.80 (1.48–2.19)
Setting			
Community	52	81.6 (<0.0001)	1.52 (1.38–1.69)
Hospital	52	90.6 (<0.0001)	2.65 (1.62–4.36)

Subgroups	No. subjects	Heterogeneity % (Cochran Q, P value)	Summary meta-analysis
Occupation measured as			
Primary exposure	50	81.3 (<0.0001)	1.60 (1.44–1.77)
Secondary exposure	20	88.9 (<0.0001)	1.74 (1.28–2.36)
Occupational activities			
Job title	23	77.1 (<0.0001)	1.99 (1.63–2.43)
Heavy or manual work	54	80.9 (<0.0001)	1.45 (1.20–1.76)
Elite sports	97	55.9 (0.08579)	1.72 (1.35–2.20)
Kneeling	92	68.2 (0.0009)	1.30 (1.03–1.63)
Squatting	131	25.5 (0.2013)	1.40 (1.21–1.61)
Lifting/carrying	111	77.7 (<0.0001)	1.58 (1.28–1.94)
Climbing stairs	162	72.5 (<0.0001)	1.29 (1.08–1.55)
Standing work	78	80.8 (<0.0001)	1.11 (0.81–1.51)
Knee bending/straining	26	72.1 (0.0007)	1.60 (1.15–2.21)
OA definition criteria			
Symptomatic	51	86.9 (<0.0001)	1.62 (1.43–1.83)
Asymptomatic	19	77.4 (<0.0001)	1.57 (1.33–1.86)
Gender			
Male data	44	69.5 (<0.0001)	1.53 (1.36–1.73)
Female data	63	52.2 (0.0052)	1.61 (1.42–1.82)
Region			
Rajshahi	150	83.6 (<0.0001)	1.71 (1.48–1.96)
Chapai Nawabgonj	127	74.2 (0.0038)	1.32 (1.09–1.60)
Pabna	36	84.5 (<0.0001)	1.63 (1.20–2.23)
Rest of World	1,360	88.6 (<0.0001)	1.40 (0.83–2.35)
Occupational exposure time period			
Current job	36	87.1 (<0.0001)	1.83 (1.42–2.35)
Longest-held job	81	63.8 (0.0073)	1.60 (1.25–2.04)
Early adulthood	11	59.6 (0.008)	1.73 (1.34–2.22)
Lifetime	140	89.8 (<0.0001)	1.47 (1.24–1.74)
Knee compartment			
Tibiofemoral	18	78.4 (<0.0001)	1.41 (1.17–1.71)
Tibiofemoral or patello femoral	120	78.8 (<0.0001)	1.47 (1.12–1.94)
Not reported	49	84.8 (<0.0001)	1.76 (1.52–2.03)

Subgroup analysis to show if heterogeneity is related to certain study characteristics. The percentage values for heterogeneity are from the I2 test and the P values for are from the Cochran Q test.

Table 4.8: Prevalence of Knee Osteoarthritis by Age and Sex

(Detailed data in Appendix 4)

	Males 49.9 %	**Females 50.1 %**	**Differential significance between sexes, p**
Knee osteoarthritis a			
All ages	6.3 (146)	8.9 (206)	0.001
18–44	1.5 (17)	1.7 (19)	0.651
45–64	8.1 (62)	10.9 (78)	0.063
>65	18.8 (61)	24.3 (97)	0.069
Knee osteoarthritis b			
All ages	4.4 (23)	6.7 (33)	0.112
18–44	3.2 (8)	1.1 (3)	0.121
45–64	3.9 (7)	9.5 (15)	0.042
>65	10.3 (8)	17.2 (14)	0.210

Data are based on weighted estimates

a Values reported are self-reported data based on phone interviews

b Values reported are based on robust values. Robust values represent participants responding ‘yes’ to having OA through both the phone survey and clinic survey, and indicating their OA was diagnosed by a general practice physician or rheumatologist (Table 4.8).

4.1.5 Obesity

The age adjusted odds ratio (95% CI) of radiographic OA at the knee comparing the high and low tertiles of the Body Mass Index (BMI) was 6.17 (3.26 - 11.71), for bilateral knee radiographic OA it was 17.99 (6.25 - 51.73), and 8.57 (3.25 - 22.54) for radiographic and symptomatic osteoarthritis. Comparing the middle and low tertiles of BMI, the odds ratio for radiographic OA knee was 2.86 (1.44 -5.68). For every two-unit increase in body mass index (equivalent to approximately 5 kg), the odds ratio for radiographic knee osteoarthritis increased by 1.36. (Figure 4.2)

People with a BMI^{3} 30 kg/m2 whose work had entailed prolonged kneeling or squatting had an OR of 14.7 (95% CI 7.2 - 30.2), compared with subjects with a BMI <25 kg/m2 who were not exposed to occupational kneeling or squatting. Thus the combination of obesity and occupational bent knee activities leads to an even higher risk of knee osteoarthritis. (Figure 4.2)

Figure 4.2: Mean Change in WOMAC Physical Function

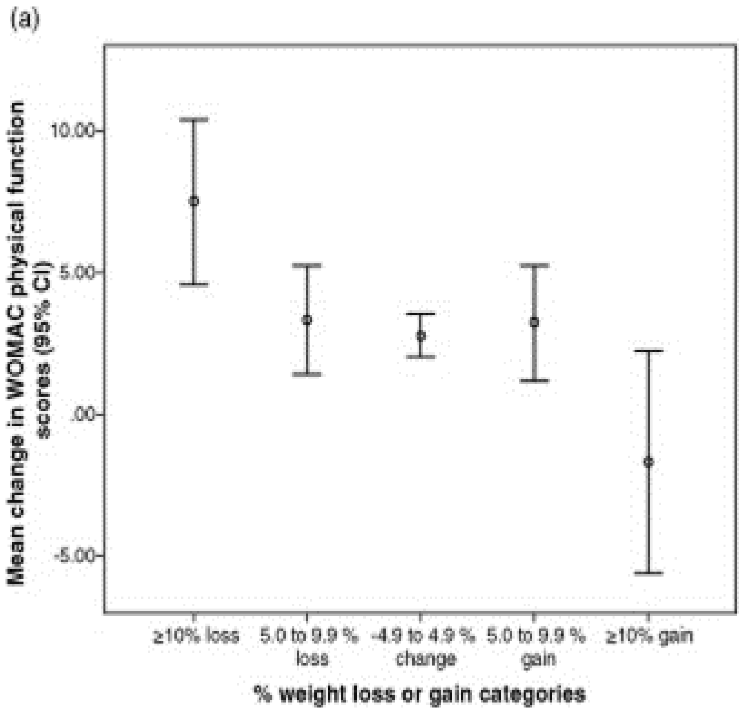
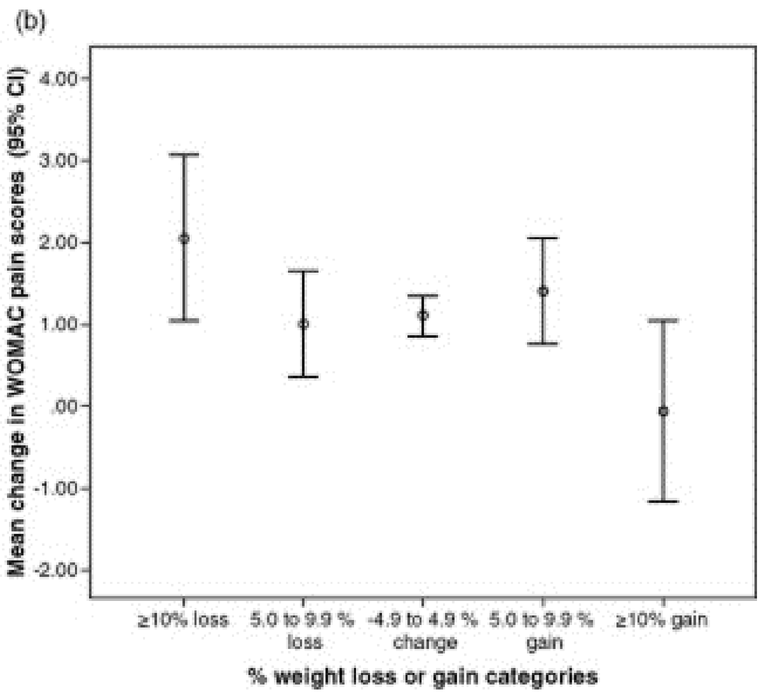


Figure 4.3: Mean change in WOMAC pain score



Dose–response relationship for the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) physical function (a) and pain (b) scales. Point estimates and 95 confidence interval (95 & CI) bars were derived from unadjusted estimates. Reproduced with permission from Riddle DL, Stratford PW.

4.1.6 Exercise and Sports

The studies that evaluated the relationship between regular recreational weight - bearing exercise and osteoarthritis of the knee generally found no effects. However, when former elite athletes were assessed cross-sectionally, those athletes who performed their activities with high impact and high stress to the joints had an increased risk for osteoarthritis in the hips and knees compared with age-matched controls.

The long-term effects of running on the development of osteoarthritis of the hip and knees. Nine year radiographic results for both runners and non-runners for the knees showed significant within-group progression of both osteophytes and total knee radiographic scores ($p = 0.01$ for runners and $p = 0.05$ for non-runners) and joint space narrowing in no runners ($p = 0.01$). Runners tended to have higher radiographic scores, but no significant differences in between - group differences were seen. The authors concluded that the presence and progression of radiographic knee OA was similar for older runners and no runners. Therefore, the results from cross-sectional and longitudinal studies show that individuals who had normal joints and participated in low-impact exercises did not have an increased risk of developing osteoarthritis of the knee as they aged.

4.1.7 Diet

The association of reported dietary intake of anti-oxidant micro nutrients with knee OA was evaluated longitudinally in the Framingham Cohort Study. There was no significant association of incident radiographic knee OA with any micronutrient. Those in the highest tertiles for vitamin C intake also had reduced risk of developing knee pain during the course of the study (aOR = 0.3; 95% CI 0.1 - 0.8).

The association of vitamin D status with the incidence and progression of knee OA was assessed in the Framingham Study. Two measures of vitamin D status were used; dietary intake, estimated using a food frequency questionnaire, and serum 25 hydroxy-vitamin D. As with the anti-oxidant study, there was no effect of vitamin D status on the risk of incident knee OA (for example, OR for lowest versus highest tertiles of dietary vitamin D intake was 1.02, 95% CI 0.45-1.87). Risk of progression (Table 4.9), however, increased 3 to 4 fold for participants in the middle and lower tertiles of both vitamin D intake (OR for lowest versus highest tertiles = 4.0, 95% CI 1.4-11.6) and serum concentration (OR = 2.9, 95% CI 1.0-8.2).

Table 4.9: Demographic and Clinical Characteristics of the Study Participants

Characteristic	Healthy lifestyle (n = 178)	Diet only (n = 82)	Exercise only (n = 80)	Diet plus exercise (n = 76)
Age, mean ± SEM years	69 ± 0.1	68 ± 0.7	69 ± 0.8	69 ± 0.8
% female	68	72	74	74
% nonwhite	21	28	25	22
Weight, mean ± SEM kg	96 ± 0.2	95 ± 0.2	92 ± 0.2	92 ± 0.2
Height, mean ± SEM meters	1.67 ± 0.01	1.66 ± 0.01	1.64 ± 0.01	1.64 ± 0.01
BMI, mean ± SEM kg/m2	34.2 ± 0.6	34.5 ± 0.6	34.2 ± 0.6	34.0 ± 0.7
Annual household income, %				
<15,000	19	19	17	19
15,000–35,000	30	33	32	36
35,000– 50,000	15	24	31	20
>50,000	36	24	21	24
Education, %				
<12 years	4	3	1	0
12 years	11	8	9	11
>12 years	85	90	90	89
Arthritis in other joints	58	58	55	53
Kellgren/Lawrence score	2.21 ± 0.09	2.31 ± 0.75	2.19 ± 0.81	2.31 ± 0.88
WOMAC function (range 0–68)	26.0 ± 1.3	23.3 ± 1.3	24.0 ± 1.3	23.6 ± 1.4

SEM – Standard Error of the Mean

4.1.8 Joint Injury

Joint injury substantially increased the risk for subsequent knee osteoarthritis (relative risk, 5.17 [CI, 3.07 to 8.71]). A number of studies have corroborated the association between ligamentous or meniscal injury to the knee or surgical meniscectomy and subsequent increased risk for osteoarthritis. Meniscal injury and subsequent meniscectomy is often accompanied by cartilage degeneration and the onset of OA because of the high focal stresses imposed on articular cartilage and subchondral bone.

4.1.9 Hormone

Sex hormones have long been considered a possible factor in the systemic predisposition to osteoarthritis, especially in women. Descriptive epidemic-ologic studies have shown that the risk of OA is comparable in men and women up to ~ 50 years of age. After this age, however, both the incidence and prevalence of OA increase more rapidly in women than in men.

There is a growing body of evidence to suggest that postmenopausal estrogen replacement therapy (ERT) may protect against large joint osteoarthritis. Of these studies, four evaluated the effect of ERT on prevalent disease and one studied the effect on incident and progressive radiographic disease. Four of these studies found that postmenopausal estrogen replacement therapy was associated with a reduced prevalence of knee OA, of which two also reported that long-term estrogen users had a lower prevalence of OA than did short-term users.

The results from the Framingham prospective cohort study, whose subjects are elderly, suggest that current estrogen use may have a moderate non-significant protective effect on the development and progression of radiographic knee OA. A similar non-significant protective effect for incident knee osteophytes was seen with current estrogen replacement therapy in the Chingford data. A recent retrospective cohort study examined the influence of ERT on MRI knee cartilage volume. They found that women using long-term ERT have more knee cartilage than controls.

4.1.10 Bone Density

Present there is no unifying theory to account for the inverse relationship between Osteoarthritis (OA) and Osteoporosis (OP) observed in the studies discussed above. In theory increasing bone density, and in particular subchondral bone density, could lead to increased mechanical load through the cartilage of weight-bearing joints (Table 4.10), thereby increasing the risk of OA. None of the large randomised controls trials on agents used in the prevention or treatment of OP have looked closely at either arthritic symptoms or radiological features of OA in their outcome measures.

Table 4.10: Summary of risk factors, effect of risk, and strategy for the prevention of knee OA

(Detailed data in Appendix 5)
(Appendix 10: Diagnostic Reports (X-Ray) on Knee OA Patients)

Risk factor (references)	Effect of risk	Range of odds ratio	Suggested intervention
Occupation, posture and age (3-12)	Knee bending, heavy lifting # risk of incident knee OA	1.7 - 3.4	Joint protection
Exercise and sports (13-19)	Low impact, no # risk. High impact, elite athletes # risk of incident and progressive knee OA	Insufficient evidence	Insufficient evidence
Joint injury (24-32)	Ligament/meniscal injury # risk of incident knee OA	5.2 - 14.0	Injury prevention
Obesity (33-38, 41-47)	# Risk of incident and progressive knee OA	1.4 for 1 unit # in BMI	Weight reduction
Diet (48-52)	Low vitamin C & D # risk of progressive knee OA	Low Vit D 2.9	Insufficient evidence
Hormones (56-62)	Insufficient evidence	Insufficient evidence	Insufficient evidence
Bone density (66-70)	High BMD # risk of incident and progressive knee OA	Insufficient evidence	Insufficient evidence

4.2 Sustainable Management of Knee Osteoarthritis by Using Swimming Exercise

(Detailed data in Appendix 6)

The 299 patients ranged from 40 to 77 years old (mean age 65.0 ± 6.4), with a female: male ratio of 113: 27. The duration of knee pain ranged from 5 months to 12 years.

Swimming provides an overall workout for the body that can benefit anyone, but it's especially effective for people with arthritis. While it’s hard to choose any single “best” exercise for everyone, doctors often recommend swimming for people with arthritis. The exercise combined with the water's support provides an aerobic workout without putting extra stress on aching joints.

Many older people can certainly benefit from water-based exercises, such as swimming, or other water activities that require equipment. Besides the benefit to the joints and inflammatory pain, exercising in the water has been found to benefit those who are overweight or suffering from injuries or lower back pain. Water exercise can also improve muscular and cardiovascular strength. No statistically significant between-group differences were found for any outcome measured. Within-group analysis indicated that Step Test results improved significantly in both groups.

There is a lack of high quality studies in this area. Six RCTs(Randomized Control Trails) 299 participants were included. There was moderate evidence for a moderate effect on physical function in favor of swimming exercise immediately after the intervention, but no evidence for pain or QOL (Quality Of Life) when comparing swimming exercise with non-exercise. Only one trial reported 3 months of follow-up measurements, which demonstrated limited evidence for pain improvement with swimming exercise and no evidence for QOL or physical function when comparing swimming exercise with non-exercise. There was limited evidence for pain improvement with land-based exercise and no evidence for QOL or physical function, when comparing swimming exercise with land-based exercise according to follow-up measurements. No evidence was found for pain, physical function, stiffness, QOL, or mental health with swimming exercise immediately after the intervention when comparing swimming exercise with land-based exercise. Two studies reported swimming exercise was not associated with serious adverse events.

After the exercise interventions, there were significant reductions in joint pain, stiffness, and physical limitation accompanied by increases in quality of life in both groups. Functional capacity as assessed by maximal handgrip strength, isokinetic knee extension and flexion power, and the distance covered in the 6-min walk test increased in both exercise groups. No differences were observed in the magnitude of improvements of swimming exercise.

Water's buoyancy accommodates both the fit and unfit. Water cushions stiff and painful joints or fragile bones that might be injured by the impact of land exercises. When immersed to the waist, body bears just 50% of its weight; immersed to the chest, it's 25%-35%; and to the neck, 10%. In addition, says See, the lower gravity promotes the return of blood to the heart from the extremities.

While water significantly reduces exercise's impact to the back and joints, running and other vertical shallow-water exercises do cause some impact. That's one reason experts advise wearing shoes. "Initially, any type of shoe will work," says See. "You don't want to invest a lot of money when you start an exercise program." For starters, she suggests lightweight sneakers such as Kids.

Water cools body and prevents overheating. See points out that even in 80 to 85 degree water, the recommended temperature for exercise should warm up in the water before workout to prevent injury. Just as with a land workout will sweat during water exercises, so it's important to drink water.

4.2.1 The Physical Principles of Water

Nearly all the biological effects of immersion are related to the fundamental principles of hydrodynamics. These principles should be understood to make the medical application process more rational. The essential physical properties of water that effect physiologic change are density and specific gravity, hydrostatic pressure, buoyancy, viscosity, and thermodynamics.

4.2.2 Density

Although the human body is mostly water, the body’s density is slightly less than that of water and averages a specific gravity of 0.974, with men averaging higher density than women. Lean body mass, which includes bone, muscle, connective tissue, and organs, has a typical density near 1.1, whereas fat mass, which includes both essential body fat plus fat in excess of essential needs, has a density of about 0.9. Highly fit and muscular men tend toward specific gravities greater than one, whereas an unfit or obese man might be considerably less. Consequently, the human body displaces a volume of water weighing slightly more than the body, forcing the body upward by a force equal to the volume of the water displaced, as discovered by Archimedes.

4.2.3 Hydrostatic Pressure

Pressure is directly proportional to both the liquid density and to the immersion depth when the fluid is incompressible. Water exerts a pressure of 22.4 mm Hg/ft of water depth, which translates to 1mmHg/1.36 cm (0.54 in.) of water depth. Thus a human body immersed to a depth of 48 inches is subjected to a force equal to 88.9mmHg, slightly greater than normal diastolic blood pressure. Hydrostatic pressure is the force that aids resolution of edema in an injured body part.

Hydrostatic pressure effects begin immediately on immersion, causing plastic deformation of the body over a short period. Blood displaces cephalad, right atrial pressure begins to rise, pleural surface pressure rises, the chest wall compresses, and the diaphragm is displaced cephalad.

4.2.4 Buoyancy

A human with specific gravity of 0.97 reaches floating equilibrium when 97% of his or her total body volume is submerged. As the body is gradually immersed, water is displaced, creating the force of buoyancy, progressively offloading immersed joints. With neck-depth immersion, only about 15 lb of compressive force (the approximate weight of the head) is exerted on the spine, hips, and knees. A person immersed to the symphysis pubis has effectively offloaded 40% of his or her body weight, and when further immersed to the umbilicus, approximately 50%. Xiphoid immersion offloads body weight by60%or more, depending on whether the arms are overhead or beside the trunk. Buoyancy may be of great therapeutic utility. For example, a fractured pelvis may not become mechanically stable under full body loading for a period of many weeks. With water immersion, gravitational forces may be partially or completely offset so that only muscle torque forces act on the fracture site, allowing active assisted range-of-motion activities, gentle strength building, and even gait training. Similarly, a lower extremity patient with weight-bearing restrictions may be placed in an aquatic depth where it is nearly impossible to exceed those restrictions.

4.2.5 Viscosity

Viscosity refers to the magnitude of internal friction specific to a fluid during motion. A limb moving relative to water is subjected to the resistive effects of the fluid called drag force and turbulence when present. Under turbulent flow conditions, this resistance increases as a log function of velocity. Viscous resistance increases as more force is exerted against it, but that resistance drops to 0 almost immediately on cessation of force because there is only a small amount of inertial moment as viscosity effectively counteracts inertial momentum. Thus, when a person rehabilitating in water feels pain and stops movement, the force drops precipitously as water viscosity damps movement almost instantaneously. This allows enhanced control of strengthening activities within the envelope of patient comfort.

4.2.6 Benefits of Exercises for Knee Osteoarthritis in the Pool

If a person with osteoarthritis of the knee is immersed in a pool, with water to the shoulders, will weigh only 10% of their body weight, by force of push or flotation, therefore, the loads to their joints will be very so that it will not damage the hyaline cartilage that covers the joint. In addition, it will be able to move more easily, without pain or stiffness, because the water temperature and that generated with exercise, causes the collagen fibers to be more flexible and lax, decreasing the joint stiffness and also, the pain is relieves by the secretion of beta-endorphins (natural analgesic 30 to 50 times more potent than morphine) and by the pressure of water on the body, which blocks pain at the spinal cord. Then, when performing Kaenz, the person will weigh less, favoring the movement that stimulates the secretion of synovial fluid, lubricating and nourishing the cartilage; including the aforementioned benefits that decrease joint stiffness, pain and overload. Also, it has been studied that hydrostatic pressure is a great proprioceptive stimulus, which generates a feedback of the sensory organs (mechanoreceptors) located in the skin, ligaments, capsule, tendons and muscles, that avoid future injuries and correct the altered movement by the dysmetria of legs and compensations generated by the osteoarthritis of hip.

4.2.7 Easy on the Body

Exercise physiologist Robert A. Robergs says swimming is a good fitness choice for just about everyone, especially those who have physical limitations or who find other forms of exercise painful. "It is a good, whole-body exercise that has low impact for people with arthritis, musculoskeletal, or weight limitations," says Robergs, director of the exercise physiology laboratories at The University of New Mexico in Albuquerque. Water's buoyancy accommodates the unfit as well as the fit. Water cushions stiff joints or fragile bones that might be injured by the impact of land exercises. When immersed to the waist, your body bears just 50% of its weight; immersed to the chest, it's 25%-35%; and to the neck, 10%.

4.2.8 Fitness Benefits

Not only is swimming easy on the body, it's a great way to get fit, according to Tay Stratton, head swim coach at the Little Rock Athletic Club. Swimming recruits all the major muscle groups, including the shoulders, back, abdominals, legs, hips, and gluteus, she says. And because water affords 12 times the resistance as air in every direction, it really helps to build strength, she says. "It's cardiovascular and strengthening at the same time, and not many workouts have that," says Stratton. There are some questions about how efficiently swimming burns calories, says Robergs. "Research done on swimming showed that weight loss seemed more difficult," he says. "The theory is that the water submersion initiates a complex [nerve pathway] to lower metabolic rate." And with a lower metabolic rate, the body uses fewer calories to maintain normal function.

4.2.9 Water exercise is a great option for painful joints and arthritis pain relief

As a kid I loved to swim. In fact, you couldn't keep me out of the water. The old swimming hole near my home was a summertime place of fun for me and my friends. Even in this day and age you still can't keep most people out of the water. According to the Centers for Disease Control and Prevention, swimming is considered the fourth most common sports activity. It is also an excellent way to get in some aerobic exercise.

Many older people can certainly benefit from water-based exercises, such as swimming, or other water activities that require equipment. Besides the benefit to the joints and inflammatory pain, exercising in the water has been found to benefit those who are overweight or suffering from injuries or lower back pain. Water exercise can also improve muscular and cardiovascular strength. Now that I'm getting older, jumping back in the swimming pool may not be such a bad idea, especially since I'm starting to develop joint and arthritis pain in my knees.

4.2.10 Water-Based Exercises Help relieve Arthritis Pain

Osteoarthritis is an extremely common condition. In the U.S. it affects over 50 million people and 80% of those are over 50-years-old. Although autoimmune disorder rheumatoid arthritis is less common, it still affects two percent to three percent of the population at any age.

I'm starting to experience many of the common symptoms associated with arthritis, including morning stiffness, and painful and swollen joints. I also seem to have a restricted range of motion overall and I could benefit from losing a few pounds! Since activities like running and walking can also be painful on the joints, my physiotherapist recommended water exercises.

Water exercise eases arthritis pain and can actually help protect the joints. Some people with arthritis prefer swimming in cold water, whereas others find comfort in warmer water. Research is also very supportive of water exercise to treat arthritis relief. In a 1987 study published in the Scandinavian Journal of Rehabilitation Medicine, eight chronic rheumatoid arthritis patients performed water exercise therapy in a heated swimming pool. After two months of participating in the water exercise program, the patients' maximal isometric and isokinetic quadriceps strength had increased by 38% and 16% respectively. A more recent review published in the journal Musculoskeletal Care in 2012 found that a warm water exercise called hydrotherapy reduced joint tenderness and pain in rheumatoid arthritis patients. It also increased grip strength and improved mood and overall wellbeing.

4.2.11 Applications in Musculoskeletal Rehabilitation

Water immersion causes significant effects on the musculoskeletal system. The effects are caused by the compressive effects of immersion as well as reflex regulation of blood vessel tone. During immersion, it is likely that most of the increased cardiac output is redistributed to skin and muscle rather than to the splanchnic beds. Resting muscle blood flow has been found to increase from a dry baseline of 1.8 mL/min/100 g tissue to 4.1 mL/min/100 g tissue with neck immersion. With muscle blood flow increased 225% above dry land flow, even higher than the rise in cardiac output during immersion, it is therefore reasonable to conclude that oxygen availability to muscles is significantly increased during immersion at rest. Blood flow during exercise is likely enhanced as well and there is research that supports this supposition, finding a 20% increase in blood flow in sedentary middle-aged subjects subjected to 12 weeks of swim training. The hydrostatic effects of immersion, possibly combined with temperature effects, have been shown to significantly improve dependent edema and subjective pain symptoms in patients with venous varicosities. Similarly, a rehabilitation program of hydrotherapy using contrasting temperatures produced subjective improvement, systolic blood pressure increases in the extremities, and significant increases in ambulation in patients with intermittent claudication. Where peripheral circulation is severely compromised, it is prudent to maintain immersion temperatures at a level below those potentially increasing metabolic demand that cannot be met by available circulation (*i.e.*, below thermo neutrality [37°C]).

An aquatic exercise program may be designed to vary the amount of gravity loading by using buoyancy as a counterforce. For acute injury, such as tibial stress fracture, programs typically should start at non–weight-bearing depths, limiting activity below pain onset, and progressing in weight bearing and exercise levels as symptoms permit. Rehabilitative programs for specific joints may be more effective as either closed or open kinetic chain programs. Shallow-water vertical exercises generally approximate closed chain exercise, albeit with reduced joint loading because of the counterforce produced by buoyancy. Deep water exercises more generally approximate an open chain system, as do horizontal exercises, such as swimming. Paddles and other resistive equipment tend to close the kinetic chain. Aquatic programs, however, offer the ability to damp the force of movement instantaneously because of the viscous properties of water. Offloading of body weight occurs as a function of immersion, but the water depth chosen may be adjusted for the amount of loading desired. The spine is especially well protected during aquatic exercise programs, which facilitates early rehabilitation from back injuries. Spine rehabilitation programs will typically include aquatic spinal stabilization techniques as well as an aerobic component of exercise activity. The former is best done with a therapist in the water one-on-one with the patient.

4.2.12 Arthritis and Fibromyalgia

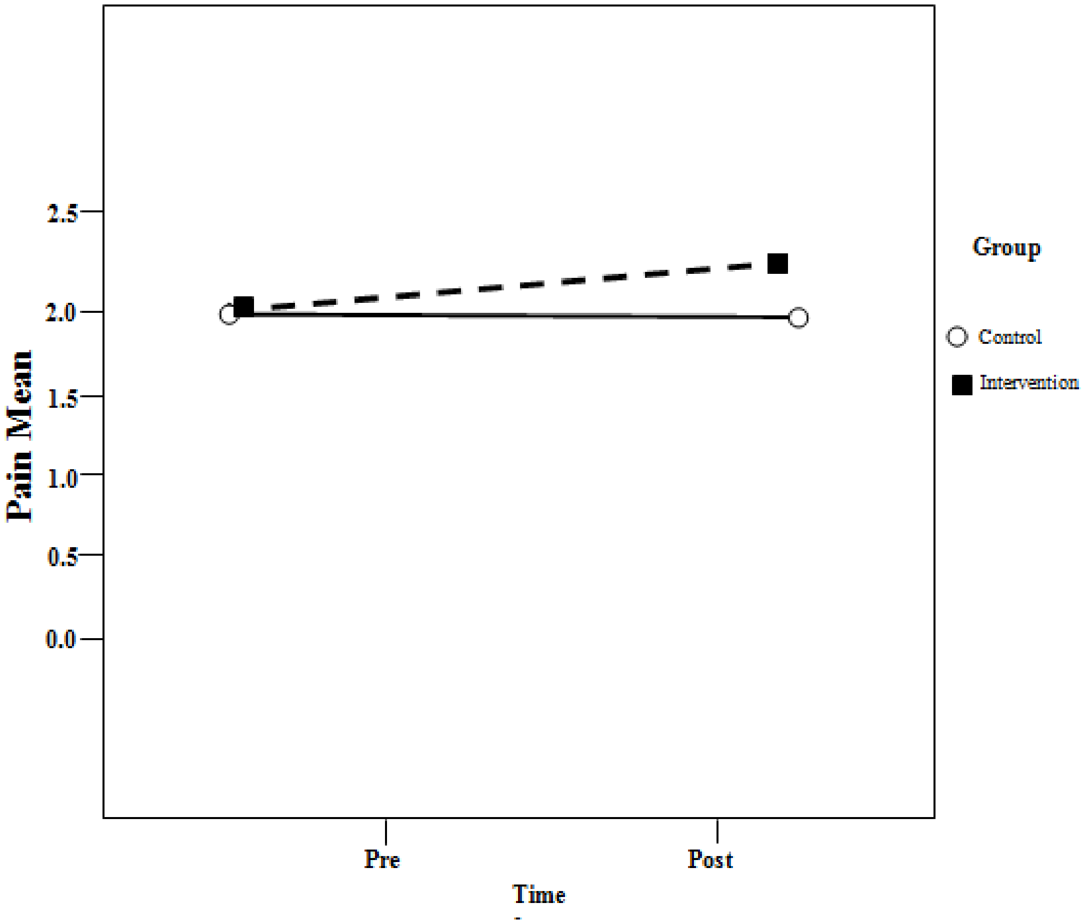
Aquatic exercise has been studied extensively in individuals with arthritis as well as fibromyalgia patients. The physiology behind efficacy remains enigmatic, but improvements in joint mobility and reductions in pain have been extensively reported. Acute joint symptoms may respond to warm water immersion and gentle active or active assisted range of motion, whereas sub-acute or chronic arthritis often responds to more active exercise regimens. The YMCA Arthritis Exercise program has been found effective in reducing disability and improving functional fitness and strength in older adults with arthritis and these programs are widely available in many communities. Numerous studies of fibromyalgic patients have demonstrated reduction in pain, improvement in sleep patterns, fibromyalgia impact, mood state disorders, and when compared with land-based exercise programs, the aquatic groups typically showed faster and larger gains, with longer post-study improvements. Typical programs for fibromyalgia include both deepwater flotation assisted exercise, and chest depth aerobic exercise programs, but programs such as Ai Chi, an aquatic equivalent of Tai Chi have been found to be effective as well.

There is a substantial volume of literature that supports the potential value of using aquatic exercise as a cross-training mode. Much of the literature dealing with deepwater running with flotation belts concludes that skill levels determine maximal oxygen consumption, but that training levels can easily be achieved equal to land-based training. It does need to be recognized that while aquatic cross training can present a very significant aerobic challenge to the athlete, there are differences in motor activity, muscle recruitment and cardiovascular performance. While there are some significant differences in cardiovascular function, the overall cardiac demand appears to be at the least, equivalent. For maintenance of cardio respiratory conditioning in highly fit individuals, water running equals dry land running in its effect on maintenance of maximum VO_2 (Volume of Oxygen) when training intensities and frequencies are matched for training periods of up to 6 weeks, currently the longest published training studies. Similarly, when aquatic exercise is compared with land-based equivalent exercise in effect on maximum VO_2 gains in unfit individuals, aquatic exercise is seen to achieve equivalent results, and when water temperature is below thermo neutral (37°C), the gains achieved are usually accompanied by a lower heart rate. Thus, water-based exercise programs may be used effectively to sustain or increase aerobic conditioning in athletes who need to keep weight off a joint, such as when in injury recovery or during an intensive training program in which joint or bone micro trauma is likely with exclusively land-based training. Although research has shown aquatic exercise to be at least the equivalent in aerobic training value to land-based training, a key question frequently raised is whether aquatic exercise programs have sufficient specificity to provide a reasonable training venue for athletes in this situation. A study by Kilgore and coworkers specifically addressed the issue of running kinematics during deep water running as compared with treadmill running and found a very close comparison between the 2 when using a cross-country skiing pattern with respect to knee and ankle kinematics, whereas high-kick running styles did not match the treadmill kinematics. Aquatic training in plyometric performance, finding comparable performance improvement to land plyometric training but with reduced post-training muscle soreness, and of course decreased joint loading. It is unlikely that aquatic training can substantially improve dry land performance in coordination skills such as hurdles, high jump, or other complex coordination activities, where reflex timing becomes a major part of the performance success. But for many athletic activities, aquatic cross-training can sustain or even build aerobic fitness, with the side benefits of reduced joint loading, decreased muscle soreness and improved performance, and a significant potential for improved respiratory function. Programs typically used for vertical water exercise include buoyancy-assisted deep water running and cross-country skiing, aquatic treadmill running, waist-depth aqua-running, and upper extremity work using resistive devices in cool pool environments.

Many effects have been observed anecdotally throughout centuries of aquatic environment use for health maintenance and restoration but they are difficult to study. Predominant among these are the relaxation effect of water immersion and the effect that water immersion has on pain perception. Skin sensory nerve endings are stimulated. Both animal and human studies suggest that sensory overflow may be the mechanism by which pain is less well perceived when the affected body part is immersed in water. Pain modulation is consequently affected with a rise in pain threshold, which increases with temperature and water turbulence, producing the proposed therapeutic effect of agitated whirlpool immersion. Numerous studies of pain in persons with fibromyalgia have shown statistically significant improvement in pain and function.

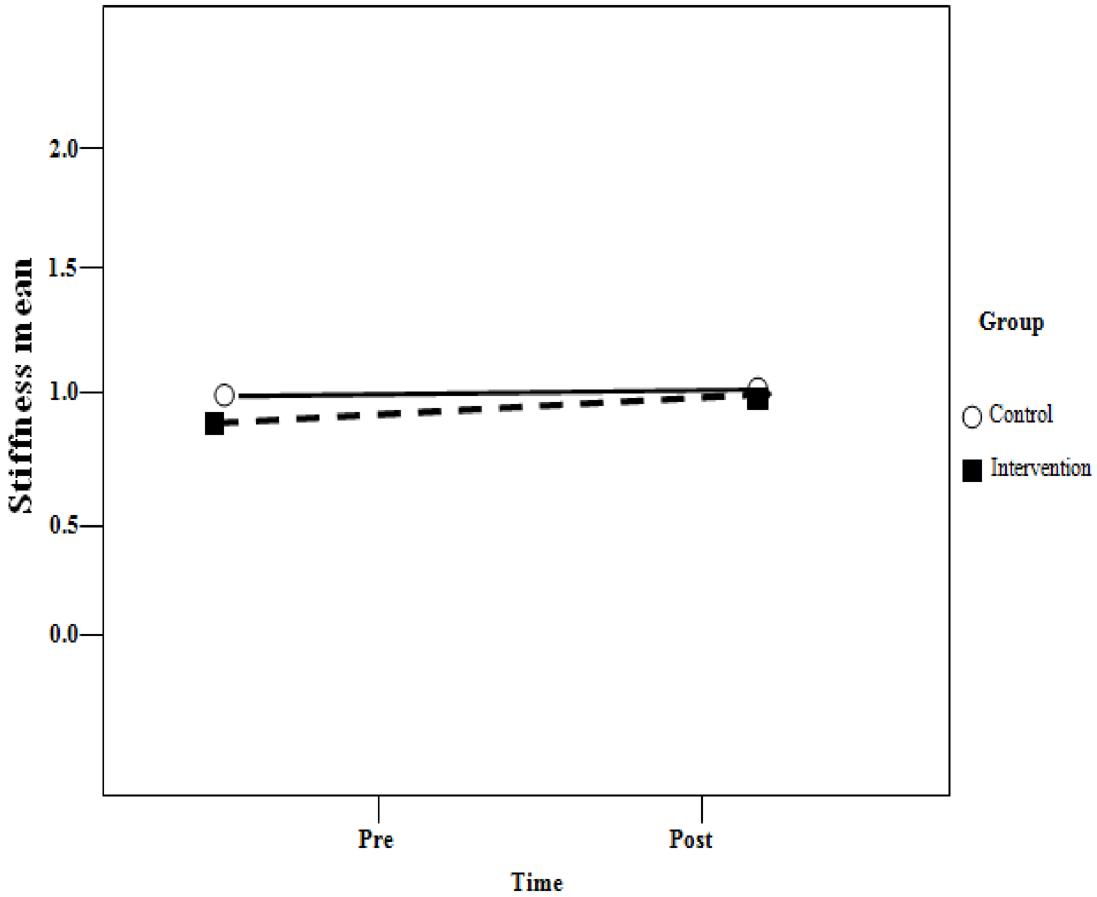
Studies have shown that aquatic exercise reduces anxiety scores and increases perceived well-being, equal to or superior to the effects noted with land exercise activity. Heart rate variability can be analyzed to assess the impact of respiration and autonomic nervous system activity. During relaxation states, heart rate variability demonstrates an autonomic bias toward vagal or parasympathetic nervous system control, whereas during stressed states, sympathetic nervous system influence predominates and heart rate variability decreases. The heart rate variability pattern seen during immersion is that of vagal or parasympathetic control, indicating perhaps an inherent bias toward the relaxation state. In work done in the author's laboratory studying heart rate variability, peripheral circulation and core temperature during cool, neutral, and warm water immersion in both younger (ages 18-30) and older (ages 40-65) subjects, the authors found a dramatic decrease in sympathetic nervous system activity during warm water immersion, but less so during neutral immersion and an increase in sympathetic bias during cool water immersion. During warm water immersion, the authors also found a significant increase in sympathovagal balance, the interplay between the 2 components of the autonomic nervous system. Both groups of subjects responded similarly, although the older group had a more muted response. During the same study, the authors found consistent decreases in diastolic blood pressures and dramatically increased distal circulation. Aquatic therapy techniques for pain management may include Watsu, an aquatic technique derived from Shiatsu massage and Bad Ragaz, a floating technique focusing on carefully controlled movement and breathing, and gently progressive strengthening combined with aerobic exercise.

Figure 4.4: Knee pain mean pre-and post-scores for swimming exercise



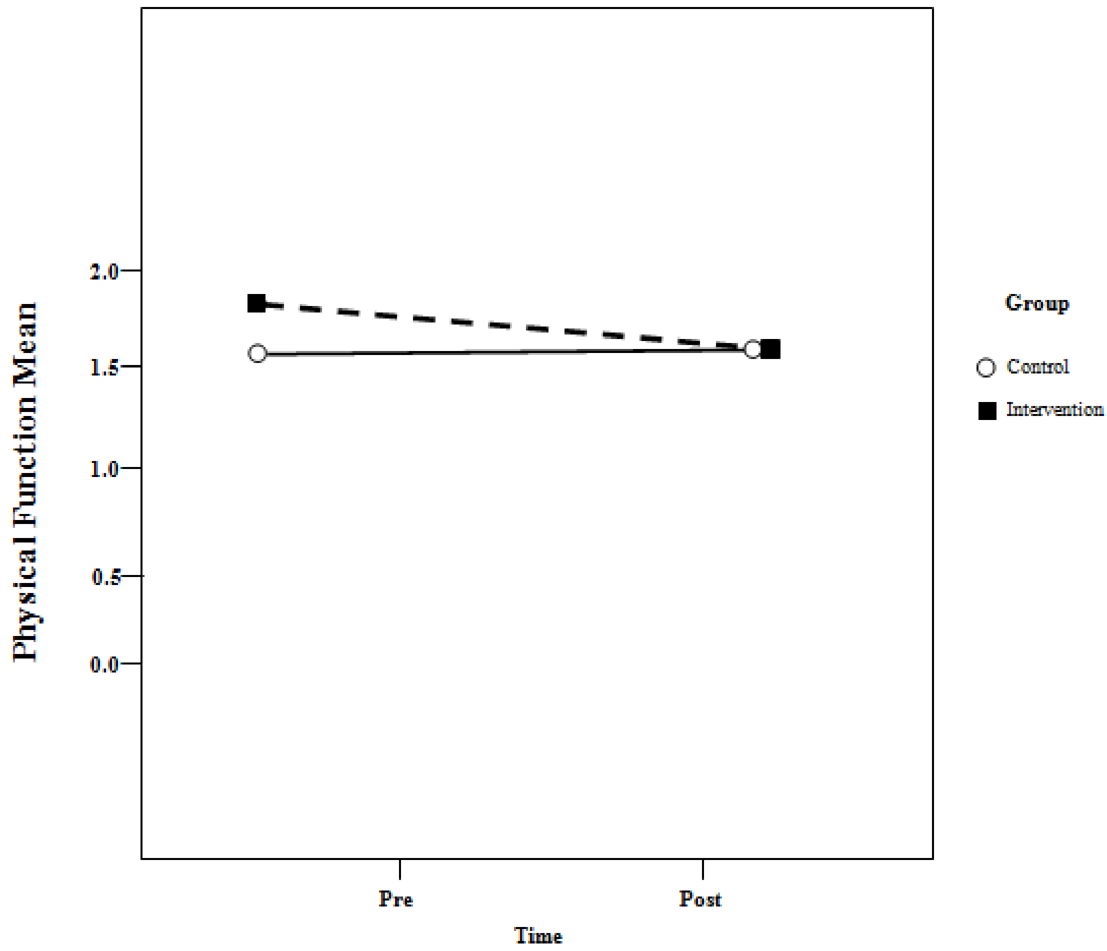
When a patient swimming than the knee move rapidly. There is markedly increase pain because there is Crepitus movement and diminished joint range of motion. At the same time water temperature is less than the body temperature. Water temperature is the factor to increase joint pain. Score shows 2.00 → 2.3 that's mean slightly increase pain. (Figure 4.4)

Figure 4.5: Knee stiffness mean pre- and post-scores for swimming exercise



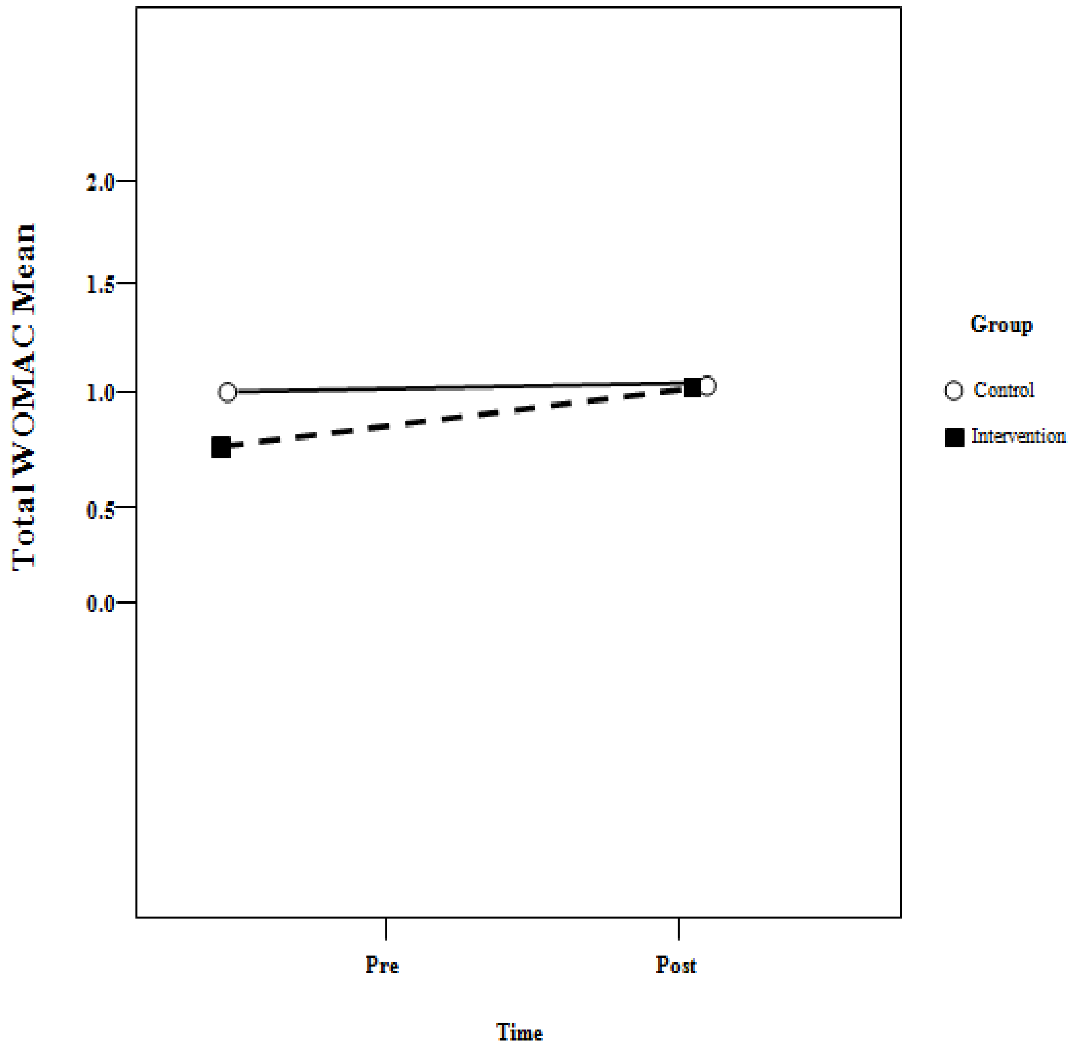
Mild to severe stiffness present in every Osteoarthritis patient. When a patient swimming than there is 40°-45° degree move the joint (Flexion & Extension). Movement decrease the joint inflammation and increase the range of motion. Score shows 1.00→0.8 that's mean slightly improve the degree of movement. So if a patient swimming continuously, then slightly increase the joint range of motion. (Figure 4.5)

Figure 4.6: Physical function mean pre and post scores for swimming exercise



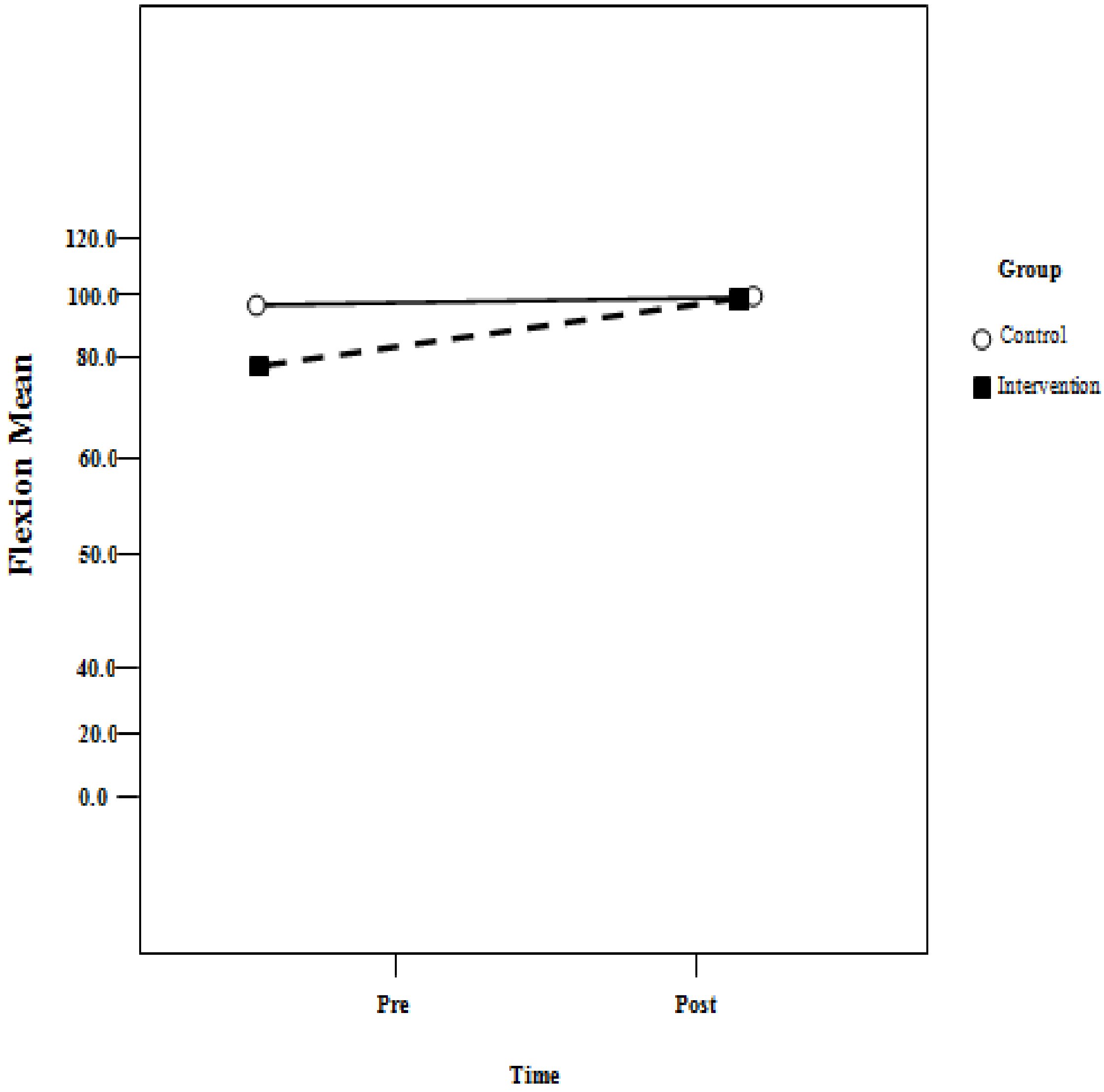
Physical function means daily activity. If a patient swimming regularly than reduce his/her joint inflammation resulting decrease stiffness. Score shows 1.8 → 1.5 in the post period. That's why slightly increase activities of daily living. (Figure 4.6)

Figure 4.7: Total means WOMAC pre-and post-scores for swimming exercise



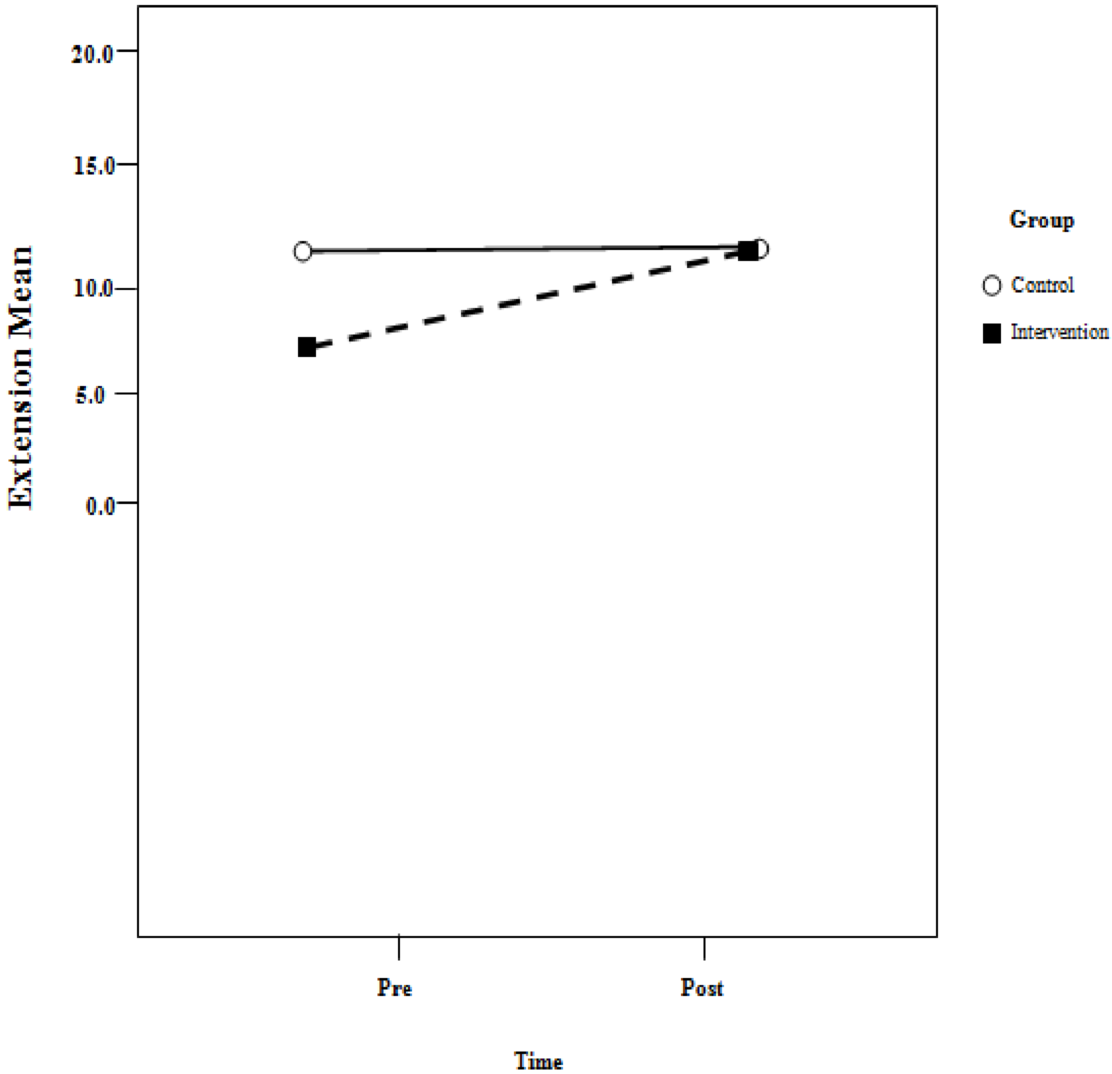
WOMAC scale measuring the total knee joint function. Figure shows 1.0 →0.7. When a patient swimming continuously than slightly decrease the symptoms but not effective and also harmful for the patient. (Figure 4.7)

Figure 4.8: Mean knee ROM flexion scores for swimming exercise



Score shows 80° in pre period and 100° in post period that's mean slightly decrease knee flexion in post period. (Figure 4.8)

Figure 4.9: Mean knee ROM extension scores for swimming exercise



Score shows 5° in pre period and 12° in post period that's mean slightly decrease knee extension in post period. (Figure 4.9)

4.3 Sustainable Management of Knee Osteoarthritis by using Quadriceps Stretching Exercise and Hot Pack

(Detailed data in Appendix 7)

The 299 patients ranged from 40 to 85 years old (mean age 65.0 ± 6.4), with a female: male ratio of 113:27. The duration of knee pain ranged from 5 months to 12 years.

4.3.1 Changes in Range of Motion

The changes in average ROM (Range of Motion) of the arthritic knees for each group are shown in Table 4.11. Nine patients stopped the therapeutic exercises due to intolerable pain during exercise (5 patients in group I, 3 in group II, and 1 in group III). Contact with 13 patients was lost during the follow up period (4 patients in group I, 3 in group II, 2 in group III, and 4 in the control group). The average ROM of each group was initially similar, but ROM scores later increased significantly in all treated groups, with patients in group III showing the greatest improvement of ROM, both after treatment and in the follow up period.

Table 4.11: Range of Knee motion in each group (Control, before and after treatment)

	I	II	III	IV(Control)
Before	203 ± 13 (70)	204 ± 10 (70)	203 ± 12 (70)	201 ± 13 (70)
After	208 ± 17 (60)†	214 ± 15 (64)‡	220 ± 13 (68)‡	198 ± 10 (64)
ROM	5 ± 10†	10 ± 14†	16 ± 15§	–4 ± 13
Follow up	210 ± 14 (52)†	218 ± 14 (58)†	224 ± 18 (64)§	198 ± 17 (56)

- Values are the mean ± SD (number of knees in each group at various times intervals). ROM = range of motion.
- Significant difference in Lequesne's Index (LI) in each group compared with the control group at various time intervals ($P < 0.05$).
- Significant difference in LI in each group after treatment and compared with the control group at various time intervals ($P < 0.05$).
- Significant difference in LI in each group compared with the control group at various time intervals and compared with other treated groups ($P < 0.05$). (Table 4.11)

4.3.2 Changes in knee pain

The changes in average scores for knee pain in each group are shown in Table 4.12. Pain scores for groups I–IV were initially similar, but pain scores decreased significantly in all treated groups, and pain scores had continued to decrease significantly in groups II and III at the follow up, whereas pain scores increased in the controls. Patients in group III showed the greatest degree of pain reduction, both after treatment and in the follow up period.

Table 4.12: Average score of VAS (Visual Analog Scale) for knee pain in each group

	I	II	III	IV(Control)
Before	5.3 ± 1.5 (70)	5.5 ± 1.7 (70)	5.6 ± 1.4 (70)	5.4 ± 1.7 (70)
After	4.1 ± 0.6 (60)†	3.0 ± 1.8 (64)†	2.5 ± 1.6 (68)‡	4.9 ± 1.2 (64)
VAS	1.2 ± 1.6	2.5 ± 1.9	3.1 ± 1.8§	0.5 ± 1.7
Follow up	3.9 ± 1.4 (52)†	2.6 ± 1.5 (58)¶	2.0 ± 1.3 (64)#	6.6 ± 1.5 (56)**

- Values are the mean ± SD (number of knees in each group at various times intervals). VAS = visual analog scale.
- † Significant difference in VAS score in each group after treatment and compared with the control group at various time intervals ($P < 0.05$).
- ‡ Significant difference in VAS score in each group after treatment, compared with the control group at various time intervals, and compared with other treated groups ($P < 0.05$).
- § Significant difference compared with other treated groups ($P < 0.05$).
- ¶ Significant difference in VAS score in each group between after treatment and those at follow up, and compared with the control group at various time intervals ($P < 0.05$).
- # Significant difference in VAS score in each group between after treatment and those at follow up, compared with the control group at various time intervals, and compared with other treated groups ($P < 0.05$).
- ** Significant difference in VAS score in each group between after treatment and those at follow up ($P < 0.05$).

4.3.3 Changes in Muscle Power

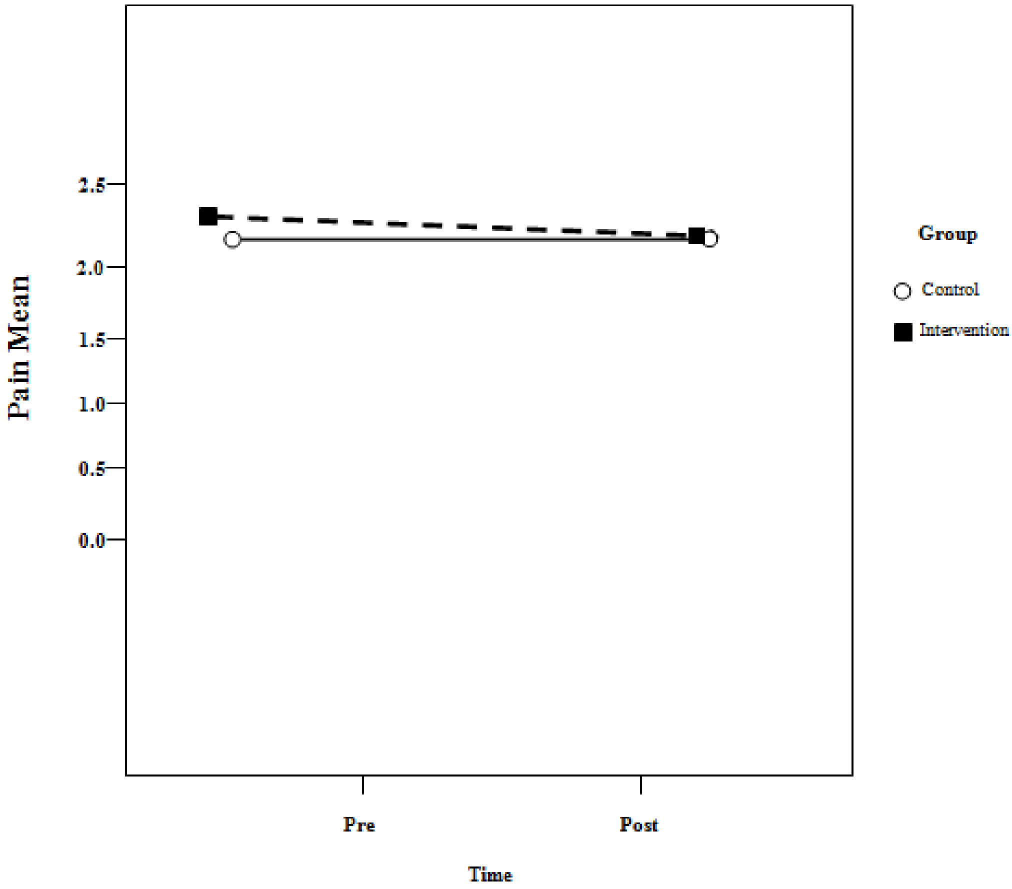
The changes in mean peak torques of knee flexion and extension in concentric and eccentric contraction in all patient groups are shown in Table 4.13. The average peak torques of 60°/second in Ex/Con, Ex/Ecc, Flex/Ecc, and Flex/Con increased significantly in all treated groups, both after treatment and at the follow up. Patients in group I showed the least improvement in peak torques after treatment, but group I patients still showed significant improvements in MPT when compared with the control group at follow up. Group III had the greatest improvement in peak torque at 180°/second in all contraction modes (Ex/Con, Ex/Ecc, Flex/Con, and Flex/Ecc) after treatment and at follow up.

Table 4.13: Mean peak torque of knee flexion and extension in concentric and eccentric contraction at 60°/second in each group

	I	II	III	IV(Control)
60° (Ex/Con)				
Before	230.4 (70)	232.7 (70)	230.4 (70)	229.3 (70)
After	250.8 (60)†	293.5 (64)‡	326.1 (68)§	225.1 (64)
MPT	20.3	60.8	95.3¶	−4.2
Follow up	273.3 (52)#	346.5 (58)**	380.1 (64)††	211.3 (56)
60° (Ex/Ecc)				
Before	425.3 (70)	423.7 (70)	428.9 (70)	426.3 (70)
After	465.5 (60)‡	504.1 (64)‡	561.3 (68)§	424.7 (64)
MPT	40.4	80.3	132.1¶	−1.5
Follow up	485.1 (52)#	557.3 (58)**	627.4 (64)††	400.4 (56)
60° (Flex/Con)				
Before	276.3 (70)	273.1 (70)	278.2 (70)	270.7 (70)
After	296.4 (60)#	322.0 (64)‡	357.9 (68)§	260.8 (64)
MPT	22.0	49.3	80.9¶	−10.3
Follow up	286.3 (52)#	353.7 (58)**	392.1 (64)††	230.0 (56)‡‡
60° (Flex/Ecc)				
Before	335.3 (70)	344.5 (70)	338.8 (70)	341.1 (70)
After	365.5 (60)#	406.6 (64)‡	458.3 (68)§	330.5 (64)
MPT	30.1	62.0	80.51¶	−10.6
Follow up	375.6 (52)#	420.3 (58)#	473.6 (64)§§	290.3 (56)‡‡

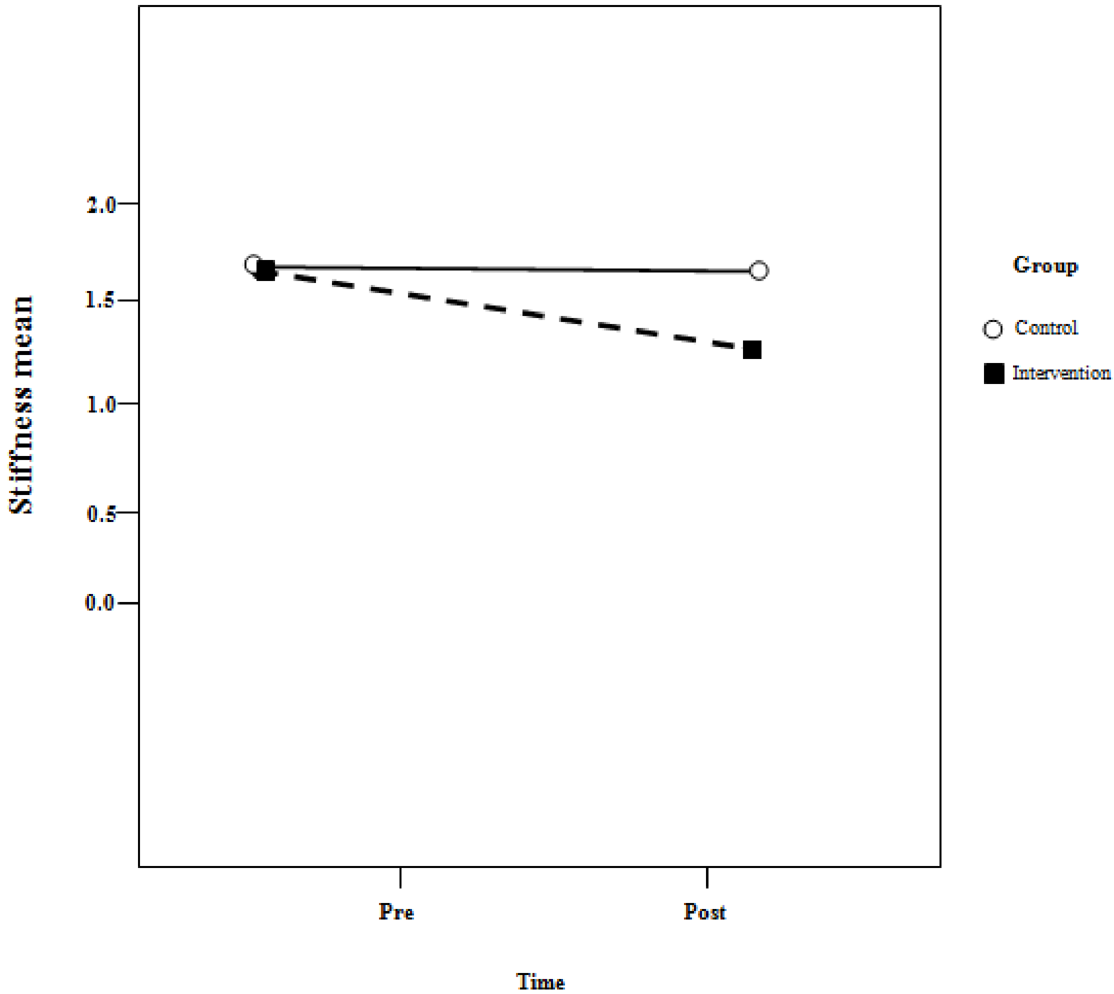
- Values are the mean (number of knees in each group at various time intervals). Ex/Con = knee extension with concentric quadriceps contraction; MPT = mean peak torque; Ex/Ecc = knee extension with eccentric biceps femoris contraction; Flex/Con = knee flexion with concentric biceps femoris contraction; Flex/Ecc = knee flexion with eccentric quadriceps contraction.
- † Significant difference in peak torque in each group after treatment ($P < 0.05$).
- ‡ Significant difference in peak torque in each group after treatment and compared with the control group at various time intervals ($P < 0.05$).
- § Significant difference in peak torque in each group after treatment, compared with the control group at various time intervals, and compared with other treated groups ($P < 0.05$).
- ¶ Significant difference compared with other treated groups ($P < 0.05$).
- # Significant difference in peak torque in each group compared with the control group at various time intervals ($P < 0.05$).
- ** Significant difference in peak torque in each group between after treatment and those at follow up, and compared with the control group at various time intervals ($P < 0.05$).
- †† Significant difference in peak torque in each group between after treatment and those at follow up, compared with the control group at various time intervals, and compared with other treated groups ($P < 0.05$).
- ‡‡ Significant difference in peak torque in each group between after treatment and those at follow up ($P < 0.05$).
- §§ Significant difference in peak torque in each group compared with the control group at various time intervals and compared with other treated groups ($P < 0.05$).

Figure 4.10: Knee pain means pre-and post-scores for quadriceps stretching exercise and hot pack



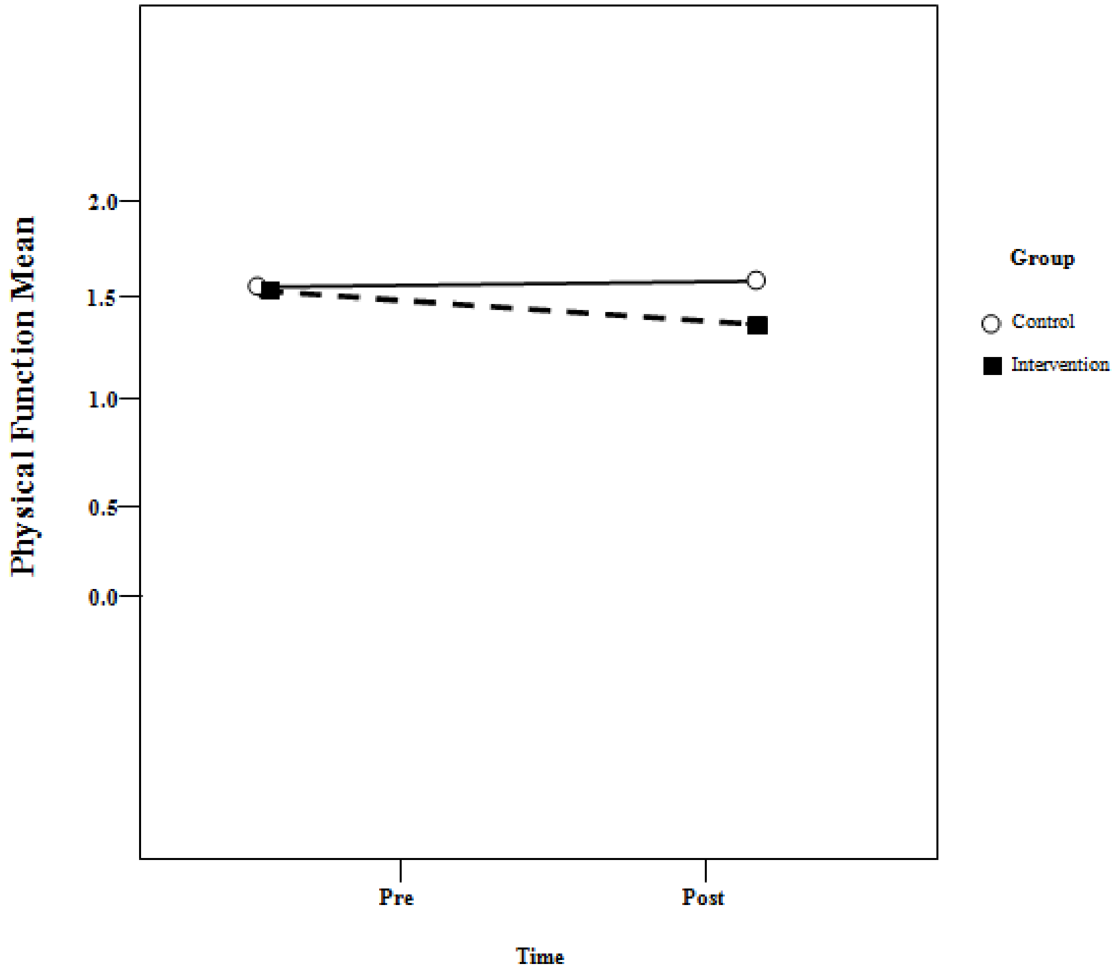
For applying quadriceps stretching exercise and hot pack for 12week duration, score shows there is slightly increase pain after intervention. Before treatment patient has no complain but after 12week patient complain that he/she feel discomfort and his/her pain increase. (Figure 4.10)

Figure 4.11: Knee stiffness mean pre- and post-scores for quadriceps stretching exercise and hot pack



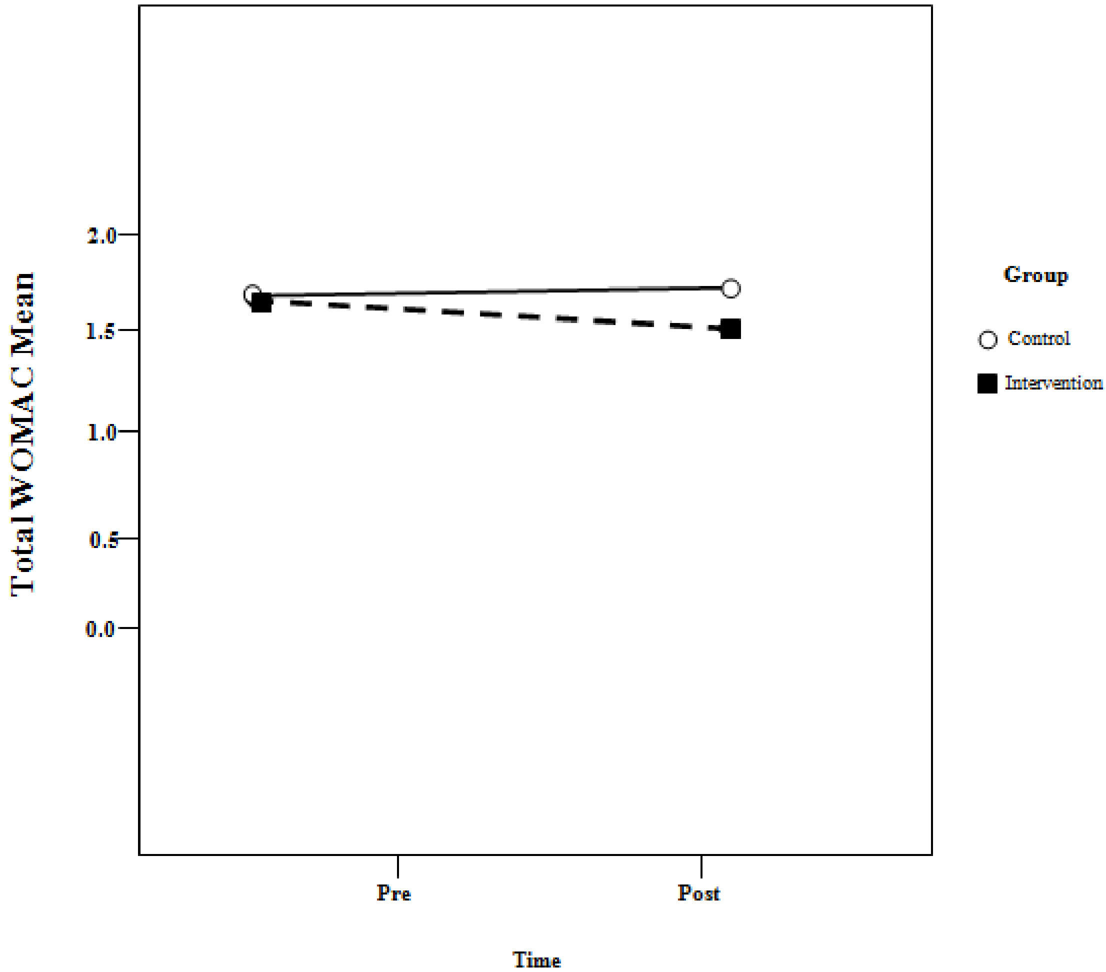
When a patient performs this treatment method for 12 week duration independently, score shows there is mild reduce joint stiffness. (Figure 4.11)

Figure 4.12: Physical function mean pre and post scores for quadriceps stretching exercise and hot pack



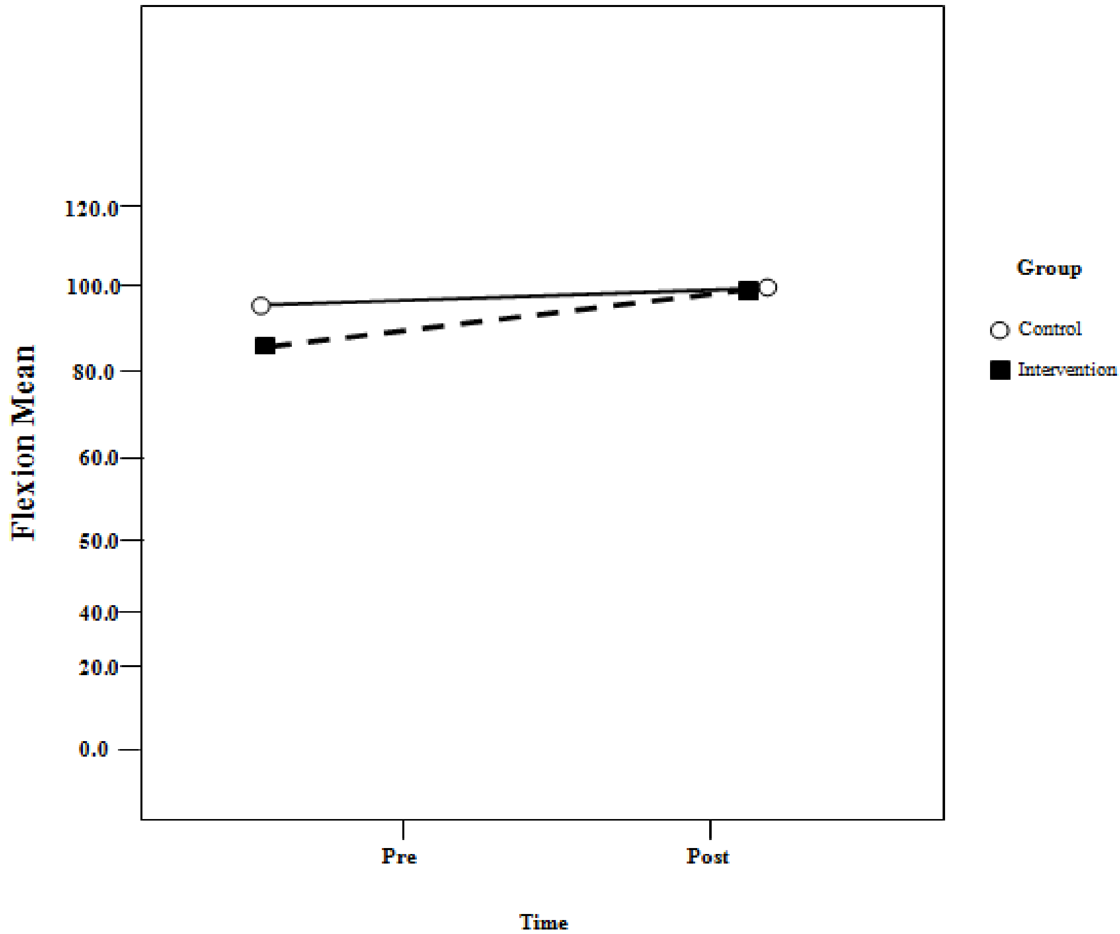
After complete 12 week of treatment period, result shows 1.5→1.3 in post period that's mean slightly reduce physical function during intervention. (Figure 4.12)

Figure 4.13: Total mean WOMAC pre-and post-scores for quadriceps stretching exercise and hot pack



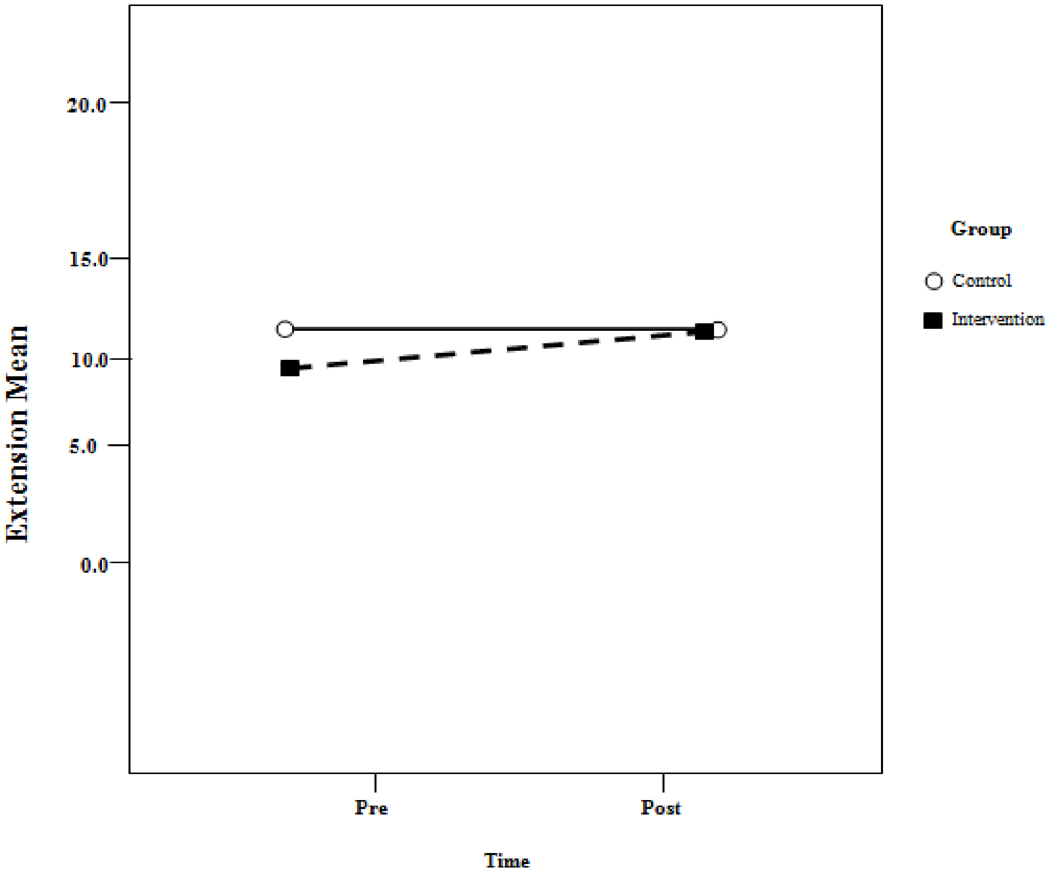
The study found slightly difference in post score and the score is 1.6 → 1.4. (Figure 4.13)

Figure 4.14: Mean knee ROM flexion scores for quadriceps stretching exercise and hot pack



The study found slightly reduce post period of treatment (100°→80°) that mean increase flexion degree. (Figure 4.14)

Figure 4.15: Mean knee ROM extension scores for quadriceps stretching exercise and hot pack



The study found (12°→8°) slightly reduce post period of treatment that mean increase extension degree. (Figure 4.15)

4.3.4 Hot pack

As shown in Table 4.14, participants reported a range of individual preferences for treatment setting. More participants preferred the warm treatment condition, but nearly one-half preferred contrast treatment. Most (32 of 34) preferred treatment with the water-circulating device compared to the use of a standard heating pad or no treatment. Regardless of the preference, there were, on average, significant ($P < 0.05$) improvements in pain, symptoms, FDL (Function in Daily Living), QOL(Quality Of Life) and KOOS (Knee injury and Osteoarthritis Outcome score) subscale measures with the water circulating device treatment options, (see Table 4.14 and 4.15), when compared with baseline and control week measurements. Twice daily rest (control treatment) resulted in improvements over baseline measures, and therefore the control week data served as our means for comparison with all active treatment options. The extent of improvement in pain and symptoms was often more pronounced when subjects utilized their preferred treatment versus their non-preferred treatment.

Table 4.14: Breakdown of treatment preferences for all subjects (N = 299)

Overall preference (N = 299)		
Most preferred treatment (% of population)	2nd most preferred treatment (% of population)	3rd most preferred treatment (% of population)
Warm (47%)	Warm (36%)	Contrast (42%)
Cold (24%)	Cold (26%)	Cold (29%)
Contrast (24%)	Contrast (21%)	Hot pad (18%)
Hot pad (5%)	Hot pad (17%)	Warm (11%)

Table 4.15: The KOOS scale (0–100) for FDL and QOL from the baseline measure for the indicated treatment option on the water-circulating device for the entire group and then for the subgroups of subjects based on preference

	Change in KOOS scale after control treatment	Change in KOOS scale after cold treatment	Change in KOOS scale after contrast treatment	Change in KOOS scale after warm treatment	Change in KOOS scale after hot pad treatment
KOOS-FDL					
Average for all subjects	−0.1 ± 15.5	6.1 ± 16.1a	6.6 ± 16.0 a	7.2 ± 15.6 a	4.2 ± 15.1 a
Average for prefer cold treatment	−7.5 ± 17.2	3.3 ± 22.3	4.4 ± 20.6	8.7 ± 18.4	0.3 ± 17.9
Average for prefer contrast treatment	4.5 ± 5.8	8.2 ± 17.7b	8.0 ± 15.5	4.8 ± 15.6	−1.8 ± 17.2
Average for prefer warm treatment	4.1 ± 17.9	7.7 ± 15.6	8.4 ± 16.3	8.1 ± 17.2	7.4 ± 14.1
KOOS-QOL					
Average for all subjects	3.3 ± 12.6	8.0 ± 14.9 a	9.1 ± 14.4 a	9.0 ± 16.2 a	9.0 ± 14.0 a
Average for prefer cold treatment	5.9 ± 18.8	10.1 ± 8.7 a	9.9 ± 7.4 a	13.9 ± 14.0 a	15.9 ± 13.8 a
Average for prefer contrast treatment	−2.0 ± 11.3	7.7 ± 16.3b	6.5 ± 14.7a,b	4.5 ± 5.2	0.9 ± 15.4
Average for prefer warm treatment	0.5 ± 10.7	7.3 ± 18.2	8.9 ± 17.6	8.1 ± 19.1a	8.3 ± 13.7

a Indicates values of change significant from change after control, T-test $P < 0.05$.

b Indicates that change from preferred treatment is significantly greater than any other treatment option, T-test $P < 0.05$.

Abbreviations: KOOS, knee injury and osteoarthritis outcome score; FDL, function in daily living and recreation; QOL, quality of life.

4.4 Sustainable Management of Knee Osteoarthritis by using Mobilization Exercise and Hot Pack

(Detailed data in Appendix 8)

A total of 299 subjects (85%) completed the study. Of nine subjects who withdrew during the intervention, 100 were from the experimental group and 199 from the control group. In the experimental group, 2 withdrew due to transportation problem, 1 developed hip pain prior to the intervention, and 1 had to care for a sick family member. In the control group, 3 withdrew due to other commitments, 1 developed pain and swelling of the ankle prior to the intervention, and 1 was excluded after receiving a corticosteroid injection for knee pain. Subjects in the experimental and the control group attended 87.5% and 100% of the therapy sessions, respectively. On completion of the study, data for 120 men and 179 women were available for analysis. There were no significant differences between the two groups in all variables at baseline ($p>0.05$), except for stairs ascending-descending time (Table 4.16).

4.4.1 Mobilization Exercise

Table 6 shows the differences in post-treatment VAS and stairs ascending-descending time between the groups. The mean VAS reduced by 18.07+3.82 mm (44.07%) in the experimental group and by 6.66+4.11 mm (20.44%) in the control group. There were no significant differences for the between-groups effect $F(1,11) = 2.7$, $p = 0.13$, but within-group differences demonstrated significant reduction in VAS in the experimental group ($t(144) = 3.48$, $p = 0.01$), compared to the control group ($t(155) = 0.44$, $p = 0.68$). No significant difference was found in stairs ascending-descending time between the two groups, $F(1,10) = 0.70$, $p = 0.42$. Spearman Correlation analysis found a moderate but non-significant correlation, $r = 0.34$, $p = 0.16$, between pain and stairs ascending-descending time. (Table 4.16 and 4.17)

Table 4.16: Characteristics of the two groups at baseline

Variable	Control(n=100)	Experimental(n=199)	P value
Mean age +SD, year	59.7+4.9	63.1+10.8	0.47*
Gender			
Female	85	150	1.0#
Male	15	49	
BMI (median, range), kg/m2	26.2(23.6-39.3)	28.5(21.7-40.0)	0.57¶
OA duration (median, range), year	2.0(0.75-3.0)	1.2(1.0-10.0)	0.94¶
Knee affected			
Unilateral	88	180	1.0#
Bilateral	12	19	
Valgus/varus deformity			
Yes	2	4	0.59#
No	4	3	
Mean VAS+SD, mm	32.58 + 21.09	41.00 + 20.86	0.57.*
Stairs ascending-descending time (mean+SD), s	5.93 + 1.17	8.75 + 1.77	0.007*

* Unpaired t test

Chi-square test

¶ Mann-Whitney U test

Table 4.17: Post-treatment VAS and adjusted stairs ascending-descending time

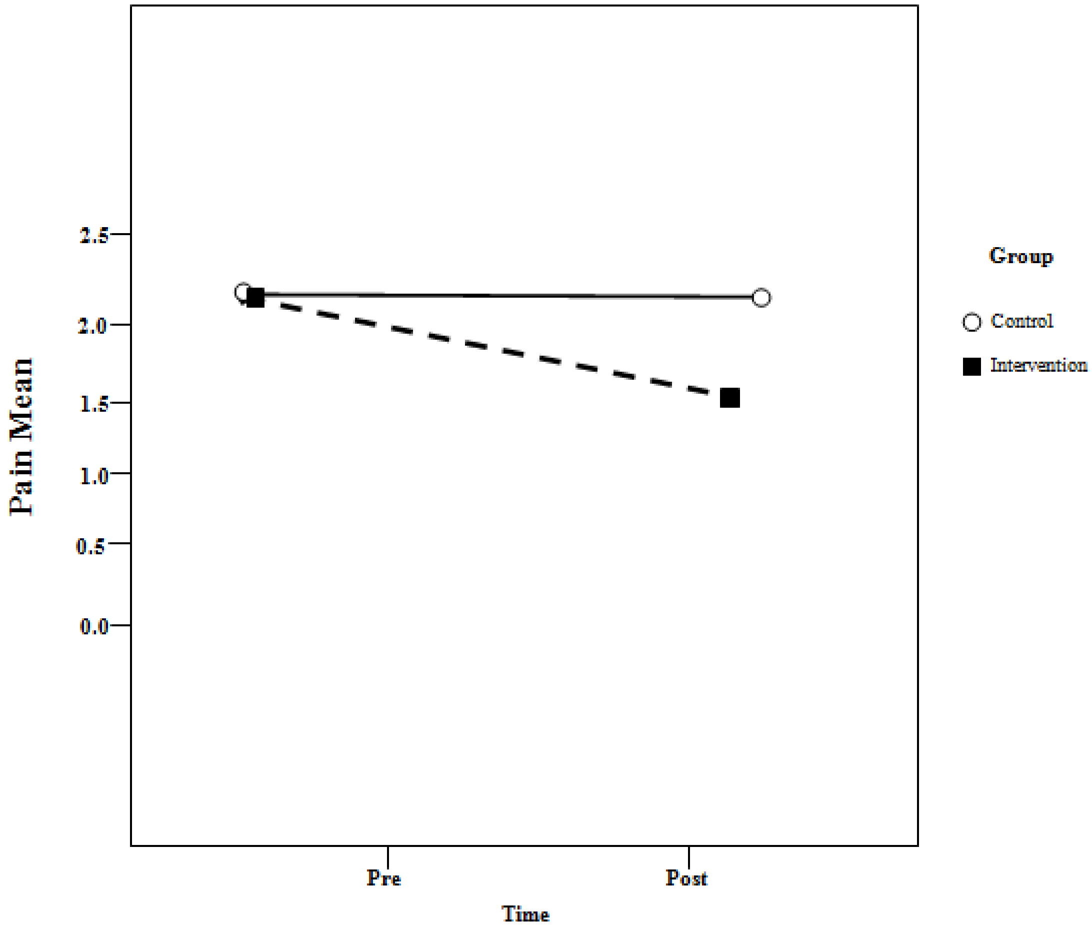
	Control (n=100)	Experimental (n=199)	Mixed ANOVA (F, p value)	ANCOVA (F, p value)
Baseline	32.58 + 21.09	41.00 + 20.86		
At 4 weeks	25.92 + 16.98	22.93 + 17.04	0.07, 0.80	
Within group differences	6.66 + 4.11	18.07+ 3.82		
Paired t test (t, p value)	0.44, 0.67	3.48, 0.01*		
#Stairs ascending-descending time (Mean + S.D), s	6.78 + 0.41	6.25 + 0.37		0.70, 0.42

* p is significant at 0.05

adjusted for stairs ascending-descending time at baseline.

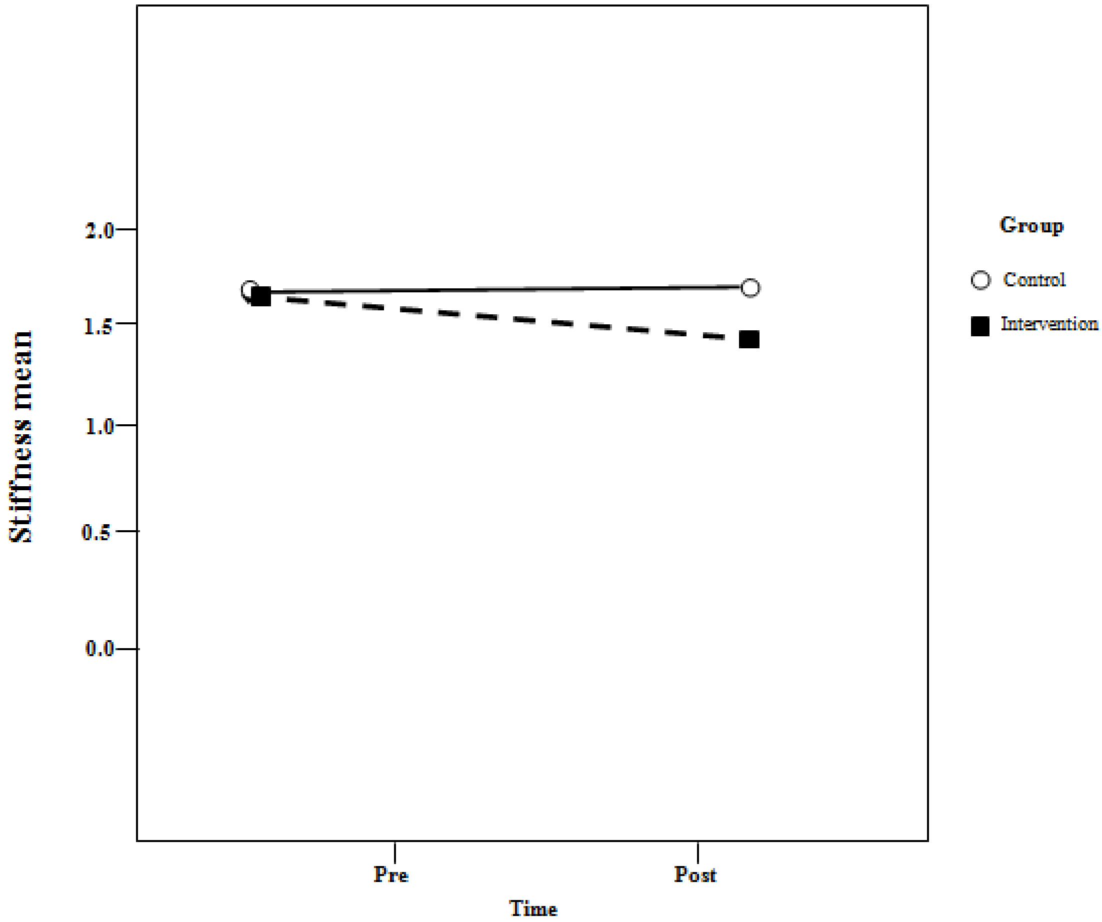
VAS – Visual Analogue Scale

Figure 4.16: Knee pains mean pre-and post-scores for knee mobilization exercise and hot pack



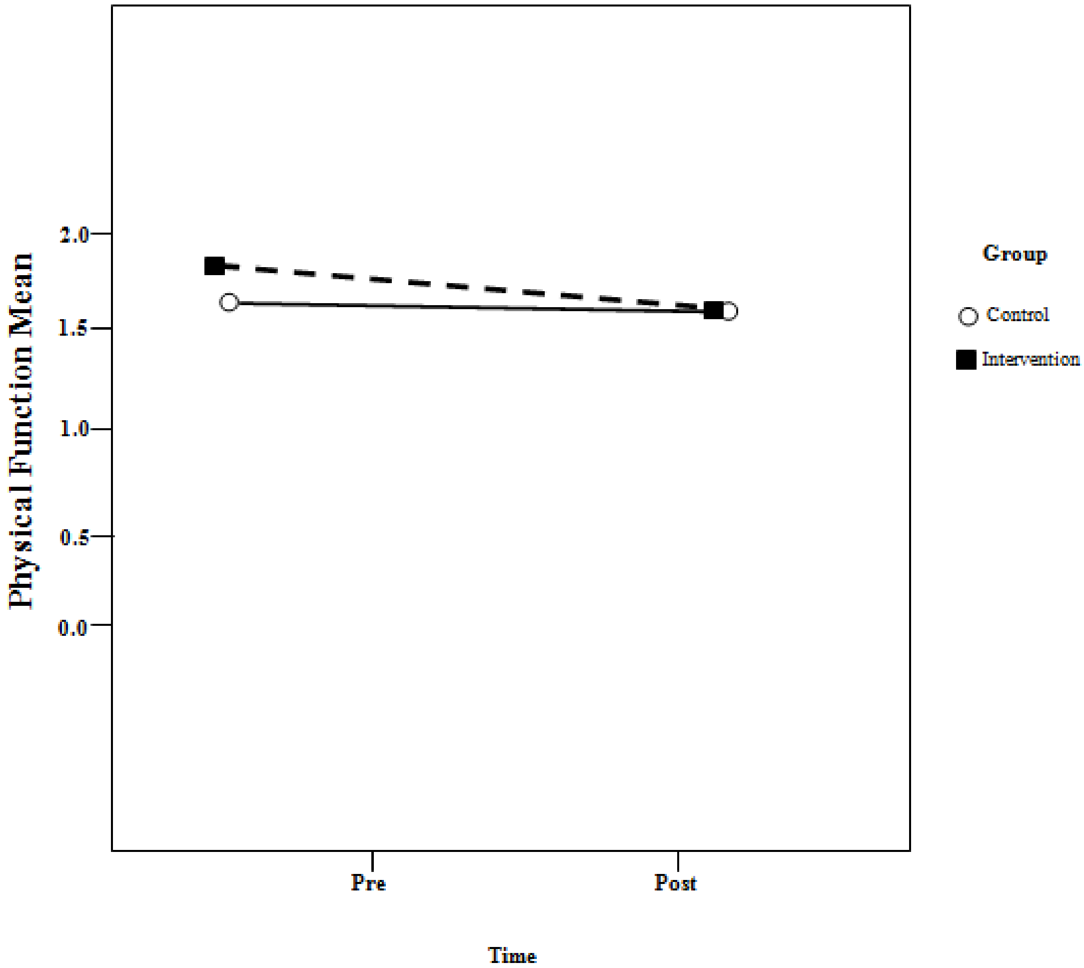
The patient perform knee mobilization and hot pack independently. The study shows 2.0 → 1.3 in post period that there is markedly reduce pain because the score is lower. (Figure 4.16)

Figure 4.17: Knee stiffness mean pre- and post-scores for knee mobilization exercise and hot pack



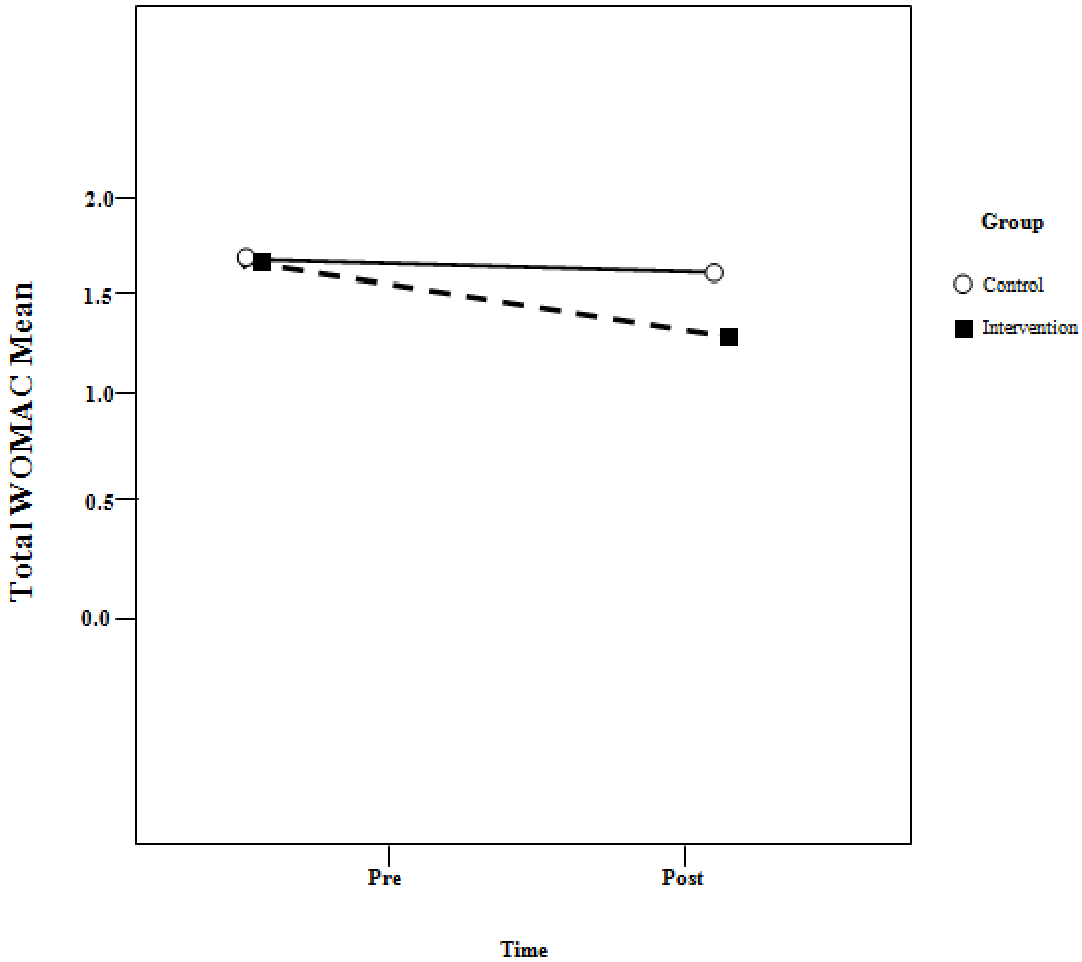
The patient perform knee mobilization and hot pack independently. The study shows 1.7 → 1.4 in post period that there is markedly reduce stiffness because the score is lower. (Figure 4.17)

Figure 4.18: Physical function mean pre and post scores for knee mobilization exercise and hot pack



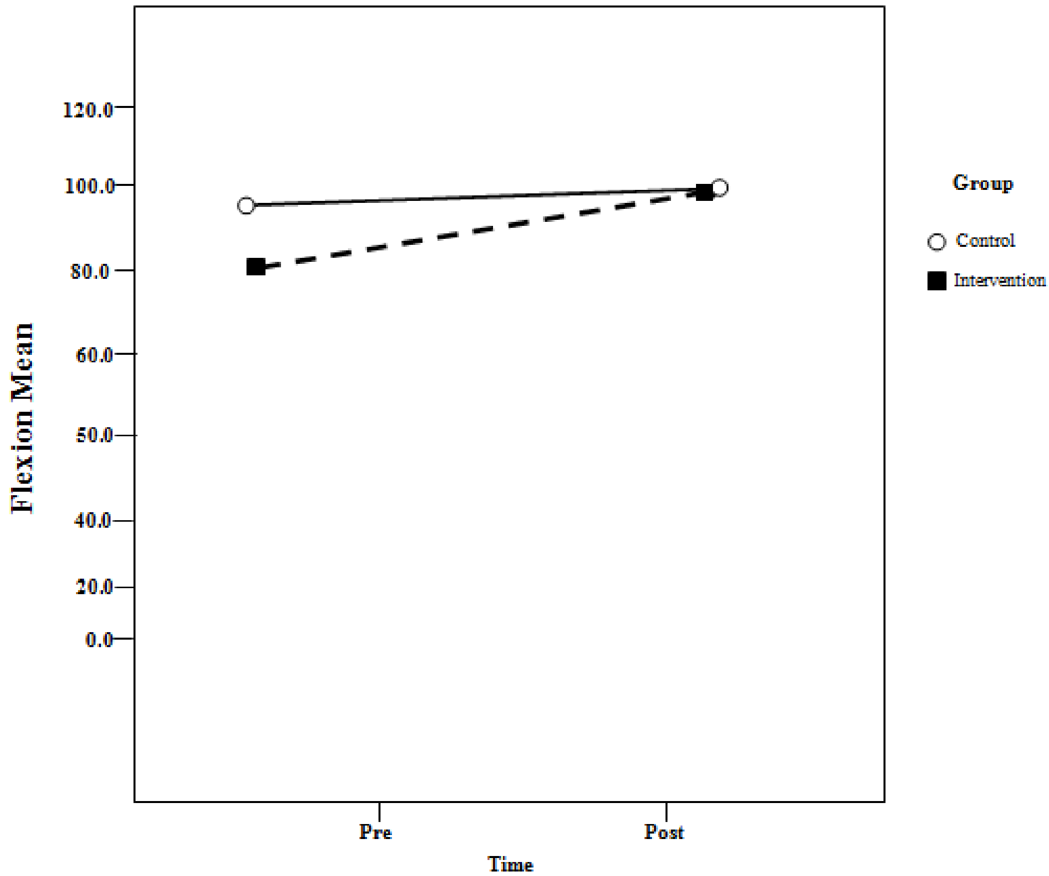
The patient performs knee mobilization and hot pack independently. The study shows 1.8 → 1.5 in post period that there is slightly increase physical function because the score is slightly high. (Figure 4.18)

Figure 4.19: Total mean WOMAC pre-and post-scores for knee mobilization exercise and hot pack



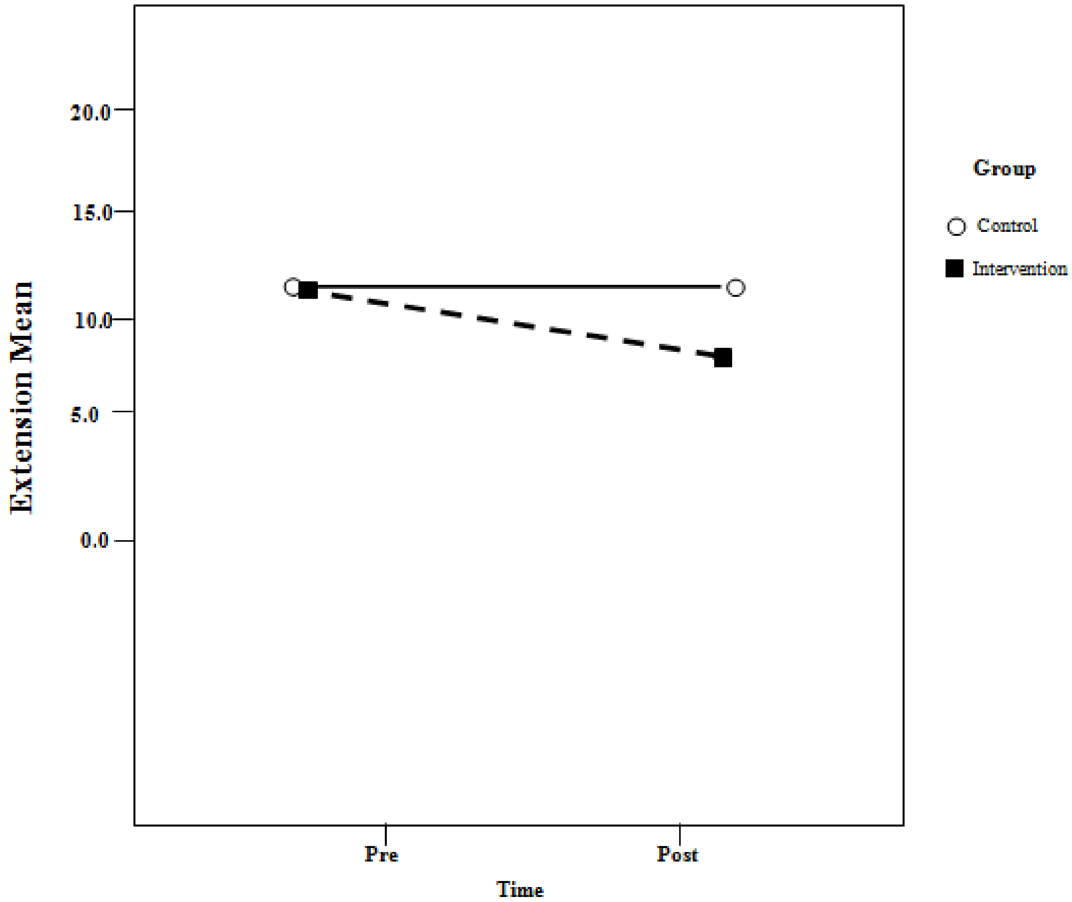
When the patient perform knee mobilization and hot pack independently for 12 week. The study shows 1.7→1.2 in post period, there is markedly reduce the symptom because the score is lower. (Figure 4.19)

Figure 4.20: Mean knee ROM flexion scores for knee mobilization exercise and hot pack



The patient performs knee mobilization and hot pack independently. The study shows 80°→100° in post period that there is markedly increase flexion degree in post period because the score is low. (Figure 4.20)

Figure 4.21: Mean knee ROM extension scores for knee mobilization exercise and hot pack



The patient performs knee mobilization and hot pack independently for 12 week. The study shows that there is slightly increase extension degree in post period (12° → 6°) because the post score is low. (Figure 4.21)

Hot pack – Result same as previous results

4.5 Sustainable Management of Osteoarthritis by using Deep Transverse Friction Massage and Hot Pack

(Detailed data in Appendix 9)

(Appendix 10: Diagnostic Reports (X-Ray) on Knee OA Patients)

The 299 patients ranged from 40 to 77 years old (mean age 65.0 ± 6.4), with a female: male ratio of 113: 27. The duration of knee pain ranged from 5 months to 12 years.

4.5.1 Deep Transverse Friction Massage

Baseline demographics along with WOMAC and ROM data comparing the intervention group to the control group are presented in Table 4.20. The Wilcox on rank-sum test was used to compare continuous and ordinal variables, and Fisher's exact test was used to compare discrete variables. There is an insignificant p-value for all variables at the 5% significance level, which means that the intervention and control groups came from the same population and were appropriate for the comparison of results of the participants in the two arms of this study. This determines whether participants in the self-massage intervention therapy arm had improved pain level, diminution of joint stiffness, improved physical functioning, and improved ROM at the conclusion of the study period.

Table 4.18: Self-Massage Therapy Study Baseline Demographics of Invaluable Participants in the Intervention Group Compared to the Control Group

Intake Questions	Statistics	Intervention (N = 100)	Control (N = 199)	Total (N = 299)	p-value
Age	Mean (Std)	65.8 (9.36)	65.6 (8.33)	65.7 (8.73)	0.91
Pain	Median (IntQ)	2 (1.00)	2 (1.00)	2 (1.00)	0.66
Joint Stiffness	Median (IntQ)	2 (0.00)	2 (1.00)	2 (1.00)	0.53
Physical Function	Median (IntQ)	2 (1.00)	1 (1.00)	2 (1.00)	0.25
Global WOMAC	Median (IntQ)	2 (1.00)	2 (1.00)	2 (1.00)	0.84
Right Flexion	Mean (Std)	108 (13.6)	113 (13.0)	110 (13.4)	0.20
Left Flexion	Mean (Std)	108 (16.2)	114 (11.5)	111 (14.2)	0.27
Both Flexion	Mean (Std)	108 (13.8)	114 (10.2)	111 (12.3)	0.24
Right Extension	Mean (Std)	6.7 (4.54)	9.4 (3.79)	8.1 (4.36)	0.07
Left Extension	Mean (Std)	7.1 (3.46)	10.3 (5.81)	8.7 (4.98)	0.09
Both Extension	Mean (Std)	6.9 (3.75)	9.9 (3.88)	8.4 (4.05)	0.02
Gender	Female	80 (77%)	120 (94%)	200 (86%)	0.33
	Male	40(22%)	59(5 %)	99 (13%)	
Marital Status	Divorced	3 (16%)	5 (27%)	8 (22%)	0.61
	Married	10 (55%)	10 (55%)	20 (55%)	
	Single	2 (11%)	0 (0.00 %)	2 (5 %)	
	Widowed	3 (16%)	3 (16%)	6 (16%)	

* ap-value based on Wilcoxon rank-sum for ordinal and continuous and Fisher's exact test for discrete data.

The average age of the participants was 66. Participants resided in the South Jersey area within a 20-mile radius of Collingswood, NJ. The majority of these participants were female (86%) and Caucasian (89%). The scores for pain level, joint stiffness, and physical functioning of the knees at baseline were moderate. The average range of motion at baseline for right flexion and left flexion was 108°. The average ROM at baseline for right extension was 6.7° and left extension was 7.1°.

4.5.2 Summary of Findings

The post-treatment outcome measures of the differences between control and intervention groups in the data from the self-reported measures of pain, stiffness, function, and total mean of WOMAC scores were statistically significant; the lower scores in the figures indicate improvement of symptoms. There was no difference between the groups in knee ROM. Specifically, the significant differences between control and experimental groups on pain, stiffness, physical function, and total mean WOMAC mean scores are outlined in the following paragraphs.

The measures of pain showed significant differences between control and intervention groups in posts core walking on flat surface, posts core ascending or descending stairs, posts core at night while in bed, posts core sitting or lying, and posts core standing up (Table 4.21). For stiffness, significant differences between groups were observed for posts core first waking in the morning and posts core lying, sitting, or resting later in the day (Table 4.21). The results showed significant differences in physical function, including highly significant results for posts core descending stairs, ascending stairs, rising from sitting, getting in and out of bed, going shopping, putting on socks, rising from bed, lying in bed, getting on and off toilet, and light domestic duties (Table 4.21). WOMAC total mean score improved significantly in post-treatment compared to control (Table 4.21).

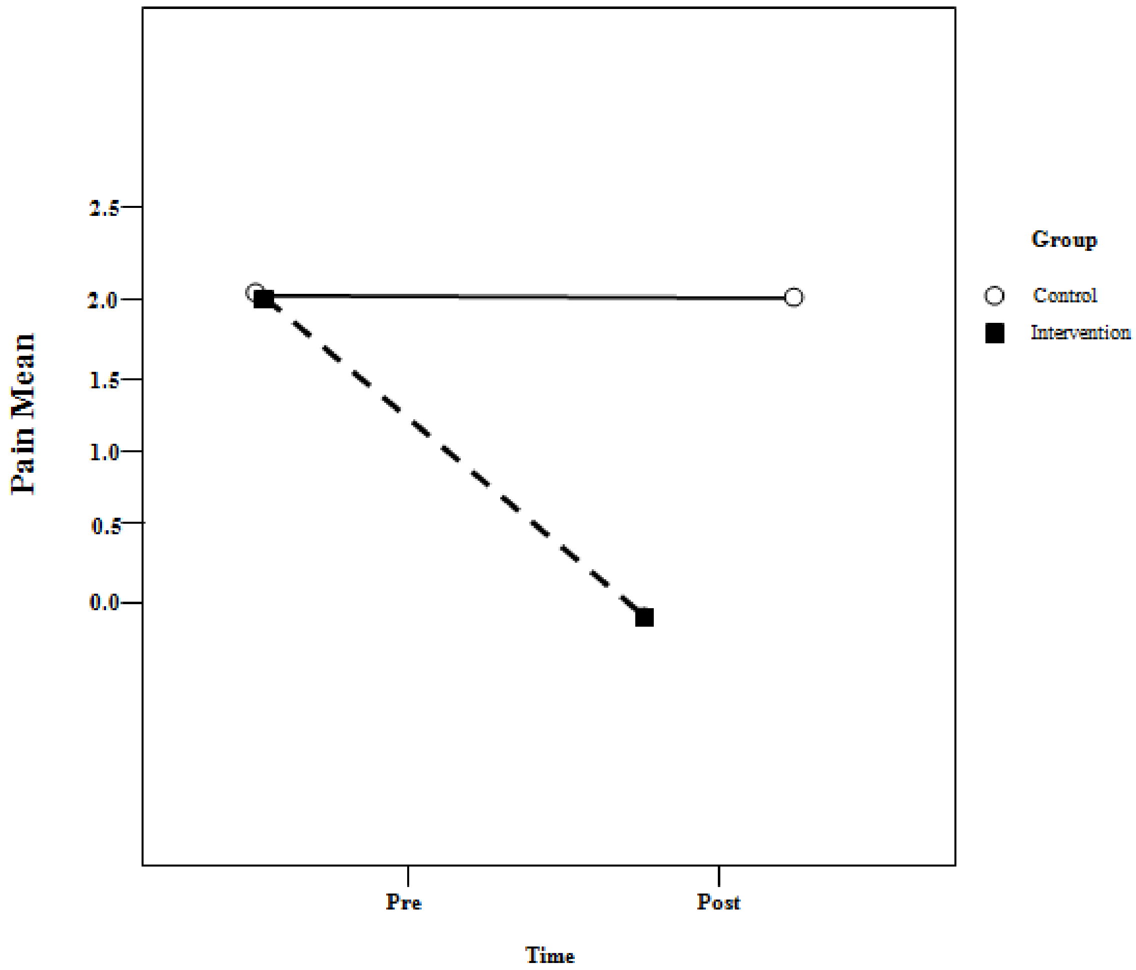
Table 4.19: Summary of Pre-Post–WOMAC ANCOVA Analyses Comparing Intervention and Control Groups

WOMAC Scale Item	Variable	Group	Pre-Score Mean	Post-Score Mean	p
1	walking on flat surface	Control	1.389	1.278	.048a
	WFS	Intervention	1.556	0.842	
2	going up or down stairs	Control	2.222	2.111	.007a
	UDS	Intervention	2.222	1.278	
3	night while in bed	Control	1.167	1.278	.001a
	NnB	Intervention	1.111	0.444	
4	sitting or lying	Control	1.222	1.222	.024a
	SiLy	Intervention	1.278	0.611	
5	standing up	Control	1.556	1.444	.017a
	StUp	Intervention	1.556	0.833	
6	Stiff waking in the mrng	Control	2.056	2.056	< .001a
	WMng	Intervention	2.111	1.111	
7	stiff lyng, sit or rstng later	Control	2.111	1.833	.119
	LSRnD	Intervention	1.833	1.278	
8	descending stairs	Control	2.000	2.167	.001a
	DS	Intervention	2.056	1.333	
9	ascending stairs	Control	2.222	2.167	.003a
	AS	Intervention	2.278	1.389	
10	rising from sitting	Control	2.111	2.111	.006a
	RfS	Intervention	1.944	1.278	
11	standing	Control	1.500	1.500	.018a
	St	Intervention	1.722	0.889	
12	bending to the floor	Control	2.560	1.611	.011a
	BFI	Intervention	2.000	0.778	
13	diff. walkg on flat surface	Control	1.444	1.389	.023a
	DWFS	Intervention	1.389	0.778	
14	in and out of bed	Control	1.500	1.667	.002a
	InOB	Intervention	1.722	1.000	
15	shopping	Control	1.722	1.611	.003a
	Shp	Intervention	1.722	1.000	
16	Putting on socks	Control	1.333	1.500	< .001a
	Sck	Intervention	1.389	0.611	

WOMAC Scale Item	Variable	Group	Pre-Score Mean	Post-Score Mean	p
17	rising from bed	Control	1.333	1.556	< .001a
	RsB	Intervention	1.222	0.765	
18	taking off socks	Control	1.278	1.444	.027a
	TOSg	Intervention	1.278	0.643	
19	lying in bed	Control	0.944	1.278	< .001a
	Lybd	Intervention	1.000	0.444	
20	In and out of bath	Control	1.813	1.824	.330
	InObth	Intervention	1.000	0.941	
21	sitting	Control	1.167	1.167	.065
	Stg	Intervention	1.000	0.611	
22	on and off toilet	Control	1.556	1.833	.002a
	OnOf	Intervention	1.556	1.000	
23	heavy duties	Control	2.056	2.167	.011a
	HD	Intervention	2.333	1.611	
24	light duties	Control	1.333	1.444	.007a
	Ltd	Intervention	1.500	0.889	

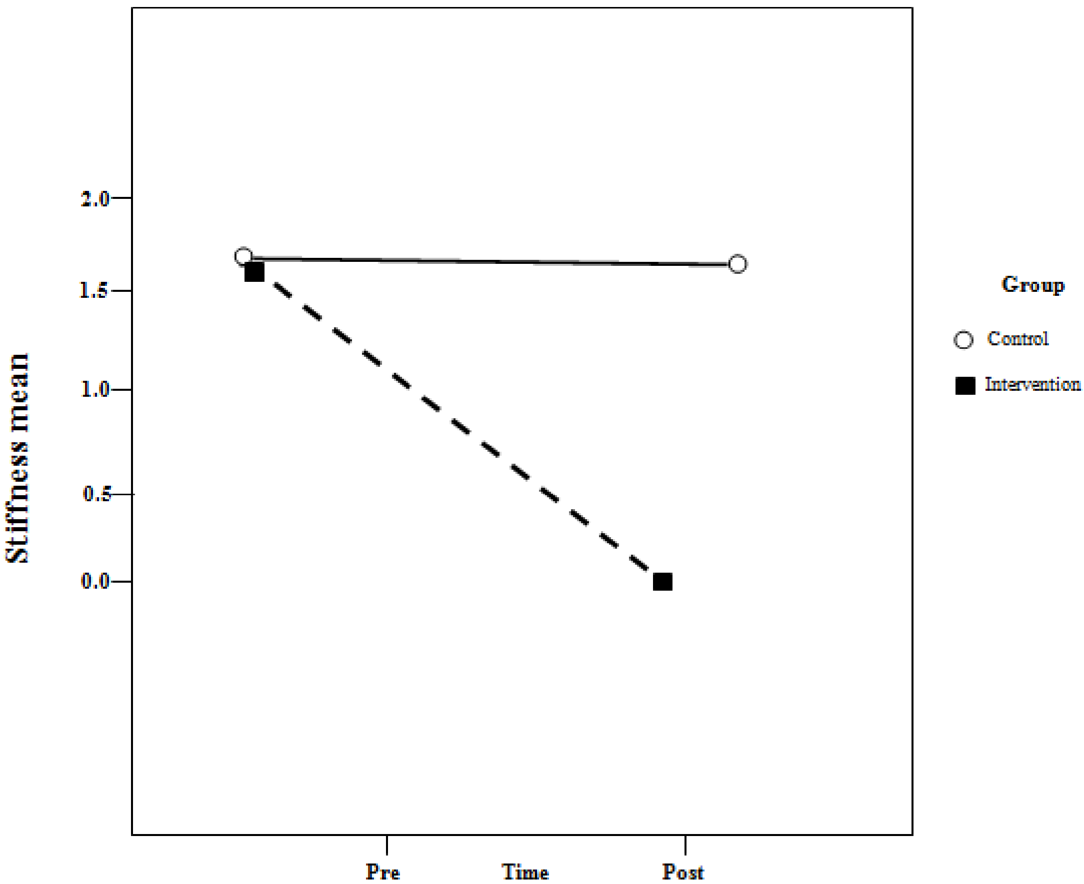
a Indicates significant result at $p < .05$, $n = 36$.

Figure 4.22: Knee pain mean pre- and post-scores for deep transverse friction massage and hot pack



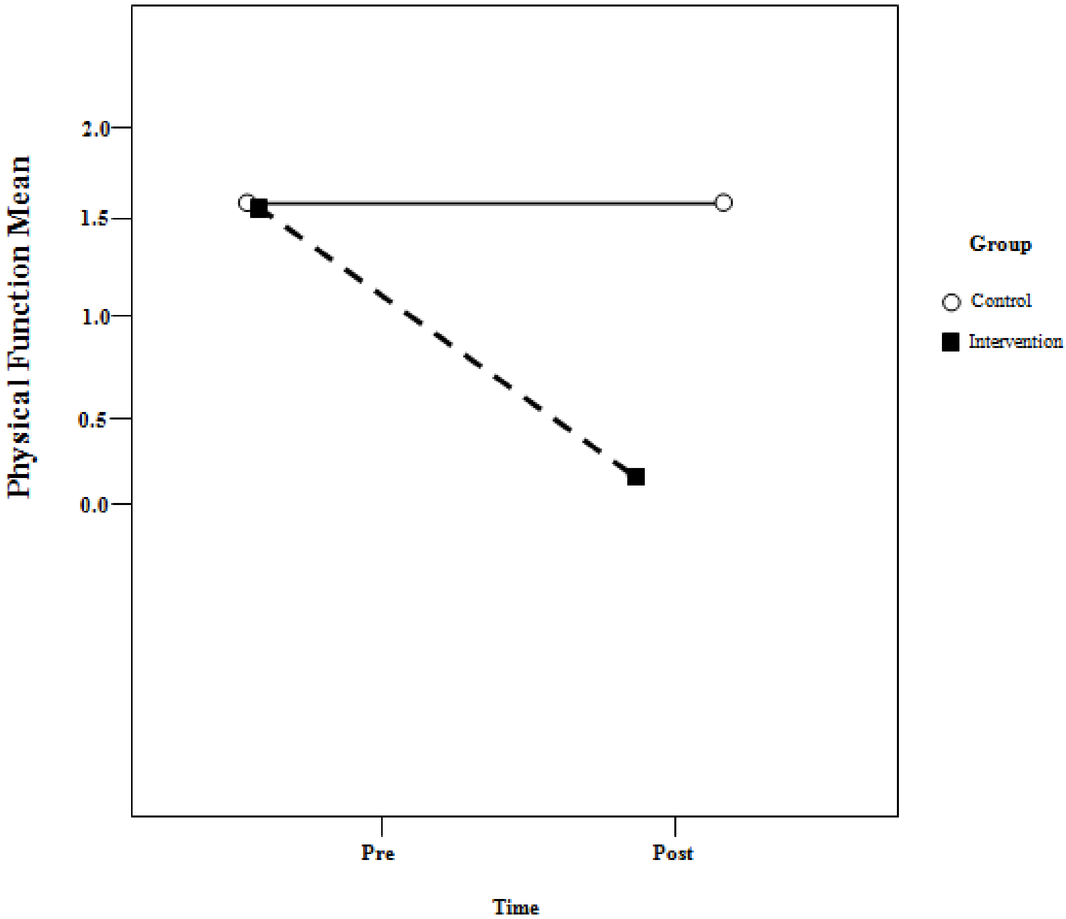
When the patient perform deep transverse friction massage and hot pack independently for 12 week. The study shows that there is reduce pain because the score is 2.0 → 0.0 of post period that's mean minimize pain. (Figure 4.22)

Figure 4.23: Knee stiffness mean pre- and post-scores for deep transverse friction massage and hot pack



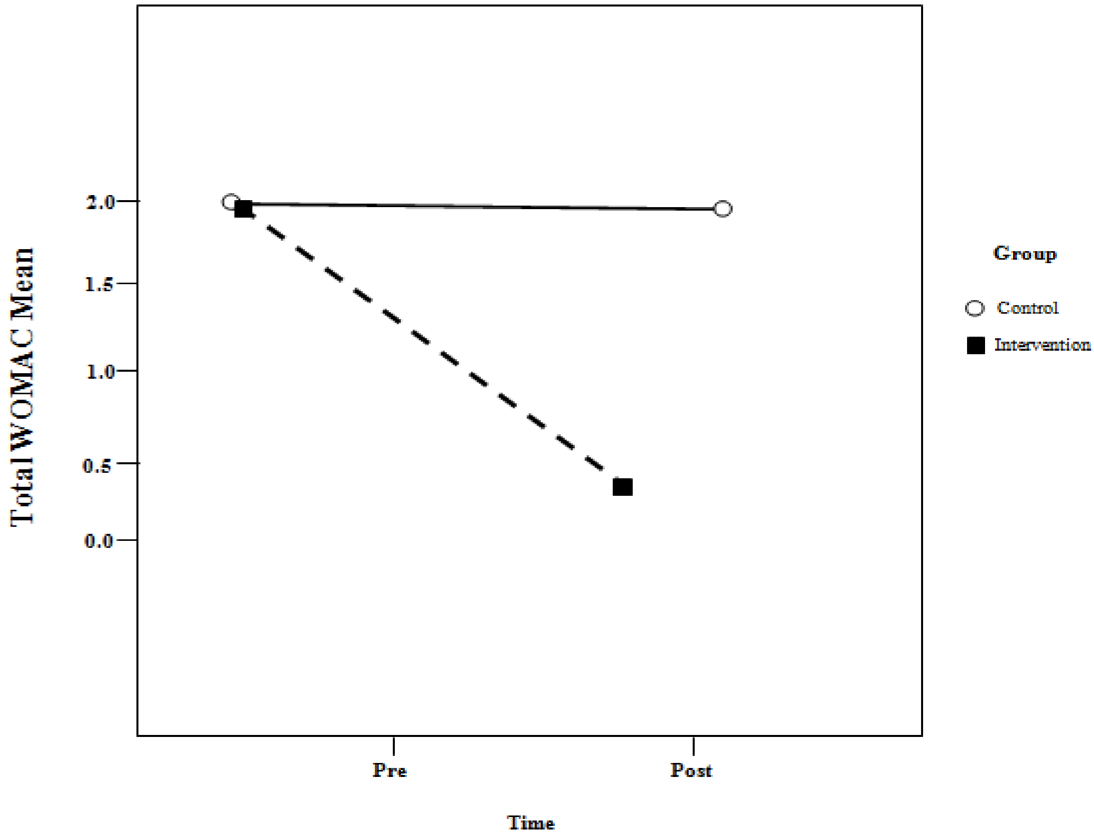
When the patient perform deep transverse friction massage and hot pack independently for 12 week. The study shows that there is rapidly reduce stiffness because the score is 1.8 → 0.0 of post period that's mean minimize and control stiffness. (Figure 4.23)

Figure 4.24: Physical function mean pre- and post-scores for deep transverse friction massage and hot pack



When the patient perform deep transverse friction massage and hot pack independently for 12 week. The study shows that there is reduce physical function rapidly and the score is 1.5 → 0.0 of post period that's mean control physical function. (Figure 4.24)

Figure 4.25: Total means WOMAC pre- and post-scores for deep transverse friction massage and hot pack

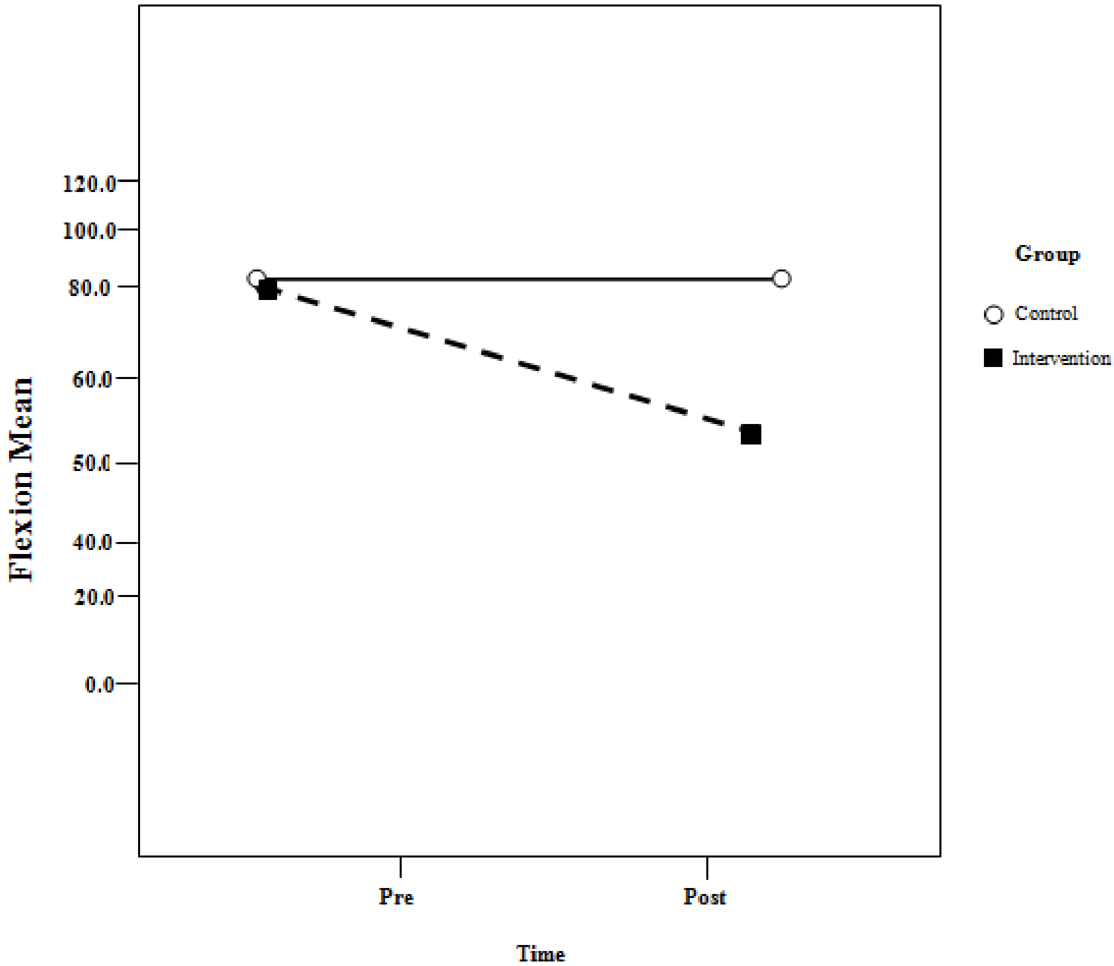


When the patient perform deep transverse friction massage and hot pack independently for 12 week. The study shows that there is rapidly reduce the symptoms because the score is 2.0 → 0.5 of post period that's mean minimize the symptoms. (Figure 4.25)

Table 4.20: Summary of Pre-Post–ROM ANCOVA Analyses Comparing Intervention and Control Groups

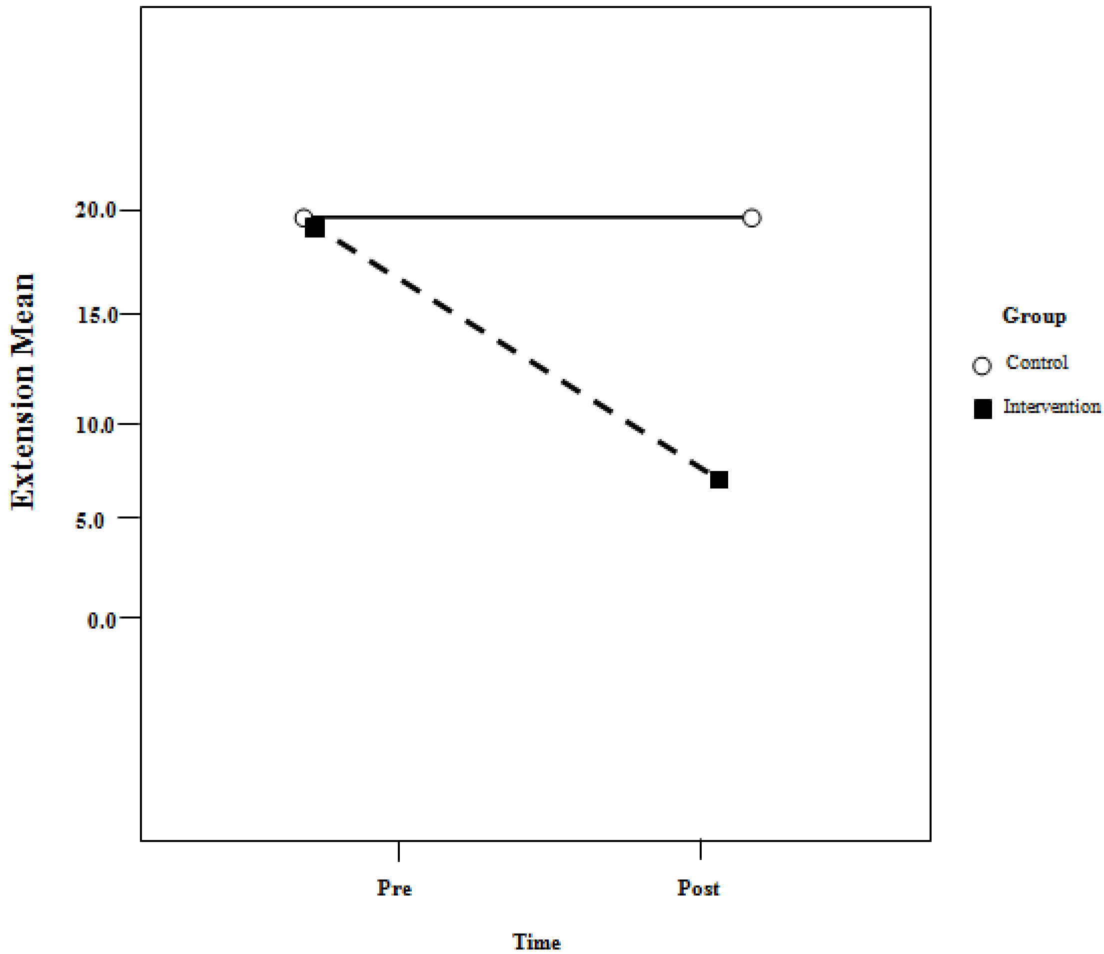
ROM Measurement	Variable	Group	Pre Score Mean	Post Score Mean	p
1	Knee Rt. flexion	Control	113.056	115.278	.715
	KBRF ROM	Intervention	116.944	116.944	
2	Knee Lt. flexion	Control	113.333	116.111	.120
	KBLF ROM	Intervention	118.611	113.611	
3	KneeExtRt.ext.	Control	9.444	8.333	.889
	KSRE ROM	Intervention	15.278	10.556	
4	KneeExtLtext.	Control	10.556	10.278	.592
	KSLE ROM	Intervention	15.278	11.389	

Figure 4.26: Mean knee ROM flexion scores for deep transverse friction massage and hot pack



When the patient perform deep transverse friction massage and hot pack independently for 12 week. The study shows that there is increase of flexion because the score is 80.0 → 52.0 of post period that's mean normal flexion movement. (Figure 4.26)

Figure 4.27: Mean knee ROM extension scores for deep transverse friction massage and hot pack



When the patient perform deep transverse friction massage and hot pack independently for 12 week. The study shows that there is increase of extension movement because the score is 20.0 → 5.0 of post period that's mean normal extension movement. (Figure 4.27)

Hot pack – Result same as previous results

4.6 A case study of female knee OA patient

Osteoarthritis is a leading cause of disability in older adults in Bangladesh. Approximately 33% of Bangladeshi adults report some kind of arthritis or chronic joint symptoms. The incidence increases with age and is higher in women than in men. More than 5 million adults report having osteoarthritis in a knee joint, with pain, swelling, and stiffness, and >75% of these people are women (WHO Representative).

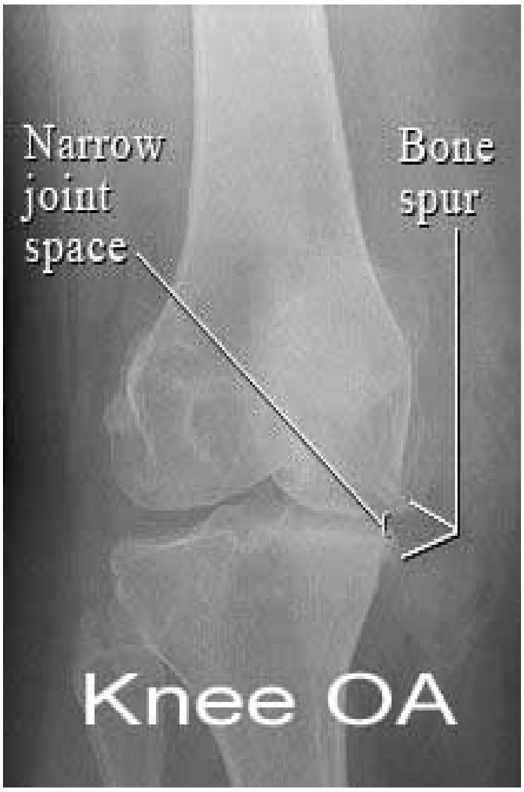
Osteoarthritis of the knee has a tremendous impact on a person's ability to function and to perform everyday activities. Between 25% and 50% of people with osteoarthritis of the knee experience at best significant difficulty with walking, carrying items, or stooping, while 20% either cannot perform or have difficulty performing chores around the house. This disease takes a severe emotional toll on its victims, as well. People with osteoarthritis of the knee report higher degrees of emotional distress than those without it, and many consider themselves as having poor or fair health. Patients with osteoarthritis lose more work than their healthy colleagues and spend more time confined to bed.

Case Presentation of a female patient

The clinical history in a patient with arthritis of the knee is dominated by pain. This predominantly occurs in weight-bearing, but in the end stages may be constant and unrelieved by rest. Night pain is a particularly disabling symptom that demands urgent attention. The pain may be localized to one compartment or may be diffuse. Other symptoms include stiffness, swelling, locking and giving way. It is useful to try and quantify the level of pain on a simple scale and to assess how the patient's activities of ADL is affected. The patient should be asked questions on maximum walking distance, recreational sporting ability and aspirations, stair climbing the need for walking aids, the ability to dress and perform self-care, and the ability to perform activities that require knee flexion. Some patients may have considerable interference with social interaction, sexual function and sleep deprivation and may experience exhaustion and even depression from their disease.

Plate 1: **Plate of** Mrs. Morium Bibi, **Address–** Moupara, Mohonpur, Rajshahi, **Mobile No-** 01913345743, **Reg. No-** 0108, **Age–** 60 years, **Sex–** Female, **Weight–** 36kg, **Height–** 4’00”.

Chief Complaints	:	Pain and stiffness on right knee.
Family History	:	Mother had no any disease and died 86 years old. Father died 55 years old of a road traffic accident.
Siblings	:	3 sister which is under weight.
Social history	:	Widow since 2010.
Occupation	:	Maid servant and used to sit 15-16 hours per day. Currently she works 4 house at a time.
Hobbies	:	Watching TV and listening song.
Living condition	:	Patient lives in a hut with her family member of 9 person. The house has 1 floor with 7 steps.
Abuses	:	N/A.
Diagnosis	:	Osteoarthritis of right knee.



Radiograph of the knee demonstrating features in osteoarthritis of Morium Bibi

Present Condition

Mrs. Morium Bibi is a married female person came to me for a 10-years history of progressively worsening pain in right knees joints. Professionally she was a maid servant. She claim that she feel pain at her right knee joint with swelling and Crepitus movement. Pain worse when she working, walk or stair up or down. Marked pain at resting period. When she lift a heavy object than she feel severe pain. Her physical condition is not so good because lack of proper nutrition. That's why there was marked osteoporotic change occurs. Her dietary chart is very poor. Most of the day she did not eat any food at night. Her knee was stiff for about 25-30 minutes when she arose in the morning and for a few minutes after getting up from a chair during the day. She had difficulty walking > 200 minutes because of pain, and her symptoms were exacerbated by kneeling, squatting, or descending stairs. Although sitting, resting, and reclining relieved her pain, he became stiff if she stayed in one position for too long. Her symptoms were worse on humid or cold days, and she occasionally felt as if one of her knee would "give out."

Past Medical Condition

The patient's past medical history was a severe road traffic accident, Two time typhoid, Jaundice, Gall bladder operation. Now she is presently suffering from HTN and DM, the most recent having been 2 years earlier. She was told to take Dexamethasone two time daily to relieve his current pain. she denied any history of peptic ulcer disease, upper GI bleeding or other bleeding disorders, liver or kidney disease, chronic steroid use.

Drug History

Tab. Salazine 500 mg 2 x morning/2 x evening

Tab. Beklo 10mg 1 x morning/1 x evening

Tab. Flexi 100mg 1 x morning/1 x evening

Tab. Filwel silver 0 x morning/1 x evening

Cap. PPI 20mg 1 x morning/1 x evening

Tab. Comet 500 mg 1 x morning/1 x evening

Tab. Osartil 50 mg 0 x morning/1 x evening

Tab. Leptic .5 mg 0 x morning/1 x evening

Mrs. Morium Bibi was moderately underweight, and physical examination of the lower extremities revealed mild genu varum, which suggested medial compartment involvement. Her gait pattern was mildly antalgic, and passive range of motion of right knee indicated palpable Crepitus. She was unable to flex or extend her knee completely. On physical examination, the patient was unable to walk without an assistive device but demonstrated a slightly antalgic gait. Hip internal rotation was painful and limited to 15° bilaterally. External rotation was 50° on the right side and 40° on the left side. Hip flexion and extension were within normal limits. Flexion-abduction-external rotation (FABER) provocative testing produced hip pain bilaterally. Results of a lower-extremity strength examination are indicated in Table. Sensation was intact to light touch. Examination of the patient's knees demonstrated mild Crepitus bilaterally, and results of a lumbar spinal examination were unremarkable.

Lower-Extremity Strength:

	Hip Flex	Hip Ext	Hip Abduct	Hip Adduct	Knee Ext	Knee Flex	Ankle Dorsi flex	Ankle Plantar flex
R	5/5	5/5	4/5	4+/5	4/5	3/5	4/5	4/5
L	5/5	5/5	4+/5	4+/5	5/5	5/5	5/5	5/5

Flex – Flexion, Ext – Extension, Abduct – Abduction, Adduct – Adduction

** Graded on a scale of 0 to 5, where 1 represents minimal strength and 5 represents maximal strength.*

Patellar facet tenderness was determined by palpation. There was tenderness over the joint line and patello femoral Crepitus, which is common in patients with osteoarthritis of the knee. There was moderate warmth and soft-tissue swelling. Patellar tilt was determined clinically and, with the knee in full extension, patellar glide was measured by assessing how far the patella translated medially and laterally. Mrs. Morium Bibi exhibited moderately to severe decreased patellar glide both medially and laterally.

Knee stability was determined in the coronal (varus/valgus) and saggital (antero posterior) planes. Patients with medial inflammation and a valgus deformity commonly have medial pseudo laxity, which is a sensation of valgus laxity as the varus deformity is manually corrected with the patient supine and the leg extended. As expected, Mrs. Morium Bibi presented with medial pseudo laxity with mild instability. In addition, patients may have increased tibial translation on both Lachman's testing and anterior drawer testing, and a positive pivot shift maneuver, indicating a chronic anterior cruciate ligament insufficiency, which can lead to osteoarthritis. However, the examination indicated that this patient had none of these findings.

Because of the prevalence of atherosclerosis in the older population, a thorough neurovascular examination was performed on this patient. Her distal pulses were intact, as was sensation, and there was no evidence of cyanosis or clubbing. The examination showed no signs of neurovascular compromise. Had any of these findings been evident, a complete vascular workup would have been obtained, including blood work, to look for indications of a hyper coaguable state. If either neurovascular compromise or evidence of coronary artery disease had been found, then the risk-benefit ratio of prescribing a cyclo oxygenase (COX)-2 inhibitor would have been weighed.

Mrs. Morium Bibi's hip and back were examined thoroughly, as well, to rule out any contribution to the knee symptoms. She had full range of motion (ROM) of the lumbo sacral, and all motions were pain free. Her hip examination showed decreased internal ROM, but motions were pain free and symmetric. These findings indicate that neither hips nor back was contributing to this patient's symptoms. However, she had a leg length discrepancy, with her right leg being 0.5 cm shorter than her left. Leg length discrepancy can contribute to a patient's symptoms and affect the treatment plan.

Posture Examination

The posture examination in standing position indicate that patient is strongly influenced by an analgetic posture, supporting himself quite a lot on the crutches with indicate that she wants to decrease the pain in her lower extremity and this is non physiological and can cause secondary changes of the musculoskeletal system over time. This faulty alignment results in excessive stress on bones, joints, ligaments and muscles. Her marked velocity in knees indicate short/taut adductor muscles of thigh and elongated/weak antagonists. Her posture is kyphotic/lordotic witch can indicate anteriorly tilted pelvis, elongated neck flexors, upper back erector spine, external oblique and hamstrings, and the neck extensors and hip flexors shortened.

Pelvis Examination

The pelvic examination shows that the right PSIS, ASIS and crista is higher than on the left side, this indicate pelvic obliquity. Measurement of leg length is more difficult than might be thought, because the head and neck of the femur are not externally evident. Pelvic obliquity is therefore the most reliable clinical sign of difference in leg length, unless there is a measurable difference in the leg of the lower extremity. Typically for this pelvic obliquity is that the shoulder is seen to be lower on the side where the pelvic is higher, but in this case the shoulder is actually higher. The most likely cause to this findings is that the patient has a analgetic posture and the right side of pelvis could be elevated due to the pain in right knee. The elevated shoulder could also be caused by the analgetic posture and crutches.

Gait Examination

The gait shows eversion of plantar during steps, similar to the standing posture examination. Circumduction of right foot with slight external rotation, mostly due to painful knee and problems with flexion in knee and dorsiflexion of ankle joint. Also the step length for right foot is short with limited time spent in the stanice phase, which causes slight limping. The marked valgosity in knees is present and his limited extension in hip is quite big which secondary causes limited trunk movements.

Palpation Examination

Palpation of the soft tissue on right lower extremities indicates restrictions and dysfunction. In the skin it is present swelling, fewer, and bruising. Sub skin and fascia has restrictions in all directions and hyper toned muscles in calf and distal thigh. Making a fold along longitudinal axis is hard to perform, and not very pleasant for the patient. TrP are found in the piriformis, triceps, biceps femoris, iliopsoas and adductors of thigh. Clinical significance for TrP in biceps femoris muscle is painful periosteal pain point in head of fibula which is also present. In the left lower extremity TrP are present in adductors of thigh, piriformis and hamstrings.

Joint Play Examination

In right lower extremity pathological blockages is present in patella, the directions with restrictions is both caudocranial and latero medial. And the same is present in the left lower extremity with the 1st. PIP joint blocked in ventral direction and the patellae is blocked in cranio caudal direction. Both stress and the neuromuscular system plays a role here. One pathogenic factor is overload, another, more frequent cause is a disturbed movement pattern (motor stereotype) on the part of the patient, consisting of an imbalance of muscle function which impaired the joints.

Anthropometric Measurements Examination

The measurements show us the difference between left and right lower extremities in both circumference and length. The measurements indicate that the right knee is quite swollen. Difference from left knee is a bigger circumference up to 8 cm on the right knee. But another significant finding is that the circumference of melleolus on right leg is actually 2 cm smaller, this is probably a result caused by the osteo synthesis of left melleolus. The hematoma should be followed up, due to the big difference in anthropometric measurements in case of internal hemorrhage.

Muscle Strength Examination

Test for the upper extremity compared with the lower extremity indicates slight weakness in lower extremities and limited activity in his ADL. The muscle strength is performed in sitting position due to the patients problems with lying position. The tests for knee flexors and hip extensors is excluded due to the scar and pain for patient in prone position. The hip flexors and dorsi flexor of ankle left side is graded 4 in anti-gravity sitting position, which is against moderate pressure. Right knee extensors and dorsi flexor of ankle is graded 3, which is also anti-gravity tested in sitting position. Grade 3 shows that the patient is able to hold the position, with no pressure added. The weakness present in hip flexors can result in marked disability to climb stairs and also difficult in walking, because the leg must be brought forward by pelvic motion which is produced by anterior or lateral abdominal muscle action rather then by hip flexion. The quadriceps femoris weakness also influence on the ability to climb stairs and getting up and down from sitting position. The weakness might also cause hyperextension of knee joint due to required locking of the joint when the quadriceps is weak. Tibialis anterior weakness decreases the ability to dorsiflexion the ankle, and allows a tendency that we have already noticed during postural examination and gait examination, the eversion of the foot.

Range of Motion Examination

Range of motion examination excludes the range of motion in extension of hip joint due to patient pain in prone position and the active range of motion in knee extension due to pain and fear shown by the patient. The examination results for right lower extremity indicate decreased range of motion compared to left side. In patients left ankle joint, the decreased range of motion is most lightly caused by his osteo synthesis of melleolus. On the right side we can see that the patient has decreased motion in every joints. The reason for the limited active range of motion is of course pain, but also influenced by weakness. While the passive range of motion is affected by the change in joint space and joint structure. Her flexion of left knee could probably increase if she was able to be in prone position, but this was tested in sitting position, where the treatment table had influence on the measurement result.

Treatment Plan

Treatment plan will focus on the active range of motion and the improvement. The active range of motion in extension and flexion should reach 0-110 degrees within a few weeks (3-12 weeks). Patient can return to appropriate recreational sports and activities, enhance strength, endurance and proprioception as needed for ADL. The therapeutic exercises will continue with the previous exercises with progression of resistance and repetitions and also the duration of endurance activities. Endurance exercises and gait to increase the cardiovascular fitness, stability and balance, with the respect to her needs of crutches. Decrease inflammation, pain and swelling and improve ADL function.

Treatment Methods

1st Phase

Treatment duration – 12week
Date – 10.11.2012

Patients Status Before Therapy

Patient is underweight and pale. She seems weak and tired. She tell us that she slept bad due to the pain in the knee. Skin color and temperature in her dex. lower extremity is fine. My advisor in the clinic tell me that she is motivated for examination, exercises and therapy, but her body language seems like the opposite to me.

Goals of Therapy

- Increase ROM
- Decrease edema
- Joint play
- Increase exercise tolerance

Therapy Implementation

Swimming exercise for 20minute per day for 12 week. Patient can perform this exercise independently without help of others. If patient cannot swimming than she walk round the pond or swimming pool in man height water round the pool. It is a self-management procedure to reduce pain and increase joint mobility.

Result

After 12 week patient claims that she continue the treatment phase. She can not swim but she walk round the pond 20minute for 12 week. Patient claim that he feel better 15% during this treatment phase. The exercises produced some pain and stiffness in the beginning around the knee joint. After some repetitions it was better and easier to perform the different movements, but the pain in and around the knee joint maintained. She is comfortable with the given exercises and gait exercise in stairs. Patient finds virtualizations quite easy.

The patient had slightly increasing ROM in ankle joint after some repetitions of DVT prevention. She needs to practicing the correct performance of each exercise with guidance from therapist. She has slightly edema in sina slim his right foot. His gait was in the beginning with slightly external rotation in right hip, but after correction and telling his this, he was able to have a correct gait. His crutches was not symmetrical or corrected to her height in the beginning, so I corrected it immediately and this resulted in better gait and easier to perform gait in stairs. Her verticalization technique is perfect, so I will not focus on this.

2nd phase

Treatment duration – 12weeks.
Date – 10.02.2013.

Patients Status Before Therapy

The patient is pale, but she seems better than the day before. She is more awake and ready for exercises and therapy. Skin color and temperature in h dex. Lower extremity is fine. Patient feels comfortable with the exercise I gave him yesterday, so this maintain the same for now.

Goals of Todays Therapy

- Increase ROM
- Strengthening exercises
- Stretching and relaxation of thigh. Adductors and quadriceps muscle.
- Decrease edema
- Decrease restrictions in fascia, subs kin and skin
- Decrease pain

Therapy Implementation

Quadriceps stretching exercise can perform independently with the supervision of a physiotherapist. Patient can able to perform this exercise two time per day for 12 week period. Patient position is long sitting or supine lying position. Patient bend the knee with its maximum range of motion slowly and than straight and the heel must be touch on the floor. This procedure will be continue 20 -25 time in every session. After doing exercise patient must be apply hot pack for 20 minute. It is a combined treatment procedure.

Result

Patient take this treatment two time per day for 12week but she cannot feel much better. She said that only 35% improve his pain. Sometimes he feel severe pain. The patient does not appreciate the quadriceps stretching and hot water pack technique. She feels pain in thigh adductors and hip flexors. She liked the joint play examination and therapy.

The patient is not able to relax the adductors of thigh during applying this technique. She gets cramps in the calf every 60 seconds and its necessary for her to sit up for a minute or two. The muscles are very tense and taut. The cramps are also present during soft tissue technique with the softball strokes on the adductors. She is otherwise strong in the muscles and the strengthening exercises are successful. The blockages in joints was again present.

3rd phase:

Treatment duration – 12week
Date – 10.05.2013

Patients Status before Therapy

The patient has good skin color in his face and is walking quite fast in the stairs with good coordination and balance. He feels more secure. The patient can tell that he completed the self-therapy without any problems, but he feels some pain during night when he is performing a lot of strengthening exercises. The pain is located distal and medially to the patella. I can see that he is still swollen in his knee, and today he is quite warm lateral and medial to the scar on the knee.

Goals of Todays Therapy

- Increase ROM Strengthening exercises for leg.
- Stretching and relaxation of thigh. Adductors and quadriceps muscle.
- Decrease edema.
- Decrease restrictions in fascia and skin.
- Mobilization of restricted joints.

Therapy Implementation

Self knee mobilization exercise every day for two times per day which is done by patient. Patient position is high sitting position. Patient hold the knee by his hand, one hand place the lower end of femur and the another hand place the upper end of tibia. Upper end move slowly inside than the other end. This procedure will be continuing 20-25 repetition in a session. After doing knee mobilization exercise a hot pack was used for 20 minute.

Result

During the therapy Mrs. Morium Bibi claim that he feel 65% - 75% better and still has some problems with relaxing during the PIR. She feels a lot of tension in her adductors of the thigh. Strengthening exercises is without any problems for her, and she feels stronger than earlier.

Mrs. Morium Bibi is persistent today and in good shape. During the gait exercises in the stairs he needed to be reminded about the correct step-pattern with crutches in the stairs, but after it was correct he is able to do the exercises without any pain, and she feels slight fatigue after exercising.

4th phase

Treatment duration – 12week
Date – 10.08.2013

Patients Status before Therapy

He forgot his appointment at 11:00 AM today, so we moved the time to 13:00 PM. Mr. Mokbul Hossain seems happy and I find his sitting with some friends laughing around the table. He is without any pain today and is motivated and ready for therapy and exercise.

Goals of Today's Therapy

- Increase ROM
- Strengthening exercises
- Decrease edema
- Decrease restrictions in fascia and skin
- Joint play

Therapy Implementation

Deep Transverse Friction Message (DTFM) can be provide independently everyday for two time in a day. Patient position is sitting position in a chair or stool. One hand placed on the lateral side of the knee and the another hand is placed the medial side of the knee. Olive oil or vaseline can be needed to perform this exercise. A moderate pressure can be apply by thumb and index finger in a circular motion around the knee joint. After complete this exercise than apply hot water pack for 15 min for two time per day. Patient easily doing this exercises and perform better than before.

Result

Patient doing this exercise and applying hot pack for 10 minute per day two times for 12 week. After 12 week patient said that she feels 95% better than other treatment phase. She find it is hard to perform the straight leg raise due to weakness, but would like to continue to perform it during the therapy the next days.

Mrs. Morium Bibi don't have any blocking in his joints today, and during the exercises he appears stronger. Her motivation is higher than last week, and I suppose that it has to do with well-being and a sense of mastering the exercises better each day we are together. Her bruising on the medial thigh is significantly decreased at this time. When I touch her medially dx. thigh, she still gets cramps and has to sit up for a minute, so the thera-band exercise should be good for elongation and inhibition of the adductors so that relaxation could be possible.

Conclusion of a case study of female knee OA

When I came to Moupara at Mohonpur, Rajshahi for my practice, I had the possibility to choose between some patients. The reason for choosing Mrs. Morium Bibi as my patient was that I could meet her the first day she was registered to my chamber, and nevertheless follow him rehabilitation. In this way it may be easier for us to build up mutual trust and respect, and we both have to work after each other's expectations. By choosing a patient from first day in the self-chamber also gave me the perfect opportunity to see improvements and progression from the beginning. Totally we had 48 week sessions together during my practice, and despite some communication problems, we were able to work good along. I was able to use examinations and therapy techniques that I learned in school, in addition to some new techniques my supervisor introduced me to.

The therapy we choose for the patient was successful in the sense of patients cooperativeness and motivation. Some of the performed therapies was hard for the patient to carry out, and some he experienced as pleasant. The PIR was beneficial for the patient in the sense of ability to relax the muscles, but the progression was slow. Strength exercises has been as a benefit through the ability to climb stairs, corrected alignment of locomotor system especially in standing position, coordination, motor skills and overall function for a improved ADL. However, I have learned a lot about examination and therapies regarding the rehabilitation phase. During my work, I have collected relevant theory about osteoarthritis of knee and the disadvantages and advantages. The most exciting part of my work in my opinion, as mentioned, was that I had the opportunity to work with the patient from the beginning. It was a good feeling that I could be a part of the team who work for improvement, facilitating and planning for Mrs. Morium Bibi as an individual and be able to take care of and see his needs during his registration period.

In my opinion Mrs. Morium Bibi has good prognosis for his knee. Her motivation and eager to improve is the fastest way back to ADL, and she is quite young. Her expectations and needs for the knee is quite low, since she has a low activity level, but with motivation, exercises and follow-up she will probably have a good, stable and strong knee for several years.

4.7 A case study of male knee OA patient

Case Presentation

Plate 2: **Plate of** Mr. Mokbul Hossain, **Address–** Teghormaria, Mohonpur, Rajshahi, **Mobile no–** 01759585934, **Reg. No–** 0150, **Age–** 55 years, **Sex –** Male, **Weight–** 59kg, **Height–** 5’2”.

Chief Complaints	:	Pain and stiffness on both knee.
Family History	:	Mother had arterial hypertension and died 68 years old after stroke. Father died 55 years old of pancreatic cancer.
Siblings	:	1 sister which is healthy.
Social history	:	Widow since 2008.
Occupation	:	Farmer and used to sit 10 hours per day. Now unemployed.
Hobbies	:	Reading books and knitting.
Living condition	:	Patient lives in a family house with his father mother with spouse and kids. The house has 1 floor with 7 steps.
Abuses	:	Occasionally alcohol and cigarettes (approx. 60/month).
Diagnosis	:	Osteoarthritis of both knee.

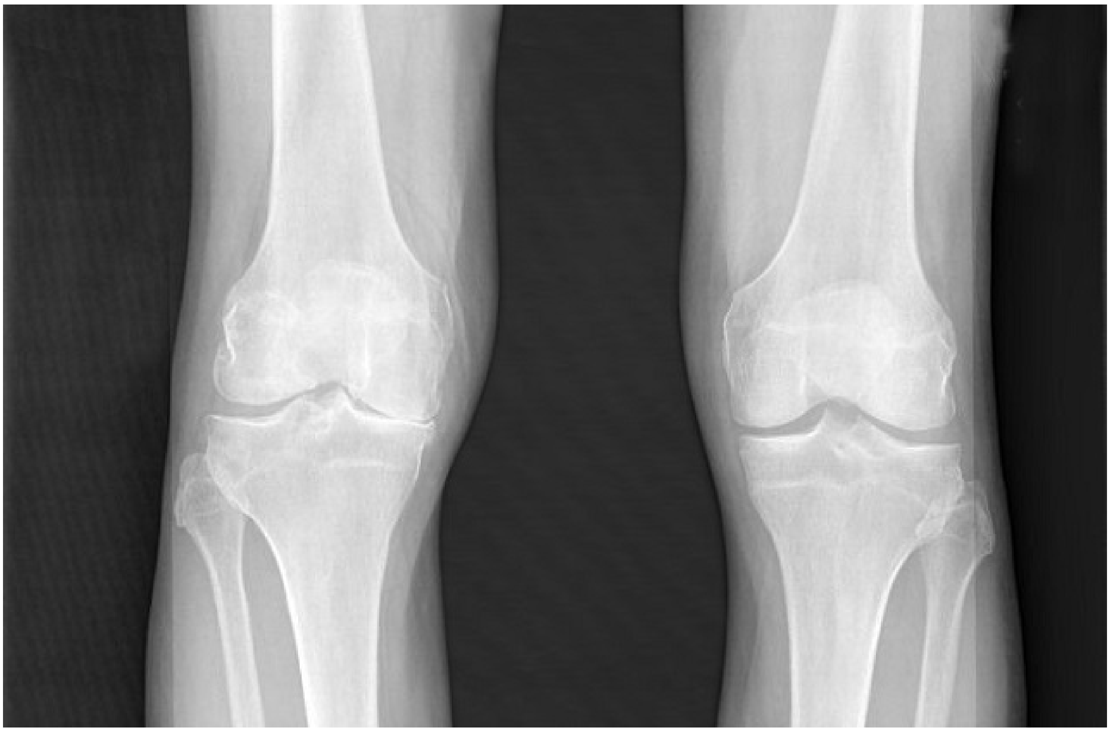


Figure: Radiograph of the knee demonstrating features of osteoarthritis

Present Condition

A married person came to me for a 5-years history of progressively worsening pain in both knees. His knees were stiff for about 20 minutes when he arose in the morning and for a few minutes after getting up from a chair during the day. He had difficulty walking > 30 minutes because of pain, and his symptoms were exacerbated by kneeling, squatting, or descending stairs. Although sitting, resting, and reclining relieved his pain, he became stiff if he stayed in one position for too long. His symptoms were worse on humid or cold days, and he occasionally felt as if one of his knees would "give out."

Past Medical Condition

The patient's past medical history was significant for coronary artery disease and three prior myocardial infarctions (MIs), the most recent having been 2 years earlier. He was told to take aspirin 80 mg once daily to relieve his current pain. He denied any history of peptic ulcer disease, upper GI bleeding or other bleeding disorders, liver or kidney disease, chronic steroid use.

Drug History

Salazopyrin en. - por tab ent 100x500 mg. 2 x morning/2 x evening

Medrol 4 mg. - por tab nob 30x4mg. 1 x morning

Perindopril 8 mg VULM - por. tab. 30x8mg. 1 x morning

Apo-Ome 20 – por. Cps. Etd. 28x20 mg. 1 x morning

Ciprinol 500 – por tab. Flm. 10x500mg. 1 x morning/1 x evening

Zaldiar port ab flm 20. 1 x morning/1 x afternoon/1 x evening

Magnesii lactici 0,5 tab. por tab nob 100x0,5mg

Mr. Mokbul Hossain was slightly obese, and physical examination of the lower extremities revealed mild genu varum, which suggested medial compartment involvement. His gait was mildly antalgic, and passive range of motion of both knees indicated palpable Crepitus. He was unable to flex or extend his knees completely. On physical examination, the patient was able to walk without an assistive device but demonstrated a slightly antalgic gait. Hip internal rotation was painful and limited to 15° bilaterally. External rotation was 50° on the right side and 40° on the left side. Hip flexion and extension were within normal limits. Flexion-abduction-external rotation (FABER) provocative testing produced hip pain bilaterally. Results of a lower-extremity strength examination are indicated in Table 1. Sensation was intact to light touch. Examination of the patient's knees demonstrated mild Crepitus bilaterally, and results of a lumbar spinal examination were unremarkable.

Lower-Extremity Strength

	Hip Flex	Hip Ext	Hip Abduct	Hip Adduct	Knee Ext	Knee Flex	Ankle Dorsi flex	Ankle Plantar flex
R	5/5	5/5	4/5	4+/5	5/5	5/5	5/5	5/5
L	5/5	5/5	4+/5	4+/5	5/5	5/5	5/5	5/5

Flex – Flexion, Ext – Extension, Abduct – Abduction, Adduct – Adduction

**Graded on a scale of 0 to 5, where 1 represents minimal strength and 5 represents maximal strength.*

Patellar facet tenderness was determined by palpation. There was tenderness over the joint line and patello femoral Crepitus, which is common in patients with osteoarthritis of the knee. There was moderate warmth and soft-tissue swelling. Patellar tilt was determined clinically and, with the knee in full extension, patellar glide was measured by assessing how far the patella translated medially and laterally. Mr. Mokbul Hossain exhibited moderately severe decreased patellar glide both medially and laterally.

Knee stability was determined in the coronal (varus/valgus) and saggital (antero posterior) planes. Patients with medial inflammation and a varus deformity commonly have medial pseudo laxity, which is a sensation of valgus laxity as the varus deformity is manually corrected with the patient supine and the leg extended. As expected, Mr. Mokbul Hossain presented with medial pseudo laxity with mild instability. In addition, patients may have increased tibial translation on both Lachman's testing and anterior drawer testing, and a positive pivot shift maneuver, indicating a chronic anterior cruciate ligament insufficiency, which can lead to osteoarthritis. However, the examination indicated that this patient had none of these findings.

Because of the prevalence of atherosclerosis in the older population, a thorough neurovascular examination was performed on this patient. His distal pulses were intact, as was sensation, and there was no evidence of cyanosis, clubbing, or edema. The examination showed no signs of neurovascular compromise. Had any of these findings been evident, a complete vascular workup would have been obtained, including blood work, to look for indications of a hypercoaguable state. If either neurovascular compromise or evidence of coronary artery disease had been found, then the risk-benefit ratio of prescribing a cyclo oxygenase (COX)-2 inhibitor would have been weighed.

Mr. Mokbul Hossain hip and back were examined thoroughly, as well, to rule out any contribution to the knee symptoms. He had full range of motion (ROM) of the lumbo sacral, and all motions were pain free. His hip examination showed decreased internal ROM, but motions were pain free and symmetric. These findings indicate that neither hips nor back was contributing to this patient's symptoms. However, he had a leg length discrepancy, with his right leg being 0.5 cm shorter than his left. Leg length discrepancy can contribute to a patient's symptoms and affect the treatment plan.

Posture Examination (same as Morium Bibi)

Pelvis Examination (same as Morium Bibi)

Gait Examination (same as Morium Bibi)

Palpation Examination (same as Morium Bibi)

Joint play Examination (same as Morium Bibi)

Anthropometric Measurements Examination (same as Morium Bibi)

Muscle Strength Examination (same as Morium Bibi)

Range of Motion Examination (same as Morium Bibi)

Treatment Plan (same as Morium Bibi)

Treatment Methods

1st Phase

Treatment duration – 12week

Date – 25.11.2012

Patients Status before Therapy

Patient is fatigue and pale. He seems weak and tired, but is smiling. He tell us that he slept bad due to the pain in the knee. Skin color and temperature in his dex. lower extremity is fine. My advisor in the clinic tells me that he is motivated for examination, exercises and therapy, but his body language seems like the opposite to me.

Goals of Therapy

- DVT prevention
- Increase ROM
- Decrease edema
- Joint play

Therapy Implementation

Swimming exercise for 20minute per day for 12 week. Patient can perform this exercise independently without help of others. If patient cannot swimming than she walk round the pond or swimming pool in man height water round the pool. It is a self-management procedure to reduce pain and increase joint mobility.

Result

After 12 week patient claims that he continue the treatment phase. He cannot swim but he walk round the pond 20minute for 12 week. Patient claim that he feel better 15% - 20% during this treatment phase. The exercises produced some pain and stiffness in the beginning around the knee joint. After some repetitions it was better and easier to perform the different movements, but the pain in and around the knee joint maintained. He is comfortable with the given exercises and gait exercise in stairs. Patient finds virtualizations quite easy.

The patient had slightly increasing ROM in ankle joint after some repetitions of DVT prevention. He needs to practicing the correct performance of each exercise with guidance from therapist. He has slightly edema in his right foot. His gait was in the beginning with slightly external rotation in right hip, but after correction and telling his this, he was able to have a correct gait. His crutches was not symmetrical or corrected to her height in the beginning, so I corrected it immediately and this resulted in better gait and easier to perform gait in stairs. Her verticalization technique is perfect, so I will not focus on this.

2nd phase

Treatment duration – 12weeks.
Date – 25.02.2013.

Patients Status before Therapy

The patient is pale, but he seems better than the day before. He is more awake and ready for exercises and therapy. Skin color and temperature in his dex. Lower extremity is fine. Patient feels comfortable with the exercise I gave him yesterday, so this maintain the same for now.

Goals of Todays Therapy

- DVT prevention
- Increase ROM
- Strengthening exercises
- Stretching and relaxation of thigh. Adductors and quadriceps muscle.
- Decrease edema
- Decrease restrictions in fascia, subs kin and skin

Therapy Implementation

Quadriceps stretching exercise can perform independently with the supervision of a physiotherapist . Patient can able to perform this exercise two time per day for 12 week period. Patient position is long sitting or supine lying position. Patient bend the knee with its maximum range of motion slowly and than straight and the heel must be touch on the floor. This procedure will be continue 20 -25 time in every session. After doing exercise patient must be apply hot pack for 20 minute. It is a combined treatment procedure.

Result

Patient take this treatment two time per day for 12week but he cannot feel much better. He said that only 40% improve his pain. Sometimes he feel severe pain. The patient does not appreciate the quadriceps stretching and hot water pack technique. He feels pain in thigh adductors and hip flexors. He liked the joint play examination and therapy.

The patient is not able to relax the adductors of thigh during applying this technique. He gets cramps in the calf every 60 seconds and its necessary for him to sit up for a minute or two. The muscles are very tense and taut. The cramps arealso present during soft tissue technique with the softball strokes on the adductors. He is otherwise strong in the muscles and the strengthening exercises are successful. The blockages in joints were again present.

3rd phase

Treatment duration – 12week

Date – 25.05.2013

Patients Status before Therapy

The patient has good skin color in his face and is walking quite fast in the stairs with good coordination and balance. He feels more secure. The patient can tell that he completed the self-therapy without any problems, but he feels some pain during night when he is performing a lot of strengthening exercises. The pain is located distal and medially to the patella. I can see that he is still swollen in his knee, and today he is quite warm lateral and medial to the scar on the knee.

Goals of Todays Therapy

- DVT prevention
- Increase ROM
- Strengthening exercises for leg.
- Stretching and relaxation of thigh. Adductors and quadriceps muscle.
- Decrease edema
- Decrease restrictions in fascia and skin
- Mobilization of restricted joints

Therapy Implementation

Self-knee mobilization exercise every day for two time per day which is done by patient. Patient position is high sitting position. Patient hold the knee by his hand, one hand place the lower end of femur and the another hand place the upper end of tibia. Upper end move slowly inside than the other end. This procedure will be continuing 20-25 repetition in a session. After doing knee mobilization exercise a hot pack was used for 20 minute.

Result

During the therapy Mr. Mokbul Hossain claim that he feel 50% - 70% better and still has some problems with relaxing during the PIR. he feels a lot of tension in her adductors of the thigh. Strengthening exercises is without any problems for him, and he feels stronger than earlier.

Mr. Mokbul Hossain is persistent today and in good shape. During the gait exercises in the stairs he needed to be reminded about the correct step-pattern with crutches in the stairs, but after it was correct he is able to do the exercises without any pain, and he feels slight fatigue after exercising.

4th phase

Treatment duration – 12week

Date – 25.08.2013

Patients status before therapy

He forgot his appointment at 11:00 AM today, so we moved the time to 13:00 PM. Mr. Mokbul Hossain seems happy and I find his sitting with some friends laughing around the table. He is without any pain today and is motivated and ready for therapy and exercise.

Goals of today's therapy

- DVT prevention
- Increase ROM
- Strengthening exercises
- Decrease edema
- Decrease restrictions in fascia and skin
- Joint play

Therapy Implementation

Deep Transverse Friction Message (DTFM) can be provide independently everyday for two time in a day. Patient position is sitting position in a chair or stool. One hand placed on the lateral side of the knee and the another hand is placed the medial side of the knee. Olive oil or vaseline can be needed to perform this exercise. A moderate pressure can be apply by thumb and index finger in a circular motion around the knee joint. After complete this exercise than apply hot water pack for 15 min for two time per day. Patient easily doing this exercises and perform better than before.

Result

Patient doing this exercise and applying hot pack for 10 minute per day two time for 12 week. After 12 week patient said that he feel 90% - 100% better than other treatment phase. He find it is hard to perform the straight leg raise due to weakness, but would like to continue to perform it during the therapy the next days.

Mr. Mokbul Hossain don’t have any blocking in his joints today, and during the exercises he appears stronger. His motivation is higher than last week, and I suppose that it has to do with well-being and a sense of mastering the exercises better each day we are together. His bruising on the medial thigh is significantly decreased at this time. When I touch his medially dx. thigh, he still gets cramps and has to sit up for a minute, so the thera-band exercise should be good for elongation and inhibition of the adductors so that relaxation could be possible.

Conclusion of case study of male knee OA patient

When I came to Teghormaria at Mohonpur, Rajshahi for my practice, I had the possibility to choose between some patients. The reason for choosing Mr. Mokbul Hossain as my patient was that I could meet him the first day he was registered to my chamber, and nevertheless follow him rehabilitation. In this way it may be easier for us to build up mutual trust and respect, and we both have to work after each other's expectations. By choosing a patient from first day in the self-chamber also gave me the perfect opportunity to see improvements and progression from the beginning. Totally we had 48 week sessions together during my practice, and despite some communication problems, we were able to work good along. I was able to use examinations and therapy techniques that I learned in school, in addition to some new techniques my supervisor introduced me to.

The therapy we choose for the patient was successful in the sense of patients cooperativeness and motivation. Some of the performed therapies was hard for the patient to carry out, and some he experienced as pleasant. The PIR was beneficial for the patient in the sense of ability to relax the muscles, but the progression was slow. Strength exercises has been as a benefit through the ability to climb stairs, corrected alignment of locomotor system especially in standing position, coordination, motor skills and overall function for a improved ADL. However, I have learned a lot about examination and therapies regarding the rehabilitation phase. During my work, I have collected relevant theory about osteoarthritis of knee and the disadvantages and advantages. The most exciting part of my work in my opinion, as mentioned, was that I had the opportunity to work with the patient from the beginning. It was a good feeling that I could be a part of the team who work for improvement, facilitating and planning for Mr. Mokbul Hossain as an individual and be able to take care of and see his needs during his registration period.

In my opinion Mr. Mokbul Hossain has good prognosis for his knee. His motivation and eager to improve is the fastest way back to ADL, and he is quite young. His expectations and needs for the knee is quite low, since he has a low activity level, but with motivation, exercises and follow-up he will probably have a good, stable and strong knee for several years.

Chapter Five
Discussion

Environment and Knee Osteoarthritis

Wilder, *et al.,* 2003 reported that the weather three conditions were examined for an association with OA-related pain at five body sites, as well as with individuals' aggregate pain scores. Among a population of exercisers aged 49yr and older, overall these findings did not support the hypothesis that weather is associated with pain from OA. While some associations were suggestive of a relationship, largely these findings indicate that weather is quite modestly, if at all, associated with pain level among individuals with OA. To a large degree, these findings suggest that women experience an enhanced relationship between pain and weather compared with their male counterparts. In the present study various approaches were used to evaluate the relationship between OA pain and weather. Numerous unadjusted relationships were highly statistically significant. For analyses testing barometric pressure direction, consideration of the absolute value of barometric pressure produced dramatically different results. After adjustment, only one test achieved statistical significance. Among women with hand OA, days of rising barometric pressure suggested higher pain levels ($P<0.001$). Precipitation contributed little to the explanation of the weather–pain relationship. However, our ability to demonstrate this may have been restricted owing to the fewer number of days with precipitation. Past attempts to summarize the weather's influence on pain from arthritis have generated equivocal conclusions. Results from this investigation are consistent with previously published findings w4, 13–16x, yet contradictory to other published results (Aikman, 1997). Although previous studies have examined populations living in cold environments (Gorin, 1999), several studies have assessed this relationship in warmer climates without extreme variations in temperature (Strusberg, 2002). Past research examining this relationship employed methodological approaches that have varied widely. Future studies may want to utilize a uniform approach, reducing the likelihood of equivocal results due to design considerations. Additionally, future analyses, which could also evaluate OA stiffness as an outcome, stratified by age group, gender and site-specific OA may serve to enhance our understanding of the mechanism(s) involved in this relationship.

Occupational Environment and Knee Osteoarthritis

Clinicians can go further, in concert with experts from other disciplines (e.g. ergonomists), in defining and promoting the principles of better work design (Fransen *et al*, 2011) for example, have advocated a “risk management” approach in which risks of knee OA are systematically assessed, prioritized, and controlled using a hierarchical method common to most health and safety planning (beginning where possible with avoidance at source, and if necessary involving new work methods and administrative controls, worker education and assistive devices (Fransen *et al.*, 2011).

A real example can be offered from the floor laying industry, where the prevalence of occupational squatting and knee OA is notably high. In Denmark, new telescopic sticks with job-specific interchangeable end fittings have been introduced to enable the tasks of gluing, filling, welding and up-cutting to be performed from a standing rather than a squatting position. Problems of non-compliance initially beset implementation of the new working methods and further modifications were needed; but encouragingly, a participatory strategy comprising additional worker education and support improved take-up among the floor layers by four-fold, after which a reduced level of knee pain was reported by 28% of those using the new tools weekly or daily (vs. 6% of those using them never or only occasionally) (Jensen and Friche, 2007). Our present finding the impact was greatest when the new tools were adopted before the initial onset of knee pain.

The evidence base on well evaluated workplace interventions is wanting at present: a systematic search by Fransen *et al* found no truly randomised controlled trials for prevention of work-related knee injuries or symptomatic OA (Fransen *et al.,* 2011). However, the Danish model suggests that progress can be made, provided that efforts are concerted and sustained.

Swimming Exercise

This result is concerned about the use of aquatic therapy in the treatment of osteoarthritis of the lower extremities. The condition is common and affects in particular, older people. There is no cure, and it is therefore important to look into both prevention and treatment. The economical consequences of this disease when it develops into disability are serious (Cardoso *et al.,* 2017). A treatment of osteoarthritis which can stop or slowdown the disabling process is therefore of great importance, both when looking at the economy, and when looking at the quality of life for the patient. The lower extremities include two joints, the hip and knee. These joints are very different both in type and loading. The treatment having an effect on the knee may therefore not have any effect on the hip joint. In an ideal world, studies would have been designed to look at aquatic therapy on only one of these joints. In the real world, it seems that it has been difficult to define patient groups which were only suffering from osteoarthritis of one of the joints. Furthermore, the described exercises in the included studies are not specific to the knee of hip, but both joints. We have therefore generally carried out analyses on mixed joint studies. To carry out a meta-analysis, a grading of retrieved studies into the categories of platinum, gold, silver and bronze is problematic when looking at aquatic or other exercises therapy. It is obvious that patient and provider cannot be blinded to the treatment. The criteria of blinding must in this case be considered irrelevant, and the overall analysis for the mixed group of patients with hip and knee OA is acceptable as gold standard. The awareness of being treated may, on the other hand, still provide a bias when compared to a control group not exposed to treatment. In the cases where aquatic exercise is compared to exercises on land, one must assume that there is no such effect, since both groups receive treatment and attention from providing staff. For all other studies, bias cannot be ignored completely.

We found very few studies of a quality acceptable for a meta-analysis. As our end result, only four studies full filled all the set criteria in the group with a mixture hip and knee OA, and only one study was acceptable for analysis in each of the groups knee OA alone and hip OA alone. A separation on joint or exercises aimed specifically on one of the two joints in question was not possible in any of the mixed group studies. In this group, two studies had less than 20% drop-out while the other two studies in this group had less than 28% drop-out. This is very good for a therapy which demands out of house treatment several times a week, although the ideal drop-out ought to be less than 20%.

At the end of the treatment, improvement was seen in physical function, pain, mental health and quality of life, when compared to a control group. These effects did not last up to a six month follow-up in the only study reporting on this (Cochrane, 2005), It may be asked if aquatic exercise has to be maintained at some level to preserve the improvements seen at the end of the treatment or if other therapies, like exercise on land, should be applied following the aquatic exercise. If the patients' physical ability has improved, exercises on land become more feasible, especially in the more disabled patients. Furthermore, exercise on land may more easily be arranged and at a lower cost. Exercise may not in all cases be beneficial for patients with knee or hip OA. One earlier study indicates that strengthening exercise may increase the OA progression if the patient has a varus mal alignment higher than five degrees (Sharma *et al.,* 2009), and another study of land-based exercise for patients with knee OA indicates an in-crease in knee oedema following exercise (Silva, *et al*., 2008). Report of adverse events of a treatment is important for any treatment. In the present review, only two studies reported that the interventions did not increase self-reported pain or symptom scores (Foley and Halbert, 2003; Wang, 2004). Since only one study (Stener-Victorin, 2004) compared aquatic exercise to control in hip OA patients, this is still an area in need of further study. From this one trial, no positive or negative effects of aquatic exercise were seen just after or at the three month follow-up. Based on this study, we can only conclude that aquatic exercise as applied here has no effect on hip OA alone. An analysis of the exercises in the programme which had no effect, and a consideration of what type of training may improve a hip joint without creating damage, would be the basis on which further studies ought to be designed, before discarding aquatic exercise as a possible treatment of hip osteoarthritis. One study comparing land exercise with aquatic exercise which concerned only knee OA qualified for inclusion (Williamson, and Wyatt, 2007).

In the present study, after the exercise interventions, there were significant reductions in joint pain, stiffness, and physical limitation accompanied by increases in quality of life in both groups. Functional capacity as assessed by maximal handgrip strength, isokinetic knee extension and flexion power, and the distance covered in the 6 min walk test increased in both exercise groups. No differences were observed in the magnitude of improvements of swimming exercise.

A large positive effect on pain at the end of treatment was found, and no adverse effects were seen. Unfortunately, no follow-up was carried out. An effect on pain though is a very important finding, since it suggests that at least part of the treatment involving training and strengthening of the muscles around the knee should take part as aquatic exercise, until the patient’s condition has improved. Pain is often the limiting factor when using exercise as part of a treatment programme. The lack of a long-term effect of aquatic exercise found when analyzing the group of mixed hip and knee osteoarthritis patients may be due to the lack of effect on the hip osteoarthritis which could hide an effect on the knee osteoarthritis. Since there is no way of separating the two types of patients in the existing studies, one can only recommend future studies to be joint specific and to design an exercise programme which is aimed at the specific joint.

Quadriceps Stretching Exercise and Hot Pack

Clinical OA is the consequence of a breakdown in the joint's normal function, which in turn is associated with altered anatomy. There is loss of freedom for the articulating surfaces to move over one another easily and a loss of joint stability. The loss of freedom of motion is associated with loss of articular cartilage, a change in joint shape, and alterations in the ligamentous support and neuromuscular control. Therefore, malfunction of an arthritic joint may result from acute or chronic injuries that produce either anatomic alterations in the shape of the articulating surface, loss of integrity of the support structures around the joint, or alterations in the mechanical properties of the tissue matrices that make up the joint. OA is not a simple wear-and-tear phenomenon, but an active process that is part of the reparative response to injury. It is reasonable to postulate that such a process might be manipulated to produce beneficial or detrimental effects on joint function and symptoms. Therefore, an integrated therapy of multiple interventions concentrating on the arthro-protective functioning of the total joint including intraarticular, periarticular, and kinesiologic management is indicated.

Present results showed that patients in group III who received more than triple therapy had the best gain in functional improvement. The changes in mean peak torques of knee flexion and extension in concentric and eccentric contraction in all patient groups are shown in Table 3. The average peak torques of 60°/second in Ex/Con, Ex/Ecc, Flex/Ecc, and Flex/Con increased significantly in all treated groups, both after treatment and at the follow up. Patients in group I showed the least improvement in peak torques after treatment, but group I patients still showed significant improvements in MPT when compared with the control group at follow-up. Group III had the greatest improvement in peak torque at 180°/second in all contraction modes (Ex/Con, Ex/Ecc, Flex/Con, and Flex/Ecc) after treatment and at follow up.

Pain in the osteoarthritic knee may be due to several conditions, including loss of articular cartilage; mechanical compression of either the medial knee compartment with varus deformity or the lateral compartment with valgus deformity; stretching of medial or lateral collateral ligaments; micro fractures and subchondral fractures; capsular distension by effusion; and patellar and associated syndromes such as anserine bursitis or pre patellar bursitis. Furthermore, the interaction of these factors results in vicious changes of intraarticular and periarticular connective tissues.

Periarticular connective tissue is composed of collagen fibers within a proteogly can matrix. The tissue may become fibrotic, contracted, or shortened when subjected to immobilization or inactivity due to arthritic joint pain, resulting in joint capsule contractures and a limited ROM. Adaptive shortening of the muscles may also occur, with muscles immobilized in a shortened position demonstrating shortening within a week. After 3 weeks in this shortened position, the loose connective tissue in the muscle becomes dense connective tissue, and a fixed muscle contracture develops (Carlsson and Anna 1983), resulting in instability of the joint. However, through an appropriate physical modality, such as the US used in the present study, the patients in groups II and III manifested the greatest improvement in MPT and the least disability, which were correlated closely with an increased ROM after periarticular soft tissue pain control.

A number of other factors have been proposed as possible explanations for the level of disability in patients with knee OA, including physical factors such as the reduced ROM of the knee joints. In a study of elderly Swedish patients (Guermazi *et al.*, 2004) strong correlations were found between knee and hip joint ROM and disability. Johani *et al.,* 2014 found that restricted flexion of the knees was a strong risk factor for locomotor disability in activities primarily involving the lower extremities, such as walking, climbing stairs, and rising from and sitting down in a chair. Studies using large animal models of OA have shown that HAs with molecular weights (MW) within the range of 0.5×106–1.0×106 Daltons were generally more effective in reducing indices of synovial inflammation and restoring the rheologic properties of synovial fluid than HAs with MW of more than 2.3 × 106 Daltons (Bohannon, 1988). These experimental findings are consistent with light and electron microscopic studies of synovial membrane and cartilage biopsy specimens obtained from patients with OA who received 5 weekly intraarticular injections of HA (MW = 0.5×106–0.73× 106 Daltons), in which evidence of partial restoration of normal joint tissue metabolism was observed. Furthermore, by mitigating the activities of pro-inflammatory mediators and pain-producing neuro-peptides released by activated synovial cells, HA may reduce the symptoms of OA.

According to Lequesne's functional index, disability may be graded by the scoring as follows: >14 points = extremely severe; 11–13 points = very severe; 8–10 points = severe; 4–7 points = moderate; 1–3 points = mild. The presented results implied that an approximately 3-point reduction of LI (from moderate-severe disability to mild-moderate) in groups II and III after treatment had a relative 20-meters/minute improvement in AS, >2.5 VAS pain score reduction in joint pain, and 10° ROM improvement in arthritic joints.

In comparing the data upon completing the treatment and at follow up, we found that there were further decreases of joint pain and increases of MPT in groups II and III; however, there were no further changes in ROM and AS. The results demonstrated that bicycling after completing treatment maintained or even improved the effects during the follow up periods.

In conclusion, an integrated therapy in Bangladesh, isokinetic strengthening exercise, and intraarticular hyaluronan therapy that deals with the intra articular and extra articular progressive pathologic changes of knee OA is suggested for the management of knee OA. Based on the variability in knee pain exhibited by subjects who wear verum and placebo knee sleeves (pooled SD of change in WOMAC pain scores = 2.6), this pilot study had only 30% power to conclude that the difference in knee pain observed between treatment groups (1.1 scale points) was statistically significant (α = 0.05). Nonetheless, given the magnitude of the change in knee pain in the active treatment group, compared to the recognizable placebo response in the controls, we conclude that a heat-retaining knee sleeve merits further study for symptomatic treatment of patients with knee OA.

Hot Pack

In the present findings that participants with knee OA have individual preferences with regard to the use of heat, cold, or contrast to relieve pain and foster greater motor function. It is also apparent that the use of a wrap-around garment that allows temperature-controlled water to heat or cool is much preferred over a standard heating pad. The reasons for preferences to heat, cold, or contrast require additional investigation, but gender, age, and severity of OA are all likely to play some role. Women most often preferred treatment providing warmth, while men were more likely to choose cold or contrast as their preferred choices of treatment. Although more women were included in our study, the gender distribution was similar to that of the Zhang *et al.,* 2008 reports, and reflects a gender difference in disease prevalence.

On the whole, all of the active treatments resulted in improvement in all measures of interest. These findings must be viewed within the context of the research design. First, we recognize that it is not possible to blind patients to treatment when applying thermal modalities. Moreover, the opportunity to use a novel treatment device may have influenced the responses provided by these patients. However, use of a water circulating device permitted us to learn what treatments (heat, cold, or contrast) these patients preferred using a single application method, and to begin examining the relationships between preference and self-report of pain and function in patients with clinically significant knee OA.

Our present finding that the average magnitude of change reported on the KOOS and visual pain scale is sufficient to warrant further attention. Hunter, and Eckstein, 2009 reported that a 32% relative change in pain represented a minimal clinically important improvement and corresponded to a “fair” response in patients with knee and hip OA treated with non-steroidal anti-inflammatory drugs (NSAIDs). When preferred treatments of cold and warm were used, the patients in this sample reported a mean pain reduction of 33% and 23% respectively. It is unknown what longer-term use might yield, but some patients can achieve meaningful relief through these interventions that persist for at least 2 days, with little risk. Responses also fell within the range of clinically important difference as reported by Roos, and correspond to the percent change in the pain in individual studies of the response to NSAIDs and non surgical treatment options for individuals with knee OA. The effect size for change in pain with use of the preferred treatment was larger (44%–48%) than the non preferred treatment options (16%–36%) when the water-circulating device was used.

Thus, our findings may be the address to measures of hot peak therapy treatment outcomes that are truly meaningful to patients.

Knee Mobilization Exercise

The results showed that clinically, inclusion of joint mobilization into a conventional physiotherapy reduces pain greater than conventional physiotherapy alone. The mean VAS reduced by 18.07 + 3.82 mm (44.07%) in the experimental group and by 6.66 + 4.11 mm (20.44%) in the control group. There were no significant differences for the between-groups effect $F(1,11) = 2.7$, $p = 0.13$, but within-group differences demonstrated significant reduction in VAS in the experimental group ($t(144) = 3.48$, $p = 0.01$), compared to the control group ($t(155) = 0.44$, $p = 0.68$). The result is in congruous with the findings by Kumar, S. and Sudhir (2006), who combined complex knee mobilization and electrotherapy, and Moss *et al.* (2007), who compared tibio-femoral joint mobilization against manual contact and non-contact control procedures, in subjects with mild to moderate knee osteoarthritis. Pain reduction following joint mobilization has been established in previous studies. Skyba *et al.* (2003) suggested that analgesic effect following knee joint mobilization was primarily due to enhancement of the descending pain inhibitory pathway in the spinal cord, which utilized serotonergic (5-HT1A) and noradrenergic receptors (alpha-2).

No significant gain in stairs ascending-descending ability of osteoarthritic knee was shown in this study. This result does not support the benefit of joint mobilization in improving motor functions as reported in previous similar studies. Sterling *et al.* (2001), in a study of cervical mobilization, found improvement in deep neck flexor function in subjects with neck pain. In another study, Crossley and Vicenzino, 2015) found that mobilization with movement on elbow joint improved pain-free grip in subjects with lateral epicondyalgia. The improvement in motor activities following joint mobilization has been associated with hypo algesic and sympatho-excitatory responses produced during the procedure. The lack of power in this study has minimized our ability to detect these effects among our subjects.

The findings of this study are subjected to several limitations. Large drop-outs in both the experimental and the control groups have threatened the validity of the study findings. At completion of the study, data from only 13 subjects (59%) were analyzed. Another limitation is the lack of experience of the therapist who applied joint mobilization on the subjects. In UKMMC, the therapists are relatively young and have not gained adequate skills in manual therapy, thus mobilization techniques intervened might not be as effective as it could have been.

Deep Transverse Friction Massage

This is the first randomized, controlled trial on the effects of a self-massage protocol applied to the quadriceps muscle on adults with knee OA. The results of the study indicated that at intake, median WOMAC measurements of three subscales (pain, stiffness, and physical function) did not differ between intervention and control groups. Intervention and control groups did, however, differ on mean intake levels of ROM extension. The ANCOVA analyses were used to test for differences in post scores between the control and experimental groups after controlling for preexisting factors. The results revealed a significant difference in mean post scores between the control and experimental groups in 21 out of 24 WOMAC subscales. Thus, the null hypothesis was rejected. The symptoms in the WOMAC subscales most significantly improved by the between-group analysis ($p = 0.001$) were pain at night while in bed; stiffness when waking in the morning; and physical functions of descending stairs, putting on socks, rising from bed, and lying in bed. On the other hand in, self-massage results in the between-group analysis showed no significant results in stiffness while lying, sitting, or resting later in the day; getting in and out of the bath; or difficulty in sitting. Pandey et al., 2014 observed that the isometric exercise and deep transverse friction massage were applied in patient with OA knee. They were taken outcome pain, ROM and WOMAC. Over all isometric exercise technique group has showed more improvement. WOMAC has improved better in isometric exercise technique group with $p=0.000$, pain has improved better with isometric exercise technique with $p=0.000$, and ROM has improved similar in both the groups with $p=0.000$.

The ANCOVA analysis of the null hypothesis measurements 1–4 revealed no difference in post-ROM scores between control and experimental groups after controlling for pre-ROM. ROM scores among the control group were slightly lower than those for the intervention group. Knee bent right flexion remained static among the intervention group and went up slightly for the control group. While knee bent left flexion increased slightly for controls, it went down slightly for those in the intervention group; however, this change in scores was not large enough to be significant. Both knee straight right extension and knee straight left extension decreased for both groups, but no significant difference in change was found.

There are various factors that may contribute to this study's difference in ROM between group results. First, the study population consisted of participants with varying symptoms of pain and stiffness of the knee in one or both knees, possibly affecting their ROM. Second, the intra-and interrupter reliability of the knee ROM measurements were not tested, possibly creating a bias with measurements. Finally, previously mentioned research on the effects of massage for knee OA used knee ROM as a secondary outcome measure and observed the groups ROM did change in a positive direction though not significant. The relationship between the slight decreases in both knees extension indicates some improvement, according to researchers in Measurement of Joint Motion: A Guide to Goniometry*:* "extension limitations greater than 5° in adults may be considered as knee flexion contractures." Additionally, researchers found in a study measuring the knee ROM among nursing home residents that 33% of the subjects had bilateral knee extension limitations of 5° and 42% had greater than 10° of extension limitations causing flexion contractures that may affect mobility. As was previously stated in the present study, researchers have found correlations between the role of the quadriceps muscle and the role of its weakness to increased pain and altered walking patterns. In conclusion, insignificant ROM results may have some beneficial effect on knee extension and affect mobility. Future research with larger samples may consider looking at what effect self-massage has on knee ROM and mobility.

Self-massage provides a self-administered, on-demand massage therapy that may meet an ongoing need for symptom relief. The significant results of this randomized self-massage study may be attributed to the administering of the twice weekly study in a supervised group setting, ensuring proper technique and compliance. Additionally, the expectation of its benefits may also contribute to its nonspecific effects. Second, the sequences were narrated and demonstrated by certified research therapists who observed participants throughout the first series of eight-week sessions and thus ensured adherence. Lastly, following each session, the WOMAC questionnaire and ROM measurement were completed, allowing participants to experience the immediate sensation of self-touch and its possible effects on ambulation.

The underlying mechanism of the action of massage is not well understood early research reviewed physiological benefits to include increasing blood flow; however, more recent studies using Doppler ultrasound techniques have found the use of massage had no effect on venous or arterial blood flow. Following this further, theories that support massage therapy's influence on lymph drainage to remove waste and reduce edema are reflected in anecdotal accounts and empirical evidence, and conclusive research is needed. On the other hand, massage therapy has been shown to relieve musculoskeletal pain. In a meta-analysis on the effects of massage therapy, 37 studies yielded a number of theories; one which may be applicable here was in the multiple-dose effects category. Weeks after massage treatments ended, pain levels averaged lower on assessment, perhaps indicating the potential on-going benefits after a series of massage sessions. Finally, self-massage research is in its early stages; thus, there is little research to support its therapeutic value. However, two studies on the benefit of massage for hand arthritis and carpal tunnel have incorporated the use of self-massage in the studies. Even though its exact mechanism of action is unknown, our findings indicate self-massage applied to the quadriceps muscle resulted in significant WOMAC improvements in knee pain, stiffness, and physical function in the intervention group in all subsets. This on-demand, natural, economical self-help therapy may be examined in future massage therapy research. In this research we have examined the effects of a single intervention self-massage applied to the quadriceps muscle, evaluated by the WOMAC questionnaire and knee ROM. The WOMAC index is a widely used disease specific evaluation of the important changes in health status that occurs as a result of an intervention. The potential benefits of the self-massage intervention were further supported in this study when the WOMAC total scores demonstrated highly significant improvement from baseline as compared to the control group. The observed improvements are most likely attributed to the knee self-massage intervention, study design, random assignment to groups, and lack of improvement in the control group. In addition, the benefits of the intervention were achieved in 12 weeks. It is easy to see these findings may have important implications for self-management and preventative options for those with knee OA.

Doley *et al.,* 2013 draw a conclusion of a research that both the technique is effective in improving the pain threshold in subjects with gluteus medius trigger point. They highlight that deep transverse friction massage is better choice of treatment in improving pain threshold in subjects with gluteus medius trigger point.

The limitations of our research design were the following issues. First, trials with blinded participants, researchers, or research therapists were not possible in a group-setting intervention. Second, research assistants' attention in and concern for the study participants could have stimulated nonspecific effects and general optimism. Third, given that the WOMAC self-report was administered after each intervention, response bias may have occurred when participants responded to the same survey questions repeatedly. Finally, the study included a three-week at home follow-up period in which the participants were encouraged to continue the intervention. In this situation it was difficult to ensure compliance in the study.

Upadhyay, *et al.,* 2017 described that reduction in pain, improvement in functional status and improvement in maximal grip strength was appreciably significant in both the groups. They mentioned that the progressive strengthening exercise therapy when given along with conventional therapy resulted in significantly better subjective and objective outcomes then conventional therapy alone in patients with chronic lateral epicondylitis.

Despite the limitations discussed above, the strengths of the study included the use of reliable and validated outcome instruments, the WOMAC and goniometer; the randomization of the study participants; and control group adherence. Equally important, the opportunity that the participants had to select the session in which they chose to participate afternoon or evening may have affected attendance and participation in a positive way. Finally, these strengths resulted in strong statistical support that a simple intervention, as described here and administered in a group setting, is something that with relative minimal training and efficient use of practitioner time, can provide effective increases in important quality of life measures for persons with osteoarthritis of the knee. Progressive strengthening exercises programme along with conventional physical therapy intervention is more effective in relieving pain, improving functional disability and improving pain free maximal isometric grip strength than conventional physical therapy alone in patients having chronic lateral epicondylitis.

Chapter Six
Conclusion and Recommendation

The prevalence of OA is increasing and this places a globally major burden on individuals; health systems, and social care systems. OA, the most common arthritis condition, is a major cause of impaired mobility and disability for the ageing populations. The OA of the knee is complex and multi-factorial. This research has focused on the risk factors in the person's environment and sustainable management by using therapeutic agents. As such they are potentially modifiable, and this has important implications for public health recommendations and treating health professionals. This result has highlighted the importance of a number of different environmental influences. There is an increased risk of knee OA from occupational kneeling and squatting, especially in jobs that also involve heavy lifting. Particularly in men, previous knee injury appears to be a very important modifiable risk factor. There is a strong association between obesity and both incident and progressive knee OA, and weight modification has an important impact on both knee OA incidence and progression. Sex hormones, diet, exercise and bone density has all been evaluated with regard to an association with knee OA. There has been considerable focus sustainable management of osteoarthritis by using deep transverse friction massage and hot pack. This study shows that there is reduce physical function rapidly and the score is 1.5 → 0.0 of post period that’s mean control physical function.

Recommendation

There is very essential substantial research in this area. I strongly recommended that the emphasize of research for new diagnostics, biomarkers and imaging technology development for the management of OA modifying therapeutic technology.

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Appendices

Appendix 1: Questionnaire (in English)

Institute of Environmental Science (IES)
Environmental Impacts on Knee Osteoarthritis and It's Sustainable Management using Therapeutic Agents
(Use only for research)

1. Name of Patient : 2. Age : 3. Sex :
4. Date : 5. Address : 6. Mobile No :
7. Weight : 8. Height : 9. Marital status: 10. Reg. No :
11. Educational qualification : 12. Occupation :
13. Economic status/ Household income :
14. Number of family member/ children :
15. Habitat/ Housing pattern :
16. How long have you been in your current job? ____________________________
17. Please tell where the actual location of pain?
    ☐ Hip ☐ Knee ☐ Ankle ☐ Other
18. Whether anyone of your family member is suffering from this pain or not ?
    ☐ Yes ☐ No
19. Does the Pain extend anywhere?
    ☐ Yes ☐ No
20. When did symptoms of this pain first occur? ____________________________
21. Was the onset related to any particular event, if yes than of what nature?
    ☐ Yes ☐ No
22. What treatment or medication do you use now? __________________________
23. Have you been recommended to use, or have you used aids to mobility (walking stick, neck brace)?
    ☐ Yes ☐ No
24. How much pain have you had when walking on a flat surface?
    ☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

25. How much pain have you had when going up or down stairs?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

26. How much pain have you had at night while in bed?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

27. How much pain have you had while sitting or lying down?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

28. How much pain have you had while standing?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

29. How much swelling have you had while standing?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

30. When you feel pain severely?

☐ Morning ☐ Afternoon ☐ Evening ☐ Night

31. When your pain worse?

☐ During working ☐ During sitting ☐ During walking ☐ During resting

32. How severe has your stiffness been after you first woke up in the morning?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

33. How severe has your stiffness been after sitting or lying down or while resting later in the day?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

34. How much difficulty have you had when bending to the floor?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

35. How much difficulty have you had getting in or out of a car, or getting on or off a bus?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

36. How much difficulty have you had while going shopping?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

37. Do you lift heavy object everyday?

Yes No

38. How much and what kind of difficulty have you had while lifting heavy object?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

39. How much and what kind of difficulty have you had when putting on your socks, panty hose, or stockings?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

40. How much and what kind of difficulty have you had when getting out of bed?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

41. How much and what kind of difficulty have you had while lying in bed?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

42. How much and what kind of difficulty have you had when getting in or out of the bathtub?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

43. How much and what kind of difficulty have you had while sitting?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

44. How much and what kind of difficulty have you had when getting on or off the toilet?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

45. How much and what kind of difficulty have you had while doing heavy household chores?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

46. How much and what kind of difficulty have you had while doing light household chores?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

47. What do you consider to be your daily eating pattern?

☐Less than normal ☐ Normal ☐ Overeat ☐ Binge ☐ Serious eating disorder ☐ Excessive snacking

48. Do you choose fast food or snacks?

☐ Yes ☐ No

49. Do you eat/snack just before bedtime?

☐ Yes ☐ No

50. Which types of fast food or snacks you eat every day? ____________________

51. How much time you eat fast food every day? ____________________________

52. How much day per week you eat meat? ________________________________

53. How much cup of tea you drink a day? ________________________________

54. How much cup of coffee you drink a day? ______________________________

55. Do you drink any types of cold drinks?

☐ Yes ☐ No If yes please specify ____________________________

56. How much bottle/can of cold drinks you drink a day? ____________________

57. Which meals do you eat each day?

☐ Breakfast ☐ Lunch ☐ Dinner ☐ Supper ☐ Snacks

58. What and how much do you usually eat for breakfast? ____________________

59. What and how much do you usually eat for lunch? _______________________

60. What and how much do you usually eat for dinner? ______________________

61. What and how much do you usually eat for supper? ______________________

62. What are your favorite snacks? ____

63. How much of them do you eat per sitting? _______________________________

64. Have you ever smoked tobacco (cigarettes, cigars, pipes, etc)?

☐ No ☐ Yes

65. How much cigarette you smoke everyday? ______________________________

66. When you smoke cigarette, do you feel knee pain?

☐ Yes ☐ No

67. Do you consume alcoholic beverages?

☐ Yes ☐ No

68. What is your exercise program?

☐ I am unable to exercise due to – ☐ Severe joint pain ☐ Shortness of breath ☐ Wheelchair/bed

☐ I am able to exercise but I do not have a regular routine.

☐ I walk / run ___ times per week for ____ minutes.

☐ I swim ____ times per week for ______ minutes.

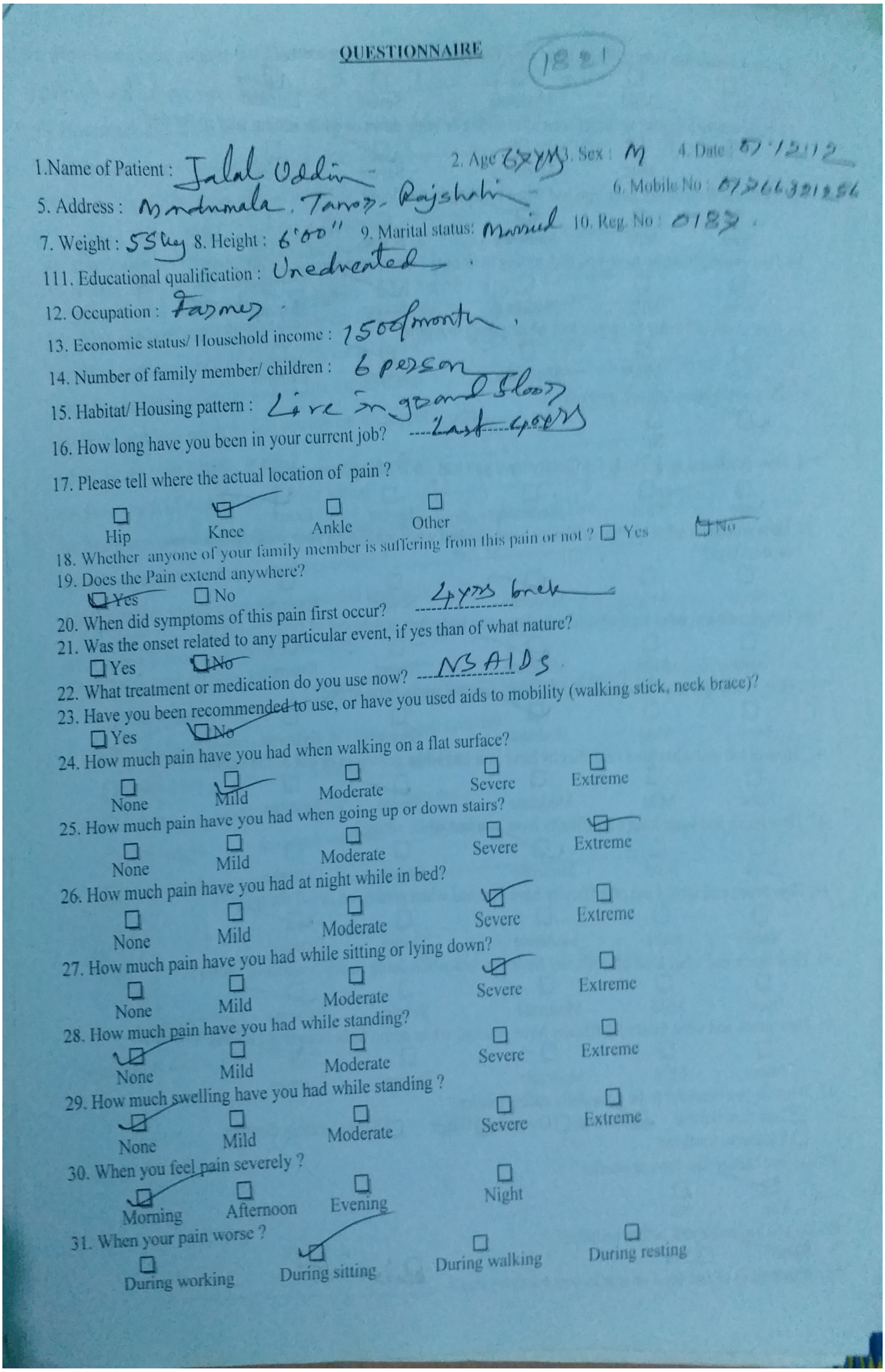
☐ I lift weights ____ times per week for ____ minutes.

☐ Other – (please explain) ____

Thanks for cordial assistance
for above information

Signature & date

Appendix 2: Sample Questionnaire with Answer (Male)



QUESTIONNAIRE (1821)

1.Name of Patient : Jalal Uddin 2. Age 67yrs 3. Sex : M 4. Date : 5/12/12

5. Address : Mondumala, Tanor- Rajshahi 6. Mobile No : 01726632125

7. Weight : 55kg 8. Height : 6'00" 9. Marital status: Married 10. Reg. No : 0187

111. Educational qualification : Uneducated

12. Occupation : Farmer

13. Economic status/ Household income : 1500/month

14. Number of family member/ children : 6 person

15. Habitat/ Housing pattern : Live in ground floor

16. How long have you been in your current job? Last 40yrs

17. Please tell where the actual location of pain ?

☐ Hip ☑ Knee ☐ Ankle ☐ Other

18. Whether anyone of your family member is suffering from this pain or not ? ☐ Yes ☑ No

19. Does the Pain extend anywhere?

☑ Yes ☐ No

20. When did symptoms of this pain first occur? 4yrs back

21. Was the onset related to any particular event, if yes than of what nature?

☐ Yes ☑ No

22. What treatment or medication do you use now? NSAIDS

23. Have you been recommended to use, or have you used aids to mobility (walking stick, neck brace)?

☐ Yes ☑ No

24. How much pain have you had when walking on a flat surface?

☐ None ☑ Mild ☐ Moderate ☐ Severe ☐ Extreme

25. How much pain have you had when going up or down stairs?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☑ Extreme

26. How much pain have you had at night while in bed?

☐ None ☐ Mild ☐ Moderate ☑ Severe ☐ Extreme

27. How much pain have you had while sitting or lying down?

☐ None ☐ Mild ☐ Moderate ☑ Severe ☐ Extreme

28. How much pain have you had while standing?

☑ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

29. How much swelling have you had while standing ?

☑ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

30. When you feel pain severely ?

☑ Morning ☐ Afternoon ☐ Evening ☐ Night

31. When your pain worse ?

☐ During working ☑ During sitting ☐ During walking ☐ During resting

Appendix 3: Sample Questionnaire with Answer (Female)

QUESTIONNAIRE (1540)

1.Name of Patient : Asia 2. Age : 60yrs 3. Sex : F 4. Date : 25.11.12

5. Address : Teghormaria, Mohonpur, Rajshahi 6. Mobile No : —

7. Weight : 40kg 8. Height : 5'00" 9. Marital status Married 10. Reg. No : 0155

111. Educational qualification : Uneducated -

12. Occupation : Housewife

13. Economic status/ Household income : 5000/month

14. Number of family member/ children : 2 person

15. Habitat/ Housing pattern : Live in ground floor

16. How long have you been in your current job? ------------------------

17. Please tell where the actual location of pain ?

☐ Hip ☑ Knee ☐ Ankle ☐ Other

18. Whether anyone of your family member is suffering from this pain or not ? ☐ Yes ☑ No

19. Does the Pain extend anywhere?

☐ Yes ☑ No

20. When did symptoms of this pain first occur? 5 yrs back

21. Was the onset related to any particular event, if yes than of what nature?

☐ Yes ☑ No

22. What treatment or medication do you use now? NSAIDs

23. Have you been recommended to use, or have you used aids to mobility (walking stick, neck brace)?

☐ Yes ☑ No

24. How much pain have you had when walking on a flat surface?

☐ None ☐ Mild ☑ Moderate ☐ Severe ☐ Extreme

25. How much pain have you had when going up or down stairs?

☐ None ☐ Mild ☑ Moderate ☐ Severe ☐ Extreme

26. How much pain have you had at night while in bed?

☑ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

27. How much pain have you had while sitting or lying down?

☐ None ☑ Mild ☐ Moderate ☐ Severe ☐ Extreme

28. How much pain have you had while standing?

☐ None ☐ Mild ☑ Moderate ☐ Severe ☐ Extreme

29. How much swelling have you had while standing ?

☑ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

30. When you feel pain severely ?

☐ Morning ☑ Afternoon ☐ Evening ☐ Night

31. When your pain worse ?

☐ During working ☐ During sitting ☑ During walking ☐ During resting

Appendix 4: Patient (n=299) life history and knee pain status

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	2	3	4	5	6	7	8	9	10	11	12	13
0001	Knee	6Yrs back	No	No	No	Moderate	Mild	Mild	Morning	During working	Severe	Severe
0002	Knee	4Yrs back	Yes	Yes	No	None	Moderate	Severe	Morning	During resting	Moderate	Moderate
0003	Knee	7Yrs back	Yes	No	No	Extreme	Mild	Mild	Morning	During walking	Mild	Severe
0004	Knee	4Yrs back	Yes	No	No	Severe	Mild	Severe	Morning	During walking	Severe	Extreme
0005	Knee	1Yrs back	No	Yes	No	None	Moderate	Mild	Night	During walking	Moderate	Severe
0006	Knee	2Yrs back	No	No	No	Mild	Moderate	Moderate	Morning	During walking	Moderate	Moderate
0007	Knee	2Yrs back	No	No	No	Severe	Moderate	Mild	Morning	During resting	Moderate	Severe
0008	Knee	10Yrs back	No	No	No	Moderate	Moderate	Moderate	Morning	During walking	Moderate	Mild
0009	Knee	10Yrs back	Yes	Yes	No	None	Moderate	Moderate	Morning	During resting	Severe	Mild
0010	Knee	3Yrs back	No	No	No	Mild	Severe	Moderate	Morning	During resting	Severe	Severe
0011	Knee	6Yrs back	Yes	No	No	Mild	Severs	Moderate	Night	During walking	Moderate	Mild
0012	Knee	4Yrs back	Yes	No	No	Moderate	Mild	Severe	After noon	During walking	Severe	Severe
0013	Knee	1Yrs back	Yes	No	No	Mild	Mild	Severe	Night	During resting	Moderate	Severe
0014	Knee	6Month	No	Yes	No	None	Mild	Moderate	Evening	During working	Moderate	Moderate
0015	Knee	3Yrs back	Yes	No	No	None	Mild	None	Night	During resting	Moderate	Moderate
0016	Knee	1Yrs back	Yes	Yes	No	Mild	Severe	Severe	Night	During working	Moderate	Moderate
0017	Knee	1Yrs back	Yes	Yes	No	Moderate	Severe	Moderate	Morning	During resting	Severe	Moderate
0018	Knee	3Yrs back	No	Yes	No	Moderate	Moderate	Severe	After noon	During working	Moderate	Moderate
0019	Knee	5Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Night	During working	Moderate	Moderate
0020	Knee	20Yrs back	Yes	No	No	None	None	None	Morning	During working	Mild	None
0021	Knee	5Yrs back	Yes	No	No	Severe	Moderate	Severe	Morning	During resting	Severe	Severe
0022	Knee	5Yrs back	No	No	No	Mild	Moderate	Moderate	Morning	During resting	Moderate	None
0023	Knee	6Yrs back	Yes	Yes	No	Moderate	Moderate	Moderate	Morning	During resting	Severe	Severe
0024	Knee	4Yrs back	No	Yes	No	Mild	Mild	Mild	Morning	During working	Moderate	Severe
0025	Knee	10Yrs back	Yes	Yes	No	Moderate	Extreme	Mild	After noon	During walking	Severe	Moderate
0026	Knee	1Yrs back	No	No	No	Moderate	Moderate	Moderate	Night	During walking	Moderate	Moderate
0027	Knee	6Yrs back	No	No	No	Mild	Mild	Moderate	Morning	During resting	Mild	Mild
0028	Knee	3Yrs back	Yes	No	No	None	Moderate	Moderate	Evening	During walking	Moderate	Moderate

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0029	Knee	7Month	Yes	No	No	Moderate	Severe	None	Morning	During walking	Moderate	Mild
0030	Knee	2Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Morning	During walking	Moderate	Moderate
0031	Knee	2Yrs back	Yes	Yes	No	Moderate	Moderate	Moderate	Morning	During walking	Moderate	Severe
0032	Knee	5Yrs back	No	No	No	Moderate	Moderate	Moderate	Morning	During resting	Severe	Moderate
0033	Knee	3Yrs back	Yes	Yes	No	Mild	Moderate	Severe	After noon	During resting	Mild	Mild
0034	Knee	2Yrs back	No	No	No	Moderate	Severe	Moderate	Morning	During working	Moderate	Mild
0035	Knee	4Yrs back	No	No	No	None	Mild	None	Morning	During resting	Moderate	Moderate
0036	Knee	10Yrs back	Yes	No	Yes	Severe	None	Extreme	Morning	During working	Severe	Severe
0037	Knee	1Yrs back	No	No	No	Extreme	Severe	Moderate	Night	During working	Severe	Mild
0038	Knee	1Yrs back	No	No	No	Severe	Moderate	Moderate	Morning	During walking	Moderate	Moderate
0039	Knee	5Yrs back	Yes	Yes	No	Moderate	Moderate	Severe	Morning	During resting	Severe	Severe
0040	Knee	2Yrs back	Yes	No	Yes	None	Mild	None	Morning	During resting	Moderate	Moderate
0041	Knee	2Ys back	Yes	No	No	Moderate	Severe	Moderate	Morning	During working	Moderate	Mild
0042	Knee	3Yrs back	No	No	No	Severe	Severe	Severe	Morning	During working	Moderate	Mild
0043	Knee	5Yrs back	No	No	No	Severe	Mild	Moderate	Night	During walking	Moderate	Mild
0044	Knee	1Yrs back	Yes	No	No	Moderate	Mild	Moderate	Morning	During walking	Moderate	Mild
0045	Knee	3Yrs back	No	No	Yes	None	Moderate	Mild	Night	During resting	Moderate	Mild
0046	Knee	4Yrsback	Yes	No	Yes	Severe	Moderate	Moderate	Night	During walking	Moderate	Severe
0047	Knee	10Yrs back	No	No	No	None	Moderate	Moderate	Night	During working	None	Severe
0048	Knee	1Yrs back	No	No	No	Moderate	Moderate	Moderate	Morning	During working	Moderate	Mild
0049	Knee	2Yrs back	Yes	Yes	No	Severe	None	Moderate	Morning	During walking	Severe	Severe
0050	Knee	6Yrs back	Yes	Yes	Yes	None	None	None	Night	During resting	Mild	Mild
0051	Knee	1Yrs back	No	No	No	None	None	None	Evening	During working	None	Mild
0052	Knee	1Yrs back	Yes	Yes	No	Mild	None	Mild	After noon	During working	Moderate	Mild
0053	Knee	2Yrs back	No	No	No	Mild	Moderate	Moderate	Morning	During working	Moderate	Severe
0054	Knee	5Yrs back	Yes	No	No	None	Moderate	Moderate	Night	During walking	Moderate	Mild
0055	Knee	3Yrs back	No	No	No	Moderate	Moderate	Severe	Morning	During walking	Moderate	Severe
0056	Knee	2Yrs back	No	Yes	No	Mild	Severe	Moderate	Night	During walking	Moderate	Mild
0057	Knee	4Yrs back	No	Yes	Yes	Moderate	Moderate	Severe	All time	During working	Severe	Severe
0058	Knee	2Yrs back	Yes	No	No	Moderate	Moderate	Mild	Evening	During resting	Moderate	Moderate
0059	Knee	3Yrsback	Yes	Yes	No	Mild	Moderate	Moderate	Morning	During resting	Severe	Severe

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0060	Knee	2Yrs back	Yes	No	No	Severe	Moderate	Moderate	Morning	During resting	Mild	Severe
0061	Knee	6Yrs back	No	Yes	No	None	None	Severe	Evening	During resting	Severe	Mild
0062	Knee	2Yrs back	No	No	No	Moderate	Moderate	Moderate	Morning	During working	Moderate	Severe
0063	Knee	7Yrs back	Yes	No	No	None	None	Moderate	Night	During walking	Moderate	Mild
0064	Knee	1Yrs back	Yes	Yes	Yes	Severe	Severe	Severe	Night	During walking	Severe	Mild
0065	Knee	1Yrs back	Yes	Yes	No	Moderate	Moderate	Moderate	Night	During sitting	Moderate	Mild
0066	Knee	2Yrs back	Yes	Yes	No	Severe	Mild	Moderate	Evening	During walking	Moderate	Mild
0067	Knee	15Yrs back	Yes	Yes	No	Moderate	Severe	Moderate	Evening	During walking	Severe	Severe
0068	Knee	4Yrs back	No	No	No	Moderate	Moderate	Moderate	Evening	During walking	Mild	Severe
0069	Knee	1Yrs back	Yes	Yes	No	Mild	Moderate	Moderate	Night	During walking	Moderate	Moderate
0070	Knee	4Yrs back	No	No	No	Severe	Moderate	Moderate	Morning	During working	Severe	Severe
0071	Knee	1.5Yrs back	No	No	No	Severe	Moderate	Moderate	Evening	During working	Moderate	Severe
0072	Knee	2Yrs back	Yes	Yes	No	Severe	Severe	Severe	Evening	During working	Severe	Moderate
0073	Knee	3Yrs back	Yes	Yes	No	Moderate	Mild	Mild	Morning	During resting	Moderate	Moderate
0074	Knee	4Yrs back	Yes	Yes	No	Moderate	Mild	Severe	Morning	During working	Mild	Mild
0075	Knee	1Yrs back	Yes	Yes	No	Severe	Severe	Moderate	Evening	During resting	Severe	Mild
0076	Knee	1Yrs back	No	No	No	None	None	Moderate	Evening	During walking	None	Moderate
0077	Knee	3Yrs back	No	No	No	Severe	Moderate	Moderate	Evening	During working	Severe	Extreme
0078	Knee	1Yrs back	Yes	No	No	Moderate	Mild	Mild	Morning	During walking	Moderate	Mild
0079	Knee	2Yrs back	No	No	No	Mild	Mild	Moderate	Morning	During working	Moderate	Mild
0080	Knee	8Yrs back	No	No	No	Moderate	Mild	Mild	Morning	During working	Severe	Severe
0081	Knee	3Yrs back	Yes	No	No	Moderate	Moderate	Severe	Morning	During walking	Moderate	Moderate
0082	Knee	15Yrs back	Yes	No	No	Moderate	Moderate	Mild	Evening	During working	Severe	Severe
0083	Knee	3Yrs back	No	No	No	Moderate	Mild	Moderate	Evening	During walking	Moderate	Mild
0084	Knee	3Yrs back	Yes	No	No	Extreme	Severe	Severe	Evening	During walking	Moderate	Mild
0085	Knee	3Yrs back	No	No	No	Moderate	Moderate	Mild	Morning	During working	Severe	Severe
0086	Knee	1Yrs back	No	No	No	Mild	Mild	None	Evening	During resting	Moderate	Mild
0087	Knee	4Yrs back	Yes	No	No	Moderate	Moderate	Moderate	After noon	During walking	Moderate	Mild
0088	Knee	1Yrs back	Yes	Yes	No	None	Moderate	Moderate	Morning	During walking	Severe	Moderate
0089	Knee	2Yrs back	No	No	No	Moderate	Moderate	Moderate	Evening	During working	Moderate	Mild
0090	Knee	3Yrs back	No	No	No	Severe	Moderate	Mild	Morning	During walking	Severe	Severe

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0091	Knee	5Yrs back	Yes	No	Yes	Moderate	Moderate	Moderate	Evening	During walking	Moderate	Mild
0092	Knee	2Yrs back	No	No	Yes	Severe	Severe	Moderate	Morning	During working	Mild	Mild
0093	Knee	10Yrs back	Yes	No	Yes	Mild	Severe	Moderate	Night	During resting	Moderate	Mild
0094	Knee	3Yrs back	Yes	No	No	None	Moderate	Mild	Evening	During working	Moderate	Moderate
0095	Knee	5Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Evening	During working	Moderate	Moderate
0096	Knee	3Yrs back	Yes	No	No	Severe	Moderate	Moderate	Night	During sitting	Moderate	Moderate
0097	Knee	2Yrs back	No	No	No	Severe	Moderate	Moderate	Morning	During working	Severe	Severe
0098	Knee	2Yrs back	No	No	No	Moderate	Mild	Moderate	Night	During working	Moderate	Moderate
0099	Knee	3Yrs back	No	Yes	No	Moderate	None	Mild	Evening	During sitting	Mild	Moderate
0100	Knee	2Yrs back	No	No	No	Severe	Severe	Mild	Morning	During working	Severe	Severe
0101	Knee	3month	No	Yes	No	None	None	Moderate	Evening	During walking	Severe	Severe
0102	Knee	2Yrs back	No	No	No	Severe	Moderate	Moderate	Morning	During working	Severe	Severe
0103	Knee	2Yrs back	No	No	No	Moderate	Mild	Mild	Evening	During working	Severe	Severe
0104	Knee	5Yrs back	No	Yes	No	Mild	Mild	Moderate	Morning	During working	Severe	Severe
0105	Knee	3Yrs back	No	Yes	No	Severe	Moderate	Moderate	Morning	During working	Severe	Severe
0106	Knee	2.5Yr back	No	Yes	No	Moderate	Mild	Moderate	Morning	During working	Moderate	Severe
0107	Knee	5Yrs back	No	No	No	Severe	Mild	Mild	Morning	During working	Severe	Severe
0108	Knee	10Yrs back	Yes	No	No	Severe	Mild	Moderate	Morning	During working	Severe	Severe
0109	Knee	5Yrs back	No	No	No	Severe	Mild	Moderate	Morning	During working	Severe	Severe
0110	Knee	2Yrs back	Yes	No	No	Severe	Mild	Moderate	Morning	During working	Severe	Severe
0111	Knee	3Yrs back	Yes	Yes	No	Severe	Moderate	Mild	After noon	During working	Severe	Severe
0112	Knee	2Yrs back	Yes	No	No	Severe	Moderate	Mild	Morning	During working	Severe	Severe
0113	Knee	5Yrs back	Yes	No	No	Severe	Mild	Moderate	Morning	During working	Severe	severe
0114	Knee	2Yrs back	No	No	No	Severe	Mild	Moderate	Morning	During working	Severe	Moderate
0115	Knee	3Yrs back	No	No	No	Severe	Mild	Moderate	After noon	During working	Moderate	Severe
0116	Knee	3Yrs back	No	No	No	Mild	None	Mild	Morning	During working	Moderate	Moderate
0117	Knee	1Yrs back	No	No	No	Moderate	None	Mild	After noon	During working	Moderate	Moderate
0118	Knee	5Yrs back	No	Yes	No	Moderate	Mild	Moderate	Morning	During working	Moderate	Moderate
0119	Knee	4Yrs back	Yes	Yes	Yes	Severe	Moderate	Moderate	Morning	During working	Mild	Moderate
0120	Knee	1.5Yr back	No	No	No	Mild	Moderate	Mild	Morning	During resting	Severe	Mild
0121	Knee	3Yrs back	Yes	Yes	No	Mild	Severe	Mild	Night	During working	Mild	Severe

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0122	Knee	10Yrs back	Yes	Yes	No	None	Moderate	Moderate	Evening	During walking	Mild	Mild
0123	Knee	1Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Night	During walking	Moderate	Mild
0124	Knee	1Yrs back	Yes	No	No	Moderate	Mild	Mild	Evening	During working	Moderate	Mild
0125	Knee	1Yrs back	Yes	Yes	No	Mild	Moderate	Mild	Morning	During walking	Severe	Moderate
0126	Knee	2month	No	No	No	Moderate	None	None	Evening	During walking	Moderate	Mild
0127	Knee	3month	No	No	No	Severe	Extreme	Severe	Night	During resting	Extreme	Mild
0128	Knee	1Yrs back	Yes	Yes	No	Severe	Mild	Moderate	Evening	During walking	Moderate	Moderate
0129	Knee	6Month	Yes	No	No	Moderate	Mild	Moderate	Morning	During sitting	Moderate	Moderate
0130	Knee	6Yrs back	No	No	No	Severe	Moderate	Moderate	Night	During walking	Severe	Mild
0131	Knee	2Yrs back	No	Yes	No	None	None	None	Morning	During sitting	Moderate	Mild
0132	Knee	1Yrs back	Yes	No	No	Moderate	Severe	Severe	Morning	During working	Severe	Moderate
0133	Knee	2Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Morning	During working	Moderate	Moderate
0134	Knee	3Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Night	During walking	Severe	Moderate
0135	Knee	5Yrs back	Yes	No	No	Severe	Moderate	Moderate	Evening	During resting	Severe	Mild
0136	Knee	2Yr back	Yes	Yes	No	Moderate	Mild	Moderate	Morning	During working	Moderate	Moderate
0137	Knee	7Yrs back	Yes	No	Yes	Moderate	Moderate	Moderate	Night	During resting	Severe	Mild
0138	Knee	1Yrs back	No	Yes	No	Moderate	Mild	Moderate	Morning	During working	Moderate	Mild
0139	Knee	5Yrs back	No	No	No	Mild	Moderate	Moderate	Morning	During working	Moderate	Mild
0140	Knee	8Yrs back	Yes	No	No	None	None	Moderate	Night	During working	Mild	Moderate
0141	Knee	3Yrs back	No	No	No	Moderate	Moderate	Moderate	Evening	During working	Moderate	Moderate
0142	Knee	3Yrs back	No	Yes	No	Moderate	Mild	Mild	Evening	During working	Moderate	Moderate
0143	Knee	3Yrs back	No	No	No	None	None	None	Morning	During working	Mild	Mild
0144	Knee	10Yrs back	Yes	Yes	No	Moderate	Moderate	Moderate	Morning	During working	Moderate	Moderate
0145	Knee	2Yrs back	No	Yes	No	Severe	Moderate	Mild	Evening	During working	Severe	Severe
0146	Knee	2.5Yrs back	No	No	No	Severe	Moderate	Mild	After noon	During working	Moderate	Severe
0147	Knee	1Yrs back	Yes	Yes	No	Severe	Mild	Mild	After noon	During working	Moderate	Moderate
0148	Knee	3Yrs back	No	No	No	Moderate	Mild	Moderate	After noon	During working	Moderate	Severe
0149	Knee	2Yrs back	No	No	No	Moderate	None	Mild	Morning	During working	Moderate	Severe
0150	Knee	1Yrs back	No	No	No	Moderate	Mild	Moderate	Morning	During walking	Moderate	Moderate
0151	Knee	5Yrs back	Yes	Yes	No	Severe	None	Mild	Night	During working	Severe	Severe
0152	Knee	4Yrs back	No	No	No	Moderate	None	Mild	Morning	During working	Moderate	Severe

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0153	Knee	1Yrs back	No	Yes	No	Moderate	None	Moderate	Morning	During walking	Moderate	Severe
0154	Knee	6Yrs back	No	No	No	Moderate	Mild	Mild	Morning	During working	Severe	Severe
0155	Knee	5Yrs back	No	No	No	Moderate	None	Moderate	After noon	During walking	Moderate	Severe
0156	Knee	2Yrs back	No	No	No	Moderate	Mild	Moderate	Morning	During walking	Moderate	Severe
0157	Knee	1Yrs back	No	No	No	Moderate	Moderate	None	Morning	During working	Moderate	Severe
0158	Knee	-	No	No	No	Severe	None	Mild	Morning	During walking	Moderate	Severe
0159	Knee	6Month	No	No	No	Severe	Mild	Mild	Evening	During walking	Severe	Severe
0160	Knee	5Yrs back	Yes	No	No	Moderate	None	Mild	Morning	During walking	Moderate	Severe
0161	Knee	3Yrs back	No	No	No	Moderate	None	Mild	Morning	During walking	Moderate	Severe
0162	Knee	1Yrs back	No	No	No	Moderate	Mild	Mild	Morning	During sitting	Mild	Moderate
0163	Knee	1Yrs back	No	Yes	No	Extreme	Moderate	Moderate	Night	During walking	Moderate	Mild
0164	Knee	3Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Morning	During resting	Moderate	Moderate
0165	Knee	3Month	Yes	No	No	Moderate	Moderate	Moderate	Evening	During working	Moderate	Mild
0166	Knee	6Month	No	No	No	Mild	Mild	Mild	Night	During sitting	Moderate	Mild
0167	Knee	2Yrs back	No	Yes	No	Mild	Mild	Mild	Night	During working	Severe	Mild
0168	Knee	1Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Morning	During walking	Severe	Mild
0169	Knee	4Yrs back	Yes	No	No	Moderate	Mild	Mild	Night	During sitting	Severe	Moderate
0170	Knee	1Yrs back	No	No	No	None	Moderate	None	Night	During resting	Mild	Severe
0171	Knee	5Yrs back	No	No	No	None	None	None	Morning	During working	Severe	Severe
0172	Knee	5Month	No	Yes	No	Mild	None	Mild	Evening	During working	Moderate	Moderate
0173	Knee	3Yrs back	Yes	Yes	No	None	None	Moderate	Evening	During working	Mild	Severe
0174	Knee	2Yrsback	No	Yes	No	None	None	None	Morning	During working	Moderate	Mild
0175	Knee	1Yrs back	No	No	Yes	Moderate	Mild	Severe	Morning	During resting	Extreme	Severe
0176	Knee	2Yrs back	No	Yes	No	Mild	Mild	Mild	Evening	During working	Moderate	Moderate
0177	Knee	2Yrs back	Yes	Yes	No	Mild	Mild	Moderate	Evening	During walking	Moderate	Moderate
0178	Knee	-	No	No	No	Moderate	Moderate	Mild	Morning	During resting	Mild	Mild
0179	Knee	2Yrs back	Yes	Yes	No	Mild	Moderate	Mild	Night	During resting	Moderate	Mild
0180	Knee	6Yrs back	Yes	Yes	No	Severe	Moderate	Moderate	Morning	During working	Extreme	Extreme
0181	Knee	15Yrs back	No	No	No	Extreme	Extreme	Extreme	Evening	During walking	Extreme	Extreme
0182	Knee	10yrs back	Yes	No	No	none	None	None	Evening	During working	None	Mild
0183	Knee	2Yrs back	Yes	Yes	Yes	Extreme	Extreme	Extreme	Evening	During resting	Extreme	Extreme

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0184	Knee	1Yrs back	Yes	No	Yes	Extreme	Extreme	Extreme	Night	During walking	Extreme	Extreme
0185	Knee	3Yrs back	Yes	No	No	Moderate	Mild	Moderate	Evening	During walking	Severe	Extreme
0186	Knee	1.5Yrs back	Yes	No	No	None	Mild	Mild	Evening	During walking	Moderate	Severe
0187	Knee	4Yes back	Yes	No	No	Mild	Severe	None	Morning	During sitting	Moderate	Extreme
0188	Knee	1Yrs back	No	No	Yes	Mild	None	Mild	Night	During sitting	Extreme	Extreme
0189	Knee	15Yrs back	Yes	Yes	No	Extreme	Severe	Extreme	Morning	During working	Severe	Extreme
0190	Knee	1Yrs back	Yes	No	No	Severe	Extreme	Extreme	Morning	During working	Extreme	Extreme
0191	Knee	1Yrs back	No	No	No	None	None	None	Evening	During walking	Severe	Severe
0192	Knee	4Yrs back	No	No	No	Severe	Mild	Moderate	Morning	During working	Mild	Moderate
0193	Knee	5Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Evening	During walking	Severe	Severe
0194	Knee	2Yrs back	No	No	No	Mild	Mild	Mild	Morning	During working	Severe	Extreme
0195	Knee	4Yrs back	Yes	No	No	None	None	Moderate	Evening	During walking	Extreme	Severe
0196	Knee	5Yrs back	Yes	Yes	No	Mild	Severe	Moderate	After noon	During walking	Moderate	Moderate
0197	Knee	20Yrs	Yes	Yes	Yes	Moderate	None	Moderate	Morning	During working	Moderate	Severe
0198	Knee	5Yrs back	No	No	Yes	Moderate	Mild	Moderate	Night	During working	Moderate	Severe
0199	Knee	3Yrs back	Yes	Yes	No	Mild	Severe	Moderate	After noon	During walking	Mild	Severe
0200	Knee	4Yrs back	Yes	No	No	Moderate	None	Moderate	After noon	During walking	Moderate	Severe
0201	Knee	3Yrs back	Yes	Yes	No	Mild	Moderate	Mild	After noon	During resting	Severe	Mild
0202	Knee	20Yrs back	Yes	Yes	Yes	Moderate	Mild	Moderate	After noon	During resting	Severe	Mild
0203	Knee	5Yrs back	Yes	No	Yes	Moderate	None	Mild	After noon	During walking	Mild	Severe
0204	Knee	2Yrs back	No	No	No	Moderate	Moderate	Moderate	After noon	During walking	Mild	Severe
0205	Knee	5Yrs back	Yes	No	No	Severe	Mild	Moderate	Evening	During walking	Mild	Severe
0206	Knee	6Yrs back	Yes	No	No	Moderate	None	Mild	Morning	During walking	Moderate	Moderate
0207	Knee	6Yrs back	Yes	Yes	Yes	Moderate	Mild	Moderate	Evening	During walking	Mild	Severe
0208	Knee	5Yrs back	Yes	Yes	No	Moderate	None	Mild	Evening	During walking	Mild	Severe
0209	Knee	5Yrs back	Yes	Yes	No	Moderate	None	Mild	Night	During resting	Moderate	Severe
0210	Knee	7Yrs back	Yes	No	No	None	Moderate	Mild	Evening	During walking	Mild	Severe
0211	Knee	3Month	No	No	No	Severe	None	None	Morning	During sitting	Moderate	Moderate
0212	Knee	3Yrs back	Yes	Yes	No	Extreme	Severe	Moderate	Morning	During walking	Extreme	Extreme
0213	Knee	3Yrs back	Yes	No	No	None	Moderate	Mild	Night	During working	Severe	Extreme
0214	Knee	10Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Morning	During working	Moderate	Mild

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0215	Knee	1Yrs back	Yes	No	No	Mild	None	Moderate	Evening	During working	Severe	Severe
0216	Knee	2Yrs back	No	Yes	No	Severe	Extreme	Extreme	Night	During working	Extreme	Severe
0217	Knee	3Yrs back	No	No	No	Severe	Severe	Severe	Night	During working	Severe	Mild
0218	Knee	2Yrs back	Yes	Yes	Yes	Severe	Severe	Severe	Evening	During resting	Severe	Extreme
0219	Knee	5Yrs back	Yes	Yes	No	Mild	Mild	Moderate	Evening	During walking	Severe	Severe
0220	Knee	1Yrs back	Yes	Yes	No	Severe	Extreme	Extreme	Night	During working	Severe	Mild
0221	Knee	3Yrs back	Yes	Yes	No	None	None	None	Morning	During sitting	Moderate	Extreme
0222	Knee	5Yrs back	Yes	No	No	Moderate	Moderate	Severe	Morning	During walking	Severe	Extreme
0223	Knee	10Yrs back	Yes	Yes	No	Moderate	Severe	Moderate	Night	During working	Moderate	Moderate
0224	Knee	10Yrs back	Yes	Yes	Yes	Mild	Moderate	Moderate	Night	During working	Moderate	Moderate
0225	Knee	3Yrs back	Yes	Yes	No	Severe	Severe	Severe	Morning	During working	Severe	Severe
0226	Knee	1Yrs back	Yes	Yes	No	Severe	Severe	Severe	Night	During working	Moderate	Severe
0227	Knee	10Yrs back	Yes	No	Yes	Severe	Severe	Severe	After noon	During working	Severe	Severe
0228	Knee	5Yrs back	No	Yes	No	None	Moderate	Moderate	Night	During working	Moderate	Severe
0229	Knee	2Yes back	Yes	No	No	Moderate	None	Extreme	After noon	During sitting	Severe	Extreme
0230	Knee	10Yrs back	Yes	Yes	Yes	None	Moderate	Severe	Morning	During walking	Moderate	Severe
0231	Knee	1Ygrs back	No	No	No	None	None	None	evening	During working	Moderate	Extreme
0232	Knee	8Yrs back	Yes	Yes	No	Severe	Severe	None	Morning	During working	Moderate	Severe
0233	Knee	1Yrs back	Yes	No	No	Moderate	Moderate	Mild	Morning	During sitting	Severe	Extreme
0234	Knee	3Yrs back	Yes	Yes	No	Severe	Severe	Severe	Night	During working	Severe	Severe
0235	Knee	1Yrs back	No	No	No	Extreme	Severe	Severe	Morning	During resting	Extreme	Extreme
0236	Knee	1Yrs back	Yes	Yes	Yes	Severe	Severe	Severe	Morning	During working	Severe	Extreme
0237	Knee	1Yrs back	Yes	No	No	Severe	Moderate	Moderate	Night	During working	Moderate	Extreme
0238	Knee	3Yrs back	No	Yes	No	Severe	Extreme	Severe	Night	During working	Severe	Severe
0239	Knee	4Yrs back	Yes	Yes	No	Extreme	No	Extreme	Night	During working	Severe	Extreme
0240	Knee	3Yrs back	No	No	Yes	Severe	Extreme	Severe	Night	During working	Severe	Extreme
0241	Knee	5Yrs back	Yes	Yes	No	Severe	Mild	Moderate	Morning	During working	Moderate	Mild
0242	Knee	4Yrs back	Yes	No	No	Severe	Moderate	Moderate	Morning	During sitting	severe	Severe
0243	Knee	3Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Night	During sitting	Severe	Severe
0244	Knee	6Yrs back	No	No	No	Mild	Mild	None	Evening	During walking	Severe	Moderate
0245	Knee	1Yrs back	Yes	No	No	Severe	Extreme	Severe	Night	During working	Severe	Severe

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0246	Knee	6Yrs back	Yes	Yes	No	Moderate	Severe	Moderate	After noon	During working	Severe	Extreme
0247	Knee	3Yrs back	No	No	No	Severe	Severe	Severe	Morning	During working	Severe	Moderate
0248	Knee	2Yrs back	No	Yes	No	Severe	Severe	Extreme	Night	During working	Extreme	Moderate
0249	Knee	6Yrs back	No	No	No	Severe	Severe	Severe	Night	During working	Severe	Severe
0250	Knee	1Yrs back	Yes	No	No	Extreme	Extreme	Severe	Morning	During working	Severe	Severe
0251	Knee	10Yrs	Yes	No	Yes	Extreme	Extreme	Extreme	Night	During working	Moderate	Severe
0252	Knee	6Month	No	No	No	Severe	Severe	Moderate	Morning	During working	Extreme	Extreme
0253	Knee	7Yrs back	Yes	No	No	Severe	Moderate	Severe	Morning	During working	Moderate	Severe
0254	Knee	10Yrs back	No	No	No	Moderate	Moderate	Severe	Morning	During working	Moderate	Extreme
0255	Knee	1.5Yrs back	No	No	No	Moderate	None	None	Night	During working	Severe	Moderate
0256	Knee	4Yrs back	No	Yes	No	Severe	Extreme	Moderate	Night	During working	Severe	Moderate
0257	Knee	2Yrs back	Yes	Yes	No	Moderate	Severe	Severe	Night	During working	Severe	Moderate
0258	Knee	1Yrs back	No	No	No	None	None	None	Evening	During sitting	Moderate	Severe
0259	Knee	2Yrs back	No	Yes	No	Moderate	Severe	Moderate	Evening	During working	Severe	Severe
0260	Knee	10Yrs back	Yes	Yes	No	Severe	Severe	Severe	Night	During working	Severe	Severe
0261	Knee	3Yrs back	Yes	No	No	Severe	Severe	Severe	Night	During working	Moderate	Severe
0262	Knee	4Ys back	Yes	Yes	No	Mild	Moderate	Mild	Morning	During working	Moderate	Moderate
0263	Knee	5Yrs back	Yes	Yes	No	Mild	None	Moderate	Morning	During working	Mild	Mild
0264	Knee	6Yrs back	No	Yes	No	Moderate	Moderate	Mild	Night	During sitting	Extreme	Extreme
0265	Knee	1Yrs back	Yes	No	No	Severe	Moderate	Extreme	Morning	During walking	Extreme	Extreme
0266	Knee	6Yrs back	Yes	Yes	No	Mild	Moderate	Severe	Night	During walking	Extreme	Mild
0267	Knee	1Yrs back	Yes	No	No	Moderate	Severe	Severe	Night	During sitting	Extreme	Extreme
0268	Knee	2Yrs back	Yes	Yes	No	None	Mild	Moderate	Evening	During working	Extreme	Moderate
0269	Knee	6Yrs back	No	Yes	No	Moderate	Mild	Severe	Evening	During working	Severe	Moderate
0270	Knee	-	No	No	No	Mild	None	Mild	After noon	During sitting	Severe	Severe
0271	Knee	6Yrs back	Yes	Yes	Yes	Moderate	Severe	Extreme	Night	During resting	Severe	Extreme
0272	Knee	2Yrs back	Yes	No	No	Severe	Severe	Severe	Night	During resting	Extreme	Extreme
0273	Knee	8Yrs back	Yes	No	Yes	Mild	Mild	None	Night	During walking	Mild	Moderate
0274	Knee	3Yrs back	Yes	No	No	Moderate	Mild	Moderate	Night	During walking	Extreme	Severe
0275	Knee	2Yrs back	Yes	No	No	Moderate	Moderate	Moderate	Night	During resting	Severe	Extreme
0276	Knee	3Month	No	No	No	None	None	None	Night	During sitting	Mild	Mild

Reg No	Location of pain	When first occur	Does the pain extended	Other family member involve	Any device used	Pain on walking	Pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	2	3	4	5	6	7	8	9	10	11	12	13
0277	Knee	5Yrs back	Yes	Yes	No	Mild	Moderate	Moderate	Night	During resting	Mild	Mild
0278	Knee	1Yrs back	Yes	Yes	No	Mild	Mild	Moderate	Night	During working	Severe	Extreme
0279	Knee	12Yrs back	Yes	Yes	No	Moderate	Moderate	Severe	Night	During working	Severe	Extreme
0280	Knee	14Yrs back	No	Yes	No	Moderate	Moderate	Moderate	Night	During sitting	Moderate	Extreme
0281	Knee	1Yrs back	No	No	No	Moderate	Moderate	Moderate	Night	During resting	Moderate	Extreme
0282	Knee	7Yrs back	Yes	No	No	Moderate	Mild	Moderate	Morning	During resting	Severe	Severe
0283	Knee	5Yrs back	No	No	No	Extreme	Extreme	Extreme	Night	During walking	Extreme	Extreme
0284	Knee	10Yrs back	No	Yes	No	Mild	Extreme	Mild	Night	During resting	Mild	Extreme
0285	Knee	3Ys back	No	No	No	Mild	None	None	After noon	During walking	Moderate	Moderate
0286	Knee	10Yrs back	Yes	No	Yes	Moderate	Severe	Moderate	Night	During working	Severe	Severe
0287	Knee	5Yrs back	No	No	No	Mild	Mild	Mild	After noon	During resting	Severe	Severe
0288	Knee	2Yrs back	No	Yes	No	None	Mild	Moderate	Night	During resting	Moderate	Extreme
0289	Knee	5Yrs back	No	No	Yes	Moderate	Moderate	Mild	Night	During walking	Extreme	Extreme
0290	Knee	12Yrs back	No	No	Yes	Severe	Moderate	Severe	Night	During walking	Extreme	Mild
0291	Knee	2Yrs back	No	Yes	No	Moderate	Moderate	Moderate	Night	During walking	Severe	Extreme
0292	Knee	2Yrs back	Yes	No	No	Severe	Moderate	Severe	Evening	During walking	Severe	Moderate
0293	Knee	4Yrs back	No	No	No	Moderate	Moderate	Mild	Night	During walking	Severe	Severe
0294	Knee	20Yrs back	No	Yes	No	Moderate	Moderate	Moderate	Night	During sitting	Severe	Moderate
0295	Knee	10yrs back	Yes	Yes	No	Severe	Severe	Moderate	Morning	During working	Severe	Mild
0296	Knee	-	-	-	-	-	-	-	-	-	-	-
0297	Knee	1Yrs back	No	No	No	None	None	None	Evening	During working	Mild	Mild
0298	Knee	1Yrs back	Yes	Yes	No	Mild	None	Mild	Afternoon	During working	Moderate	Mild
0299	Knee	2Yrs back	No	No	No	Mild	Moderate	Moderate	Morning	During working	Moderate	Severe

Contd.

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0001	Moderate	Moderate	Normal	No	-	-	Rice	Rice	Rice	Yes	No	No
0002	Severe	Severe	Over eat	No	-	-	Rice	Rice	Rice	No	No	No
0003	Severe	Severe	Over eat	Yes	1	2-3	Fast food	Rice	Rice	No	No	No
0004	Moderate	Moderate	Over eat	No	-	-	Bread	Rice	Rice	No	No	No
0005	Mild	Moderate	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0006	Extreme	Severe	Normal	No	-	-	Rice	Rice	Rice	Yes	Yes	No
0007	Severe	Severe	Over eat	No	-	-	Rice	Rice	Rice	No	No	No
0008	Extreme	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0009	Extreme	Severe	Normal	No	-	-	Bread	Rice	Bread	Yes	No	No
0010	Moderate	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0011	Severe	Severe	Over eat	No	-	-	Rice	Rice	Rice	No	No	No
0012	Severe	Moderate	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0013	Moderate	Severe	Normal	No	-	-	Rice	Rice	Bread	No	No	No
0014	Moderate	Severe	Normal	No	-	-	Bread	Rice	Rice	No	No	No
0015	Severe	Severe	Normal	No	1	5-6	Rice	Rice	Rice	No	No	No
0016	Moderate	Moderate	Normal	No	2	2-3	Rice	Rice	Rice	No	No	No
0017	Severe	Severe	Normal	No	-	-	Bread	Rice	Rice	No	No	No
0018	Severe	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0019	Moderate	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0020	Severe	Moderate	Normal	No	-	2-4	Rice	Rice	Rice	No	No	No
0021	Severe	Severe	Over eat	No	1-2	3-4	Rice	Rice	Rice	Yes	No	Yes
0022	Severe	Severe	Normal	No	-	-	Bread	Rice	Rice	No	No	No
0023	Mild	Severe	Over eat	No	-	2-3	Bread	Rice	Rice	Yes	Yes	No
0024	Mild	Severe	Normal	No	-	-	Bread	Rice	Rice	No	No	No
0025	Extreme	Severe	Normal	No	-	-	Bread	Rice	Bread	Yes	Yes	Yes
0026	Moderate	Severe	Normal	No	-	-	Rice	Rice	Rice	Yes	Yes	No
0027	Mild	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0028	Moderate	Severe	Normal	No	1-2	2-3	Rice	Rice	Rice	Yes	No	No
0029	Severe	Severe	Normal	No	1	2-3	Rice	Rice	Rice	Yes	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0030	Mild	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0031	Moderate	Moderate	Normal	No	1-2	-	Bread	Rice	Bread	No	No	No
0032	Severe	Extreme	Over eat	No	1-2	5-6	Rice	Rice	Rice	Yes	No	Yes
0033	Mild	Severe	Less normal	No	-	-	Rice	Rice	Rice	No	No	No
0034	Mild	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0035	Mild	Severe	Over eat	No	-	-	Rice	Rice	Bread	Yes	No	No
0036	Extreme	Severe	Normal	No	-	-	Bread	Rice	Bread	No	No	No
0037	Mild	Severe	Normal	No	-	-	Rice	Rice	Rice	Yes	Yes	No
0038	Mild	Severe	Normal	No	-	3-4	Bread	Rice	Rice	Yes	Yes	No
0039	Mild	Severe	Over eat	Yes	1-2	2-3	Rice	Rice	Rice	No	No	No
0040	Mild	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0041	Mild	Severe	Normal	No	1	2-3	Bread	Rice	Bread	Yes	No	No
0042	Extreme	Severe	Normal	No	-	1-2	Rice	Rice	Rice	No	No	No
0043	Mild	Severe	Normal	No	2	3-4	Bread	Rice	Bread	Yes	Yes	Yes
0044	Mild	Severe	Over eat	No	1-2	4-5	Bread	Rice	Rice	No	No	No
0045	Mild	Severe	Normal	No	1	2-3	Rice	Rice	Bread	Yes	Yes	No
0046	Mild	Severe	Normal	No	2	4-5	Bread	Rice	Rice	No	No	No
0047	Mild	Severe	Normal	Yes	1-2	2-3	Rice	Rice	Bread	Yes	Yes	No
0048	Mild	Severe	Over eat	Yes	1	4-5	Rice	Rice	Rice	No	No	No
0049	Mild	Severe	Over eat	Yes	1-2	2-3	Bread	Rice	Rice	Yes	Yes	No
0050	Mild	Moderate	Normal	Yes	1-2	-	Rice	Rice	Rice	No	No	No
0051	Severe	Severe	Normal	No	1-2	2	Rice	Rice	Bread	Yes	No	No
0052	Moderate	Moderate	Normal	No	1-2	-	Bread	Rice	Bread	No	No	No
0053	Severe	Extreme	Over eat	No	1-2	5-6	Rice	Rice	Rice	Yes	No	Yes
0054	Extreme	Severe	Normal	No	1-2	2	Bread	Rice	Bread	Yes	No	No
0055	Extreme	Severe	Normal	No	1	-	Rice	Rice	Bread	Yes	Yes	No
0056	Extreme	Severe	Normal	No	1	1-2	Bread	Rice	Rice	Yes	No	No
0057	Extreme	Severe	Normal	No	2	-	Bread	Rice	Bread	Yes	Yes	Yes
0058	Extreme	Severe	Over eat	No	1	2-3	Bread	Rice	Bread	Yes	Yes	No
0059	Extreme	Severe	Over eat	No	-	5-8	Rice	Rice	Rice	Yes	Yes	No
0060	Extreme	Extreme	Normal	No	1	2-3	Rice	Rice	Bread	Yes	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0061	Extreme	Moderate	Normal	No	2	3	Rice	Rice	Rice	Yes	No	No
0062	Extreme	Extreme	Normal	No	1-2	2-3	Bread	Rice	Bread	No	No	No
0063	Severe	Severe	Normal	No	1	1	Bread	Rice	Rice	Yes	No	No
0064	Extreme	Severe	Normal	No	1	-	Bread	Rice	Bread	No	No	No
0065	Severe	Mild	Normal	No	1	2	Bread	Rice	Bread	No	No	No
0066	Extreme	Moderate	Normal	No	1	1	Bread	Rice	Bread	No	No	No
0067	Severe	Severe	Over eat	No	2	-	Rice	Rice	Rice	No	No	No
0068	Severe	Extreme	Over eat	No	2	4-5	Rice	Rice	Bread	No	No	No
0069	Severe	Severe	Normal	No	3	-	Bread	Rice	Rice	No	No	No
0070	Severe	Severe	Normal	No	1-2	3-4	Bread	Rice	Rice	Yes	Yes	No
0071	Severe	Severe	Over eat	No	-	-	Rice	Rice	Rice	No	No	No
0072	Extreme	Extreme	Over eat	Yes	1-2	5-6	Rice	Rice	Rice	No	No	No
0073	Moderate	Severe	Over eat	Yes	1	2-3	Rice	Rice	Rice	Yes	No	No
0074	Severe	Severe	Normal	No	2	3-4	Rice	Rice	Bread	Yes	Yes	No
0075	Extreme	Extreme	Normal	Yes	1	1-2	Bread	Rice	Rice	No	No	No
0076	Severe	Moderate	Normal	No	1	2-3	Rice	Rice	Rice	No	Yes	No
0077	Moderate	Severe	Over eat	No	-	-	Bread	Rice	Bread	No	No	No
0078	Extreme	Moderate	Normal	No	1-2	4-5	Bread	Rice	Rice	Yes	No	No
0079	Extreme	Mild	Normal	Yes	1	1-2	Rice	Rice	Rice	No	No	No
0080	Mild	Severe	Over eat	No	-	-	Rice	Rice	Rice	No	No	No
0081	Moderate	Moderate	Normal	No	1-2	2	Bread	Rice	Rice	No	No	No
0082	Mild	Severe	Over eat	Yes	1	-	Bread	Rice	Rice	No	No	No
0083	Extreme	Moderate	Normal	No	1	2-3	Bread	Rice	Bread	No	No	No
0084	Extreme	Severe	Normal	No	1-2	2	Bread	Rice	Bread	No	No	No
0085	Moderate	Severe	Over eat	No	1	3	Bread	Rice	Bread	No	No	No
0086	Extreme	Moderate	Normal	Yes	1	3-4	Rice	Rice	Rice	No	No	No
0087	Extreme	Severe	Normal	No	1-2	-	Rice	Rice	Rice	Yes	Yes	No
0088	Extreme	Severe	Normal	No	2	2-3	Bread	Rice	Rice	No	No	No
0089	Extreme	Severe	Normal	No	1	1-2	Bread	Rice	Rice	No	No	No
0090	Mild	Extreme	Over eat	No	1	2-3	Rice	Rice	Rice	Yes	Yes	No
0091	Extreme	Mild	Normal	No	1-2	2-3	Rice	Rice	Rice	Yes	Yes	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0092	Mild	Moderate	Over eat	Yes	1-2	2	Bread	Rice	Bread	Yes	Yes	No
0093	Extreme	Mild	Normal	No	1-2	3	Bread	Rice	Bread	Yes	Yes	No
0094	Severe	Severe	Normal	No	1	2-3	Rice	Rice	Rice	No	No	No
0095	Extreme	Severe	Normal	Yes	1	2-3	Rice	Rice	Rice	Yes	Yes	No
0096	Extreme	Severe	Normal	Yes	-	-	Rice	Rice	Rice	No	No	No
0097	Mild	Severe	Over eat	No	-	-	Bread	Rice	Rice	No	No	No
0098	Severe	Severe	Normal	Yes	1-2	3	Bread	Rice	Rice	No	No	No
0099	Mild	Mild	Normal	No	1	-	Rice	Rice	Rice	Yes	Yes	No
0100	Mild	Severe	Normal	No	1-2	3	Bread	Rice	Bread	No	No	No
0101	Mild	Severe	Normal	No	1-2	4-5	Bread	Rice	Rice	No	No	No
0102	Mild	Severe	Over eat	Yes	1-2	4-5	Bread	Rice	Bread	No	No	No
0103	Mild	Severe	Over eat	Yes	2-3	1-2	Bread	Rice	Rice	No	No	No
0104	Mild	Severe	Over eat	Yes	2-3	4-5	Rice	Rice	Rice	Yes	Yes	No
0105	Mild	Severe	Normal	Yes	1-2	4-5	Bread	Rice	Rice	Yes	No	No
0106	Mild	Severe	Normal	Yes	1	3-4	Bread	Rice	Rice	No	No	No
0107	Mild	Severe	Over eat	Yes	1	-	Rice	Rice	Rice	Yes	No	No
0108	Mild	Severe	Over eat	No	2	-	Rice	Rice	Rice	No	No	No
0109	Mild	Severe	Normal	No	2-3	5-6	Rice	Rice	Rice	Yes	Yes	No
0110	Mild	Severe	Over eat	No	1-2	5-6	Rice	Rice	Rice	Yes	Yes	No
0111	Mild	Severe	Over eat	Yes	1-2	-	Bread	Rice	Bread	No	No	No
0112	Mild	Severe	Normal	Yes	1-2	3-4	Bread	Rice	Rice	Yes	No	No
0113	Mild	Severe	Over eat	No	1-2	-	Bread	Rice	Rice	No	No	No
0114	Mild	Severe	Normal	Yes	1	-	Bread	Rice	Bread	No	No	No
0115	Moderate	Moderate	Over eat	Yes	2-3	-	Rice	Rice	Bread	Yes	Yes	No
0116	Mild	Moderate	Normal	Yes	-	-	Bread	Rice	Rice	No	No	No
0117	Mild	Moderate	Normal	Yes	-	-	Rice	Rice	Rice	No	No	No
0118	Severe	Severe	Normal	Yes	1	2	Bread	Rice	Rice	No	No	No
0119	Mild	Severe	Over eat	Yes	1	-	Rice	Rice	Rice	No	No	No
0120	Mild	Moderate	Over eat	Yes	1-2	-	Bread	Rice	Bread	No	No	No
0121	Severe	Severe	Normal	Yes	1	2	Bread	Rice	Rice	No	No	No
0122	Extreme	Extreme	Normal	No	1	2-3	Rice	Rice	Rice	Yes	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0123	Extreme	Severe	Normal	Yes	1	5-8	Bread	Rice	Rice	Yes	No	No
0124	Extreme	Severe	Normal	No	2-3	-	Bread	Rice	Rice	Yes	No	No
0125	Extreme	Severe	Normal	Yes	-	-	Bread	Rice	Rice	Yes	No	No
0126	Severe	Moderate	Normal	Yes	1	-	Bread	Rice	Bread	No	No	No
0127	Mild	Severe	Over eat	Yes	1-2	3	Bread	Rice	Rice	No	No	No
0128	Extreme	Severe	Over eat	Yes	1	2-3	Bread	Rice	Rice	No	No	No
0129	Severe	Extreme	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0130	Extreme	Moderate	Normal	No	1	-	Rice	Rice	Rice	No	No	No
0131	Severe	Severe	Normal	Yes	1-2	-	Rice	Rice	Rice	No	No	No
0132	Extreme	Extreme	Over eat	No	1-2	1-2	Bread	Rice	Rice	No	No	No
0133	Extreme	Severe	Over eat	No	-	-	Rice	Rice	Rice	No	No	No
0134	Extreme	Extreme	Over eat	No	1-2	-	Bread	Rice	Rice	No	No	No
0135	Extreme	Severe	Normal	No	1-2	2	Bread	Rice	Rice	No	No	No
0136	Mild	Extreme	Over eat	Yes	1-2	2	Rice	Rice	Rice	No	No	No
0137	Extreme	Extreme	Normal	No	1	2	Bread	Rice	Rice	No	No	No
0138	Severe	Severe	Normal	No	1	1-2	Bread	Rice	Bread	No	No	No
0139	Severe	Severe	Normal	Yes	1	-	Bread	Rice	Rice	No	No	No
0140	Mild	Severe	Normal	No	1	2	Rice	Rice	Rice	No	No	No
0141	Extreme	Extreme	Normal	No	1	1	Rice	Rice	Rice	No	No	No
0142	Mild	Extreme	Over eat	No	1	2	Bread	Rice	Rice	Yes	Yes	No
0143	Mild	Extreme	Normal	Yes	1	2	Bread	Rice	Bread	Yes	No	No
0144	Severe	Severe	Normal	No	2	5	Rice	Rice	Rice	Yes	No	No
0145	Mild	Severe	Over eat	No	1-2	5-6	Bread	Rice	Bread	No	No	No
0146	Mild	Severe	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0147	Mild	Severe	Normal	Yes	-	2-3	Bread	Rice	Rice	No	No	No
0148	Mild	Severe	Normal	Yes	2	5-6	Rice	Rice	Rice	Yes	Yes	No
0149	Mild	Severe	Over eat	No	-	-	Bread	Rice	Rice	No	No	Yes
0150	Mild	Severe	Over eat	No	2-3	10-12	Bread	Rice	Rice	Yes	Yes	No
0151	Mild	Moderate	Normal	No	-	-	Rice	Rice	Rice	Yes	Yes	No
0152	Mild	Moderate	Normal	No	1-2	2-3	Bread	Rice	Rice	No	No	No
0153	Mild	Moderate	Normal	No	-	2-3	Bread	Rice	Bread	Yes	Yes	Yes

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0154	Mild	Moderate	Over eat	No	1-2	4-5	Rice	Rice	Rice	No	No	No
0155	Mild	Severe	Normal	No	1	1-2	Bread	Rice	Rice	No	No	No
0156	Mild	Moderate	Normal	No	1-2	-	Bread	Rice	Rice	No	No	No
0157	Mild	Mild	Over eat	Yes	1-2	10-12	Bread	Rice	Rice	Yes	No	No
0158	Mild	Moderate	Normal	No	2-3	15-20	Bread	Rice	Bread	No	No	No
0159	Mild	Moderate	Normal	No	1-2	8-10	Bread	Rice	Rice	Yes	No	No
0160	Mild	Severe	Normal	No	-	4-5	Rice	Rice	Rice	Yes	Yes	No
0161	Mild	Severe	Over eat	Yes	2	4-5	Rice	Rice	Rice	Yes	No	No
0162	Severe	Severe	Normal	No	1-2	5-6	Rice	Rice	Rice	No	No	No
0163	Extreme	Moderate	Normal	No	1-2	5-6	Rice	Rice	Rice	No	No	No
0164	Extreme	Severe	Normal	Yes	2	10-12	Bread	Rice	Rice	No	No	No
0165	Extreme	Severe	Normal	No	1	3-4	Bread	Rice	Rice	No	No	No
0166	Moderate	Mild	Normal	Yes	1	-	Rice	Rice	Rice	Yes	Yes	No
0167	Extreme	Severe	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0168	Extreme	Extreme	Normal	Yes	-	2	Rice	Rice	Rice	No	No	No
0169	Extreme	Severe	Normal	Yes	1	2-3	Bread	Rice	Rice	No	No	No
0170	Severe	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0171	Moderate	Extreme	Normal	Yes	1	2	Rice	Rice	Rice	Yes	No	No
0172	Severe	Severe	Normal	No	1	1	Bread	Rice	Rice	Yes	No	No
0173	Moderate	Severe	Normal	Yes	1	2	Bread	Rice	Rice	Yes	No	No
0174	Moderate	Mild	Normal	Yes	1	2	Bread	Rice	Bread	No	No	No
0175	Extreme	Extreme	Normal	No	-	2	Bread	Rice	Rice	Yes	No	No
0176	Severe	Extreme	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0177	Severe	Severe	Normal	No	-	-	Rice	Rice	Rice	No	No	No
0178	Extreme	Moderate	Normal	No	2	20	Bread	Rice	Rice	Yes	No	No
0179	Severe	Mild	Normal	No	2	10	Rice	Rice	-	Yes	No	No
0180	Extreme	Extreme	Normal	Yes	2	-	Rice	Rice	Rice	No	No	No
0181	Extreme	Extreme	Normal	Yes	1-2	2	Bread	Rice	Rice	Yes	Yes	No
0182	Mild	Mild	Normal	Yes	2	5	Bread	Rice	Rice	No	No	No
0183	Extreme	Extreme	Normal	Yes	-	2	Bread	Rice	Bread	No	No	No
0184	Extreme	Extreme	Over eat	No	1	2-3	Bread	Rice	Bread	No	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0185	Extreme	Extreme	Normal	Yes	1	2-3	Rice	Rice	Rice	Yes	Yes	Yes
0186	Extreme	Extreme	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0187	Extreme	Extreme	Normal	Yes	1	1-2	Bread	Rice	Rice	Yes	No	No
0188	Extreme	Severe	Normal	Yes	-	2-3	Bread	Rice	Rice	Yes	No	No
0189	Severe	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0190	Extreme	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0191	Extreme	Severe	Normal	Yes	3	2	Bread	Rice	Bread	No	No	No
0192	Mild	Severe	Over eat	Yes	2-3	5	Bread	Rice	Bread	Yes	Yes	No
0193	Extreme	Severe	Normal	No	1	3-4	Rice	Rice	Rice	Yes	Yes	No
0194	Extreme	Severe	Normal	Yes	2	3	Bread	Rice	Rice	No	No	No
0195	Extreme	Severe	Normal	No	1	-	Bread	Rice	Rice	No	No	No
0196	Mild	Severe	Over eat	Yes	1	3	Bread	Rice	Bread	No	No	No
0197	Moderate	Severe	Normal	No	2	2-3	Bread	Rice	Bread	No	No	No
0198	Severe	Moderate	Normal	Yes	1	3-4	Bread	Rice	Rice	Yes	Yes	No
0199	Mild	Severe	Normal	Yes	2	5-6	Rice	Rice	Rice	Yes	Yes	No
0200	Mild	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0201	Moderate	Moderate	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0202	Severe	Severe	Normal	No	1-2	-	Rice	Rice	Rice	No	No	No
0203	Mild	Severe	Normal	No	1-2	2	Rice	Rice	Rice	No	No	No
0204	Mild	Moderate	Normal	No	1	2-3	Rice	Rice	Rice	No	No	No
0205	Mild	Severe	Normal	Yes	1-2	4-5	Bread	Rice	Rice	No	No	No
0206	Mild	Severe	Normal	No	2-3	3-4	Rice	Rice	Rice	No	No	No
0207	Mild	Severe	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0208	Mild	Severe	Normal	No	1-2	4-5	Rice	Rice	Rice	No	No	No
0209	Mild	Severe	Normal	Yes	1-2	3-4	Bread	Rice	Rice	No	No	No
0210	Mild	Extreme	Normal	No	1	4	Rice	Rice	Rice	Yes	No	No
0211	Extreme	Moderate	Normal	No	1	3	Rice	Rice	Rice	No	No	No
0212	Extreme	Mild	Normal	Yes	2	3-4	Rice	Rice	Rice	Yes	Yes	No
0213	Mild	Mild	Normal	No	1	-	Rice	Rice	Rice	Yes	No	Yes
0214	Severe	Moderate	Normal	No	1	-	Rice	Rice	Rice	No	No	No
0215	Extreme	Extreme	Normal	No	1	2-3	Rice	Rice	Rice	No	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0216	Mild	Extreme	Normal	No	1	2-3	Rice	Rice	Rice	No	No	No
0217	Severe	Extreme	Normal	No	1	2	Rice	Rice	Rice	Yes	Yes	No
0218	Extreme	Moderate	Normal	No	1-2	3-4	Rice	Rice	Rice	No	No	No
0219	Extreme	Moderate	Normal	Yes	1-2	-	Rice	Rice	Rice	No	No	No
0220	Severe	Moderate	Normal	No	1	1-2	Bread	Rice	Bread	No	No	No
0221	Extreme	Severe	Normal	No	1	1-2	Rice	Rice	Rice	No	No	No
0222	Extreme	Mild	Normal	No	1	2-3	Bread	Rice	Bread	Yes	Yes	No
0223	Severe	Severe	Normal	Yes	1	2-3	Bread	Rice	Bread	No	No	No
0224	Severe	Moderate	Normal	No	1	1	Bread	Rice	Rice	No	No	No
0225	Extreme	Moderate	Normal	No	1	-	Bread	Rice	Bread	No	No	No
0226	Extreme	Severe	Normal	No	1	2-3	Bread	Rice	Bread	No	No	No
0227	Severe	Severe	Normal	Yes	1	2-3	Bread	Rice	Rice	No	No	No
0228	Severe	Mild	Normal	Yes	-	-	Bread	Rice	Rice	No	No	No
0229	Extreme	Mild	Normal	Yes	1	2-3	Bread	Rice	Rice	No	No	No
0230	Extreme	Severe	Normal	Yes	1	5-6	Bread	Rice	Rice	Yes	No	No
0231	Moderate	Extreme	Normal	Yes	1	2	Bread	Rice	Rice	No	Yes	No
0232	Severe	Moderate	Normal	Yes	1	2-3	Bread	Rice	Bread	Yes	Yes	No
0233	Extreme	Extreme	Normal	Yes	1	2-3	Rice	Rice	Rice	Yes	No	No
0234	Extreme	Severe	Normal	No	1	2	Bread	Rice	Rice	No	No	No
0235	Extreme	Moderate	Normal	Yes	1	2-3	Bread	Rice	Rice	No	No	No
0236	Extreme	Mild	Normal	Yes	1	-	Rice	Rice	Rice	No	No	No
0237	Extreme	Moderate	Normal	Yes	1	2-3	Rice	Rice	Rice	Yes	Yes	No
0238	Extreme	Severe	Normal	No	2	4-5	Bread	Rice	Rice	No	No	No
0239	Extreme	Severe	Normal	Yes	1	2-3	Bread	Rice	Bread	No	No	No
0240	Extreme	Mild	Normal	No	1	3-4	Rice	Rice	Rice	No	No	No
0241	Extreme	Moderate	Over eat	Yes	3	2-3	Bread	Rice	Rice	No	No	No
0242	Extreme	Moderate	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0243	Extreme	Moderate	Normal	No	1	-	Rice	Rice	Rice	Yes	No	No
0244	Extreme	Severe	Normal	Yes	2	-	Rice	Rice	Rice	No	No	No
0245	Extreme	Severe	Normal	Yes	1	2-3	Bread	Rice	Bread	Yes	No	Yes
0246	Extreme	Severe	Normal	Yes	1-2	3-4	Rice	Rice	Rice	No	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0247	Extreme	Severe	Normal	Yes	1	2	Bread	Rice	Bread	Yes	Yes	No
0248	Extreme	Moderate	Normal	Yes	1	2-3	Bread	Rice	Bread	No	No	No
0249	Extreme	Severe	Normal	Yes	1	1-2	Rice	Rice	Rice	Yes	Yes	Yes
0250	Extreme	Severe	Normal	Yes	1	3	Rice	Rice	Rice	Yes	Yes	No
0251	Extreme	Severe	Over eat	Yes	6	2-3	Bread	Rice	Rice	No	No	No
0252	Extreme	Moderate	Normal	Yes	1-2	4-5	Rice	Rice	Rice	Yes	No	No
0253	Severe	Severe	Normal	Yes	1	1-2	Rice	Rice	Rice	Yes	No	No
0254	Extreme	Moderate	Normal	Yes	1	2	Rice	Rice	Rice	Yes	Yes	No
0255	Extreme	Severe	Normal	Yes	1	2	Rice	Rice	Rice	Yes	Yes	No
0256	Extreme	Severe	Normal	Yes	1	1-2	Rice	Rice	Rice	No	No	No
0257	Extreme	Moderate	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0258	Extreme	Severe	Normal	Yes	1	1-2	Bread	Rice	Rice	No	No	No
0259	Extreme	Moderate	Normal	Yes	1	4-5	Rice	Rice	Rice	Yes	Yes	No
0260	Extreme	Moderate	Normal	Yes	1	1-2	Rice	Rice	Rice	No	No	No
0261	Extreme	Severe	Normal	Yes	1	2-3	Bread	Rice	Rice	No	No	No
0262	Severe	Severe	Normal	No	1-2	3-4	Bread	Rice	Rice	Yes	Yes	Yes
0263	Mild	Severe	Over eat	Yes	1-2	4-5	Bread	Rice	Bread	Yes	No	No
0264	Extreme	Moderate	Normal	No	1	-	Rice	Rice	Rice	No	No	No
0265	Extreme	Moderate	Normal	Yes	1-2	-	Bread	Rice	Bread	No	No	No
0266	Extreme	Moderate	Normal	Yes	1-2	5-6	Bread	Rice	Bread	Yes	No	No
0267	Extreme	Moderate	Normal	Yes	1-2	-	Bread	Rice	Bread	No	No	No
0268	Extreme	Moderate	Normal	Yes	1-2	4-5	Bread	Rice	Bread	No	No	No
0269	Extreme	Moderate	Normal	Yes	2-3	1-2	Bread	Rice	Bread	No	No	No
0270	Mild	Severe	Normal	No	1	4-5	Bread	Rice	Bread	No	No	No
0271	Extreme	Moderate	Normal	No	1	2-3	Rice	Rice	Rice	No	No	No
0272	Extreme	Moderate	Normal	Yes	-	-	Bread	Rice	Bread	No	No	No
0273	Severe	Moderate	Normal	No	1	2-3	Rice	Rice	Rice	Yes	No	No
0274	Extreme	Severe	Normal	No	3	-	Rice	Rice	Rice	No	No	No
0275	Extreme	Severe	Normal	No	1	2-3	Bread	Rice	Rice	No	No	No
0276	Mild	Mild	Normal	Yes	1-2	3-4	Bread	Rice	Rice	No	No	No
0277	Moderate	Severe	Normal	Yes	2-3	3-4	Bread	Rice	Bread	No	No	No

Reg. No	Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Any types of fast food	Day/ week eat meat	Cup of tea/coffee per day	Breakfast menu	Lunch menu	Dinner menu	Smoke tobacco	Feel pain when smoking	Consumed alcohol
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
0278	Extreme	Severe	Normal	No	1	2-3	Bread	Rice	Bread	No	No	No
0279	Extreme	Severe	Normal	No	1	-	Bread	Rice	Bread	Yes	Yes	No
0280	Extreme	Moderate	Normal	Yes	2	4-5	Bread	Rice	Bread	No	No	No
0281	Extreme	Severe	Normal	No	1	2-3	Bread	Rice	Rice	Yes	No	No
0282	Extreme	Severe	Normal	Yes	1-2	-	Rice	Rice	Rice	Yes	Yes	No
0283	Extreme	Moderate	Normal	No	1-2	-	Bread	Rice	Bread	No	No	No
0284	Extreme	Moderate	Normal	No	1	-	Bread	Rice	Bread	No	No	No
0285	Mild	Moderate	Normal	No	2	1	Bread	Rice	Rice	No	No	No
0286	Extreme	Moderate	Normal	No	2	1	Bread	Rice	Rice	No	No	No
0287	Extreme	Moderate	Normal	No	2	3-4	Bread	Rice	Bread	No	No	No
0288	Extreme	Extreme	Normal	No	1	1	Bread	Rice	Rice	Yes	No	No
0289	Extreme	Severe	Normal	No	1	-	Bread	Rice	Bread	Yes	Yes	No
0290	Extreme	Mild	Normal	Yes	1	2-3	Rice	Rice	Rice	No	No	No
0291	Extreme	Severe	Normal	Yes	1-2	2-3	Bread	Rice	Bread	No	No	No
0292	Extreme	Mild	Normal	No	1-2	4-5	Bread	Rice	Bread	No	No	No
0293	Extreme	Moderate	Normal	Yes	1	4-5	Bread	Rice	Bread	Yes	Yes	No
0294	Extreme	Moderate	Normal	No	1	2	Bread	Rice	Rice	Yes	No	No
0295	Severe	Severe	Normal	No	4-5	5-6	Bread	Rice	Bread	No	No	No
0296	-	-	-	-	-	-	-	-	-	-	-	-
0297	Extreme	Severe	Normal	No	1	-	Bread	Rice	Bread	Yes	No	No
0298	Mild	Severe	Normal	No	1	2	Rice	Rice	Rice	No	No	No
0299	Extreme	Extreme	Normal	No	1	1	Rice	Rice	Rice	No	No	No

Appendix 5: History of patient conditions ratio in study period (n = 299)

When first occur	Does the pain extended	Any other family member involve	Any device used	How much pain on walking	How much pain at night	How much pain on standing	When pain feel severely	When pain worse	Pain when bend to floor	Heavy object lifting /daily
1	2	3	4	5	6	7	8	9	10	11
3Month –	Yes – 53.51%	Yes – 37.12%	Yes – 10.70%	Mild – 16.72%	Mild – 23.41%	Mild – 22.07%	Morning – 41.13%	Walking – 29.09%	Mild – 10.70%%	Mild – 20.06%
1Yrs = 24.40%	No – 46.48%	No – 62.87%	No – 89.29%	Moderate – 37.45%	Moderate – 36.12%	Moderate – 45.48%	Evening – 20.06%	Resting – 16.05%	Moderate – 43.14%	Moderate – 22.07%
2Yrs – 5Yrs = 54%				Severe – 26.08%	Severe – 16.38%	Severe – 16.38%	Afternoon – 9.03%	Working – 44.81%	Severe – 36.12%	Severe – 36.45%
6Yrs – 10Yrs = 17.38%				None – 13.71%	None – 16.72%	None – 9.03%	Night – 28.76%	Sitting – 7.35%	Extreme – 7.35%	Extreme – 14.04%
11Yrs – 20Yrs = 5.01%										

(see next table) ---

Continuation previous table--

Difficulty when using toilet	Difficulty on household chores	Daily eating pattern	Chose any types of fast food	Breakfast menu	Lunch menu	Dinner menu	Smoked tobacco	Feel pain when smoking	Consumed alcohol
12	13	14	15	16	17	18	19	20	21
Mild – 29.43%	Mild – 6.68%	Normal – 82.60%	Yes – 39.46%	Rice – 45.15%	Rice – 100%	Rice – 73.57%	Yes – 36.45%	Yes – 19.39%	Yes – 4.34%
Moderate – 8.02%	Moderate – 20.73%	Overeat – 17.39%	No – 60.53%	Bread – 54.84%	Bread – 0%	Bread – 26.42%	No – 63.54%	No – 80.60%	No – 95.65%
Severe – 18.39%	Severe – 57.52%								
Extreme – 43.81%	Extreme – 12.04%								

Appendix 6: Swimming Exercise 20minute/day for 12 week

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0001	-	0	0	0	5-10	5-10	15	15	15-20	15-20	20	15-20
0002	0	0	5	5-10	5-10	5	10	10-15	10-15	10-15	10-15	10-15
0003	-	-	0	0	10	10	15	10-15	10-15	10-15	15	10-15
0004	0	0	0	0	0	0	0	-	-	-	-	-
0005	-	0	0	5	5	10	10	10-15	10-15	20	-	20
0006	-	0	5	10	10	10-15	10-15	-	15	15-20	20	20
0007	5	5	0	0	-	5	10	10-15	10-15	15	15-20	15
0008	-	-	0	0	5	5	0	10	10-15	15	15-20	20
0009	0	0	-	-	5	5	5	-	10	15	15	15
0010	-	-	-	0	5	5	10	10	10	15	15	20
0011	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0012	-	-	0	0	5	5	5	10	10	15	15	15-20
0013	-	0	0	5	10	10	-	15	10	-	0	0
0014	0	5	15	15	10	-	5	10	10	15	15	15-20
0015	5	5	0	0	-	15	10	10	-	15	15-20	15-20
0016	0	0	-	-	5	5	10	10	15	15	10	10-15
0017	-	-	5	5	10	10	10-15	10	10-15	15	15-20	15
0018	0	0	10	15	10	5	5	-	15	10-15	15	15-20
0019	-	-	-	-	5	5	15	10	10-15	10-15	15	15-20
0020	0	0	-	-	10	10	15	10	15	10-15	10-15	15
0021	-	0	0	5	10	10	-	15	10	-	0	0
0022	0	5	15	15	10	-	5	10	10	15	15	15-20
0023	5	5	0	0	-	15	10	10	-	15	15-20	15-20
0024	0	0	-	-	10	10	10	15	10	10	15	15-20
0025	-	-	5	5	10	10-15	10-15	10	20	15-20	15	20
0026	0	0	0	0	0	5	5	10	10	15	10	20
0027	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0028	0	0	5	5	10	15	5	-	-	10	10	-
0029	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0030	0	0	5	5	10	15	10	10	-	15	10-15	20
0031	-	-	10	10-15	5	5-10	15	10	10	20	20-25	20
0032	0	0	0	15	15-20	10-15	20	5	10	15-20	10-15	20
0033	0	5	5	10	10	10	15-20	10-15	15	10-15	15	15-20
0034	10	10	-	-	15	15	10	5-10	10	10-15	5	20
0035	-	-	0	0	0	0	5	10	10-15	5-10	15-20	25
0036	0	0	-	10	10	5	10-15	15	20	10-15	15-20	20-25
0037	5	5	10	10	15	5-10	5-10	10-15	10-15	15	15-20	15-20
0038	0	0	-	-	5-15	10-15	10	15-20	5	-	10-15	15
0039	-	-	0	0	0	0	10	10	5	15	10	20
0040	0	0	10	5	10	15	5	15	10-15	10	10-15	20
0041	0	0	-	-	5-10	10-20	10-15	-	-	15	10	20
0042	-	0	10	15	10-15	15	5-10	10	15	5-15	10-15	20
0043	0	0	0	0	0	5	5	10	10	15	10	20
0044	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0045	0	0	5	5	10	15	5	-	-	10	10	-
0046	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0047	0	0	5	5	10	15	10	10	-	15	10-15	20
0048	-	-	0	0	0	0	5	5	10	10	5	15
0049	0	0	-	10	10	10-15	5-15	10	15-20	20	15	15-20
0050	0	0	0	0	5	5-10	5	10	15-20	15	10	20
0051	10	5	15	10	15	10	10	5	-	-	15	20
0052	-	0	10	10	5	15-20	5-10	5	10	0	10	10-15
0053	0	0	-	5-15	10-15	10	10	20	15	5-15	10	20
0054	0	0	0	0	0	0	0	0	0	0	0	0
0055	0	-	-	-	-	-	-	-	-	-	-	-
0056	15	15	10	15	20	15-20	10-15	15-20	20	20	5-15	10

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0057	10	10	-	15	10-15	15	15-20	10-15	20	20	15	15-20
0058	5	5-10	10	10	15	5-15	10	15	15-20	15-20	15	20
0059	10	10	15	15-20	15-20	15	15	15	10-15	15	20	20
0060	0	0	0	0	10	15	15	10-15	10-15	15	20	20
0061	5-10	5	10-15	10	15	20	-	-	15	15-20	10	20-25
0062	5	15	15	10-15	10	15	15-20	20	15	10-15	15	15-20
0063	-	-	-	-	5	5	5	10	5	-	-	-
0064	10	10	15	15-20	15	20	10-15	15	15-20	15	10	15
0065	-	-	0	0	0	5	15	5-10	10	15-20	15	20
0066	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0067	-	-	0	0	5	5	5	10	10	15	15	15-20
0068	-	-	5	5	10	10-15	10-15	10	20	15-20	15	20
0069	0	0	0	0	0	5	5	10	10	15	10	20
0070	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0071	0	0	5	5	10	15	5	-	-	10	10	-
0072	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0073	5	10	5	0	0	15	10	5-10	15	15	20	15-20
0074	-	-	0	0	10	5	15	5	10	20	15-20	20
0075	0	0	10	10	10-15	15	5	10-15	15-20	15	20	20
0076	10	10	15	10-15	10	10-15	15	10	20	20-25	20	15-20
0077	-	-	-	-	8-10	10	15	15	10-15	15	-	-
0078	0	0	10	15	12-15	15	10-15	5-10	15	15-20	20	20
0079	-	5	5	10-15	15	10-15	10-15	15	20	-	-	15
0080	0	0	10	10	10-15	15	15	20	15	20	20	20
0081	5	5	0	0	-	5	10	10-15	10-15	15	15-20	15
0082	-	-	0	0	5	5	0	10	10-15	15	15-20	20
0083	0	0	-	-	5	5	5	-	10	15	15	15
0084	-	-	-	0	5	5	10	10	10	15	15	20
0085	0	0	0	0	10	10	5	5	15	15	15-20	15-20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0086	10	10	15	5-15	15	15-20	10	10	20	20	20-25	20
0087	-	-	5	5	10	10-15	10-15	15-20	20	10-15	15-20	20
0088	0	0	0	0	5-15	10	15	15-20	10	15-20	8-10	12-15
0089	5	5	15	5-15	12-15	15	10	10-15	15	15	20	10
0090	-	-	5-10	5-15	10	10	10-15	12-15	20	20-25	15	25
0091	0	0	10	10	15-20	20	-	-	15	10	15	20
0092	0	0	0	0	0	0	10	-	-	-	-	-
0093	10	10	12-15	15	15-20	10	10-15	8-10	10	15	20	20
0094	10	10	5-15	15	15	-	-	15-20	12-15	15	20	20-25
0095	5	5	10-15	5-15	10	10-15	10-15	15	10	15	15-20	15-20
0096	-	-	10	10	-	-	12-15	15	15	15-20	20	20
0097	0	5	15	15	10	-	5	10	10	15	15	15-20
0098	5	5	0	0	-	15	10	10	-	15	15-20	15-20
0099	0	0	-	-	5	5	10	10	15	15	10	10-15
0100	-	-	5	5	10	10	10-15	10	10-15	15	15-20	15
0101	0	0	10	15	10	5	5	-	15	10-15	15	15-20
0102	-	-	-	-	5	5	15	10	10-15	10-15	15	15-20
0103	0	0	-	-	10	10	15	10	15	10-15	10-15	15
0104	-	0	0	5	10	10	-	15	10	-	0	0
0105	0	0	10	5	10	15	5	15	10-15	10	10-15	20
0106	0	0	-	-	5-10	10-20	10-15	-	-	15	10	20
0107	-	0	10	15	10-15	15	5-10	10	15	5-15	10-15	20
0108	0	0	0	0	0	5	5	10	10	15	10	20
0109	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0110	0	0	5	5	10	15	5	-	-	10	10	-
0111	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0112	0	0	5	5	10	15	10	10	-	15	10-15	20
0113	-	-	0	0	0	0	5	5	10	10	5	15
0114	0	0	-	10	10	10-15	5-15	10	15-20	20	15	15-20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0115	0	0	0	0	5	5-10	5	10	15-20	15	10	20
0116	10	5	15	10	15	10	10	5	-	-	15	20
0117	-	0	10	10	5	15-20	5-10	5	10	0	10	10-15
0118	0	0	-	5-15	10-15	10	10	20	15	5-10	10	20
0119	5-10	5-15	10	12-15	8-10	10	15	15	10	15-20	20	20
0120	-	-	0	0	0	10-15	10-15	15	15	15-20	15-20	15-20
0121	5	5	10	5-10	10-15	5-15	15-20	15	20	15	20	20
0122	0	0	5-10	5-10	8-10	10-15	10-15	20	15	-	-	-
0123	1-2	4-5	0	0	-	-	-	10	8-10	15	-	-
0124	4-5	5-10	10	10	12-15	15	0	0	5-10	10	15	10
0125	0	0	10	15	10	5	5	-	15	10-15	15	15-20
0126	-	-	-	-	5	5	15	10	10-15	10-15	15	15-20
0127	0	0	-	-	10	10	15	10	15	10-15	10-15	15
0128	10	10	5-10	15-20	15	10	15-20	15-20	15	10	20	20-25
0129	-	0	0	0	5-10	5-10	15	15	15-20	15-20	20	15-20
0130	0	0	5	5-10	5-10	5	10	10-15	10-15	10-15	10-15	10-15
0131	-	-	0	0	10	10	15	10-15	10-15	10-15	15	10-15
0132	0	0	0	0	0	0	0	-	-	-	-	-
0133	-	0	0	5	5	10	10	10-15	10-15	20	-	20
0134	-	0	5	10	10	10-15	10-15	-	15	15-20	20	20
0135	5	5	0	0	-	5	10	10-15	10-15	15	15-20	15
0136	-	-	0	0	5	5	0	10	10-15	15	15-20	20
0137	0	0	-	-	5	5	5	-	10	15	15	15
0138	-	-	-	0	5	5	10	10	10	15	15	20
0139	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0140	-	-	0	0	5	5	5	10	10	15	15	15-20
0141	-	0	0	5	10	10	-	15	10	-	0	0
0142	0	5	15	15	10	-	5	10	10	15	15	15-20
0143	5	5	0	0	-	15	10	10	-	15	15-20	15-20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0144	0	0	-	-	5	5	10	10	15	15	10	10-15
0145	-	-	5	5	10	10	10-15	10	10-15	15	15-20	15
0146	0	0	10	15	10	5	5	-	15	10-15	15	15-20
0147	-	-	-	-	5	5	15	10	10-15	10-15	15	15-20
0148	0	0	-	-	10	10	15	10	15	10-15	10-15	15
0149	-	0	0	5	10	10	-	15	10	-	0	0
0150	0	5	15	15	10	-	5	10	10	15	15	15-20
0151	5	5	0	0	-	15	10	10	-	15	15-20	15-20
0152	0	0	-	-	10	10	10	15	10	10	15	15-20
0153	-	-	5	5	10	10-15	10-15	10	20	15-20	15	20
0154	0	0	0	0	0	5	5	10	10	15	10	20
0155	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0156	0	0	5	5	10	15	5	-	-	10	10	-
0157	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0158	0	0	5	5	10	15	10	10	-	15	10-15	20
0159	-	-	10	10-15	5	5-10	15	10	10	20	20-25	20
0160	0	0	0	15	15-20	10-15	20	5	10	15-20	10-15	20
0161	0	5	5	10	10	10	15-20	10-15	15	10-15	15	15-20
0162	10	10	-	-	15	15	10	5-10	10	10-15	5	20
0163	-	-	0	0	0	0	5	10	10-15	5-10	15-20	25
0164	0	0	-	10	10	5	10-15	15	20	10-15	15-20	20-25
0165	5	5	10	10	15	5-10	5-10	10-15	10-15	15	15-20	15-20
0166	0	0	-	-	5-15	10-15	10	15-20	5	-	10-15	15
0167	-	-	0	0	0	0	10	10	5	15	10	20
0168	0	0	10	5	10	15	5	15	10-15	10	10-15	20
0169	0	0	-	-	5-10	10-20	10-15	-	-	15	10	20
0170	-	0	10	15	10-15	15	5-10	10	15	5-15	10-15	20
0171	0	0	0	0	0	5	5	10	10	15	10	20
0172	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0173	0	0	5	5	10	15	5	-	-	10	10	-
0174	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0175	0	0	5	5	10	15	10	10	-	15	10-15	20
0176	-	-	0	0	0	0	5	5	10	10	5	15
0177	0	0	-	10	10	10-15	5-15	10	15-20	20	15	15-20
0178	0	0	0	0	5	5-10	5	10	15-20	15	10	20
0179	10	5	15	10	15	10	10	5	-	-	15	20
0180	-	0	10	10	5	15-20	5-10	5	10	0	10	10-15
0181	0	0	-	5-15	10-15	10	10	20	15	5-15	10	20
0182	0	0	0	0	0	0	0	0	0	0	0	0
0183	0	-	-	-	-	-	-	-	-	-	-	-
0184	15	15	10	15	20	15-20	10-15	15-20	20	20	5-15	10
0185	10	10	-	15	10-15	15	15-20	10-15	20	20	15	15-20
0186	5	5-10	10	10	15	5-15	10	15	15-20	15-20	15	20
0187	10	10	15	15-20	15-20	15	15	15	10-15	15	20	20
0188	0	0	0	0	10	15	15	10-15	10-15	15	20	20
0189	5-10	5	10-15	10	15	20	-	-	15	15-20	10	20-25
0190	5	15	15	10-15	10	15	15-20	20	15	10-15	15	15-20
0191	-	-	-	-	5	5	5	10	5	-	-	-
0192	10	10	15	15-20	15	20	10-15	15	15-20	15	10	15
0193	-	-	0	0	0	5	15	5-10	10	15-20	15	20
0194	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0195	-	-	0	0	5	5	5	10	10	15	15	15-20
0196	-	-	5	5	10	10-15	10-15	10	20	15-20	15	20
0197	0	0	0	0	0	5	5	10	10	15	10	20
0198	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0199	0	0	5	5	10	15	5	-	-	10	10	-
0200	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0201	5	10	5	0	0	15	10	5-10	15	15	20	15-20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0202	-	-	0	0	10	5	15	5	10	20	15-20	20
0203	0	0	10	10	10-15	15	5	10-15	15-20	15	20	20
0204	10	10	15	10-15	10	10-15	15	10	20	20-25	20	15-20
0205	-	-	-	-	8-10	10	15	15	10-15	15	-	-
0206	0	0	10	15	12-15	15	10-15	5-10	15	15-20	20	20
0207	-	5	5	10-15	15	10-15	10-15	15	20	-	-	15
0208	0	0	10	10	10-15	15	15	20	15	20	20	20
0209	5	5	0	0	-	5	10	10-15	10-15	15	15-20	15
0210	-	-	0	0	5	5	0	10	10-15	15	15-20	20
0211	0	0	-	-	5	5	5	-	10	15	15	15
0212	-	-	-	0	5	5	10	10	10	15	15	20
0213	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0214	10	10	15	5-15	15	15-20	10	10	20	20	20-25	20
0215	-	-	5	5	10	10-15	10-15	15-20	20	10-15	15-20	20
0216	0	0	0	0	5-15	10	15	15-20	10	15-20	8-10	12-15
0217	5	5	15	5-15	12-15	15	10	10-15	15	15	20	10
0218	-	-	5-10	5-15	10	10	10-15	12-15	20	20-25	15	25
0219	0	0	10	10	15-20	20	-	-	15	10	15	20
0220	0	0	0	0	0	0	10	-	-	-	-	-
0221	10	10	12-15	15	15-20	10	10-15	8-10	10	15	20	20
0222	10	10	5-15	15	15	-	-	15-20	12-15	15	20	20-25
0223	5	5	10-15	5-15	10	10-15	10-15	15	10	15	15-20	15-20
0224	-	-	10	10	-	-	12-15	15	15	15-20	20	20
0225	0	5	5	10	10	10	15-20	10-15	15	10-15	15	15-20
0226	10	10	-	-	15	15	10	5-10	10	10-15	5	20
0227	-	-	0	0	0	0	5	10	10-15	5-10	15-20	25
0228	0	0	-	10	10	5	10-15	15	20	10-15	15-20	20-25
0229	5	5	10	10	15	5-10	5-10	10-15	10-15	15	15-20	15-20
0230	0	0	-	-	5-15	10-15	10	15-20	5	-	10-15	15

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0231	-	-	0	0	0	0	10	10	5	15	10	20
0232	0	0	10	5	10	15	5	15	10-15	10	10-15	20
0233	0	0	-	-	5-10	10-20	10-15	-	-	15	10	20
0234	-	0	10	15	10-15	15	5-10	10	15	5-15	10-15	20
0235	0	0	0	0	0	5	5	10	10	15	10	20
0236	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0237	0	0	5	5	10	15	5	-	-	10	10	-
0238	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0239	0	0	5	5	10	15	10	10	-	15	10-15	20
0240	-	-	0	0	0	0	5	5	10	10	5	15
0241	0	0	-	10	10	10-15	5-15	10	15-20	20	15	15-20
0242	0	0	0	0	5	5-10	5	10	15-20	15	10	20
0243	10	5	15	10	15	10	10	5	-	-	15	20
0244	-	0	10	10	5	15-20	5-10	5	10	0	10	10-15
0245	0	0	-	5-15	10-15	10	10	20	15	5-15	10	20
0246	0	0	0	0	0	0	0	0	0	0	0	0
0247	0	-	-	-	-	-	-	-	-	-	-	-
0248	15	15	10	15	20	15-20	10-15	15-20	20	20	5-15	10
0249	10	10	-	15	10-15	15	15-20	10-15	20	20	15	15-20
0250	5	5-10	10	10	15	5-15	10	15	15-20	15-20	15	20
0251	10	10	15	15-20	15-20	15	15	15	10-15	15	20	20
0252	0	0	0	0	10	15	15	10-15	10-15	15	20	20
0253	5-10	5	10-15	10	15	20	-	-	15	15-20	10	20-25
0254	5	15	15	10-15	10	15	15-20	20	15	10-15	15	15-20
0255	-	-	-	-	5	5	5	10	5	-	-	-
0256	10	10	15	15-20	15	20	10-15	15	15-20	15	10	15
0257	-	0	0	0	5-10	5-10	15	15	15-20	15-20	20	15-20
0258	0	0	5	5-10	5-10	5	10	10-15	10-15	10-15	10-15	10-15
0259	-	-	0	0	10	10	15	10-15	10-15	10-15	15	10-15

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0260	0	0	0	0	0	0	0	-	-	-	-	-
0261	-	0	0	5	5	10	10	10-15	10-15	20	-	20
0262	-	0	5	10	10	10-15	10-15	-	15	15-20	20	20
0263	5	5	0	0	-	5	10	10-15	10-15	15	15-20	15
0264	-	-	0	0	5	5	0	10	10-15	15	15-20	20
0265	0	0	-	-	5	5	5	-	10	15	15	15
0266	-	-	-	0	5	5	10	10	10	15	15	20
0267	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0268	-	-	0	0	5	5	5	10	10	15	15	15-20
0269	-	0	0	5	10	10	-	15	10	-	0	0
0270	0	5	15	15	10	-	5	10	10	15	15	15-20
0271	5	5	0	0	-	15	10	10	-	15	15-20	15-20
0272	0	0	-	-	5	5	10	10	15	15	10	10-15
0273	-	-	5	5	10	10	10-15	10	10-15	15	15-20	15
0274	0	0	10	15	10	5	5	-	15	10-15	15	15-20
0275	-	-	-	-	5	5	15	10	10-15	10-15	15	15-20
0276	0	0	-	-	10	10	15	10	15	10-15	10-15	15
0277	-	0	0	5	10	10	-	15	10	-	0	0
0278	0	5	15	15	10	-	5	10	10	15	15	15-20
0279	5	5	0	0	-	15	10	10	-	15	15-20	15-20
0280	0	0	-	-	10	10	10	15	10	10	15	15-20
0281	-	-	5	5	10	10-15	10-15	10	20	15-20	15	20
0282	0	0	0	0	0	5	5	10	10	15	10	20
0283	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0284	0	0	5	5	10	15	5	-	-	10	10	-
0285	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15
0286	0	0	5	5	10	15	10	10	-	15	10-15	20
0287	-	-	10	10-15	5	5-10	15	10	10	20	20-25	20
0288	0	0	0	15	15-20	10-15	20	5	10	15-20	10-15	20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0289	5	5	0	0	-	5	10	10-15	10-15	15	15-20	15
0290	-	-	0	0	5	5	0	10	10-15	15	15-20	20
0291	0	0	-	-	5	5	5	-	10	15	15	15
0292	-	-	-	0	5	5	10	10	10	15	15	20
0293	0	0	0	0	10	10	5	5	15	15	15-20	15-20
0294	-	-	0	0	5	5	5	10	10	15	15	15-20
0295	-	-	5	5	10	10-15	10-15	10	20	15-20	15	20
0296	0	0	0	0	0	5	5	10	10	15	10	20
0297	-	-	0	5	5-10	5-10	10	15	5-10	10-15	20	15-20
0298	0	0	5	5	10	15	5	-	-	10	10	-
0299	15	15-20	10	15-20	10-20	15	5	0	0	10	15	15

Appendix 7: Quadriceps stretching exercise 10 repetition, 5sec. hold and apply hot water pack for two time per day for 12 week

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0001	0	0	15	20-25	20-25	15-25	20	25	25-30	25-30	30	30-35
0002	10	10-15	20	20	20	15-20	25-30	25-30	15-20	20-25	35-40	40
0003	0	0	10	10-15	10-15	20	10-15	12-15	15-20	20	20	20
0004	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0005	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0006	-	15	12-15	15-20	20	15-20	20	20	10-15	20-25	20-25	30-35
0007	5-10	5-10	10-15	5-15	15-20	15-20	15-20	18-20	15-20	20-25	25-30	25-30
0008	10	12-15	12-15	10-15	15	20	20	15-20	20-25	15-20	25-30	30-35
0009	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0010	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0011	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0012	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0013	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0014	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0015	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0016	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0017	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0018	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0019	8-10	5-8	4-5	10	10-12	10	15-20	15-20	12-15	20-25	20	20-25
0020	5	5-8	5	10	12-15	15-18	15	20	12-15	20-25	20-25	25
0021	5	5	-	-	5	10-12	15	15-18	15-20	20	25	20-25
0022	10	10	15	15	10-15	15-18	15	20-22	15-20	20-25	25	25-30
0023	5	5	5	5	-	-	15	15-18	18-20	20-22	20-22	20-25
0024	10	10	-	10	15-20	15-20	20-25	22-25	25-30	25-28	25-30	25-30
0025	15-20	15-20	12-15	15-18	12-18	15-18	15-18	20-22	22-25	25-28	25-30	30
0026	5	10-12	5-10	8-10	12-15	10-12	15-20	12-15	15-18	15-20	15-20	20
0027	8-10	12-15	12-15	15	12-15	15-20	20-22	25-30	25	25-28	30-40	40
0028	10	10	12-15	12-15	15	15-18	15-18	20	20	15-20	25	25

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0029	5-8	5-8	10	10-15	11-12	15-18	14-15	15-16	20	22-25	22-25	22-25
0030	4-5	4-5	7-8	5-6	8-10	15-18	12-15	14-15	12-15	18-20	20	20
0031	20	22-25	20-25	20	15	15-20	25-35	30-35	30	28-30	35-40	35-40
0032	4-5	5-10	5-10	8-10	12-15	15-20	10-15	-	-	14-15	15-18	20
0033	2-3	4-5	5	8-10	10	12-15	15-18	10-12	8-10	12-15	15-20	15-20
0034	5-6	5-6	8-10	10-12	10-12	10	15-20	15-18	20-22	18-20	22-25	20-25
0035	4-5	6-8	7-8	10-12	8-10	8-10	-	-	15-18	15-18	20	18-20
0036	10	12	10-15	8-10	12-15	15-18	15-18	20-25	25-28	22-25	28-30	25-30
0037	7-8	4-5	8-10	10	8-10	15	12-15	15-18	20	18-20	22-25	24-25
0038	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0039	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0040	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0041	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0042	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0043	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0044	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0045	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0046	10	7-8	7-8	6-7	8-10	8-10	10-15	20-22	25	22-25	28-30	28-30
0047	4-5	4-5	7-8	10-12	7-8	12-15	12-15	15-18	15-18	14-15	18-20	18-20
0048	15-18	14-15	20-22	22	21-22	22-25	25-28	25-30	30-32	35-38	40	38-40
0049	15	8-10	12-15	11-12	14-15	12-15	20-22	25-30	28-30	25-30	25-30	25-30
0050	7-8	-	-	4-5	15-20	15-18	15	20-22	20-25	18-20	22-25	25
0051	12-15	12-15	10-15	8-10	15-18	15-20	15-20	25-30	25-30	19-20	25-30	25-30
0052	-	-	10	12	10	8-10	8-10	15-18	20	22	22-25	25
0053	11-12	11-12	15-16	13-14	15-20	22-25	25-30	15-18	22-23	25-28	30	30
0054	15	10-12	15	15-16	0	12-15	18-20	18-20	22-25	22-25	25-28	25-30
0055	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25
0056	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40
0057	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0058	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0059	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0060	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0061	15-18	20-22	18-22	15-20	25-28	25-28	30	24-25	24-25	25-30	25-30	25-30
0062	10-11	14-15	13-14	13-14	15-18	12-15	25-28	25-30	25-30	24-25	28-30	25-30
0063	15-20	14-15	25-28	18-20	25-28	25-30	35	30-35	30-32	25-30	35	35
0064	18-20	25-30	25-30	35-40	35-40	38-40	28-30	35-36	38-40	40	40	40
0065	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0066	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0067	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0068	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0069	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0070	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0071	8-10	5-8	4-5	10	10-12	10	15-20	15-20	12-15	20-25	20	20-25
0072	5	5-8	5	10	12-15	15-18	15	20	12-15	20-25	20-25	25
0073	5	5	-	-	5	10-12	15	15-18	15-20	20	25	20-25
0074	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0075	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0076	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0077	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0078	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0079	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0080	11-12	11-12	15-16	13-14	15-20	22-25	25-30	15-18	22-23	25-28	30	30
0081	15	10-12	15	15-16	0	12-15	18-20	18-20	22-25	22-25	25-28	25-30
0082	15-20	15-20	12-15	15-18	12-18	15-18	15-18	20-22	22-25	25-28	25-30	30
0083	5	10-12	5-10	8-10	12-15	10-12	15-20	12-15	15-18	15-20	15-20	20
0084	8-10	12-15	12-15	15	12-15	15-20	20-22	25-30	25	25-28	30-40	40
0085	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25
0086	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0087	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20
0088	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0089	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0090	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0091	8-10	12-13	14-15	8-10	12-13	14-15	18-20	22-25	22-25	25	24-25	24-25
0092	14-15	14-15	10-12	15-16	14-15	18-20	18-20	-	24-25	25-26	30	28-30
0093	12-13	15-16	14-15	15-20	15-20	22-25	24-25	22-25	25-30	25-30	28-30	25-30
0094	14-15	14-15	-	-	20-25	25	25	28-30	25-28	30	30	30
0095	15-16	20-22	25	22-25	25-28	30	24-25	24-25	25-28	30	30	28-30
0096	20	22-25	23-24	24-25	24-25	28-30	25-26	25-26	30	35	35-40	40
0097	2-3	4-5	5	8-10	10	12-15	15-18	10-12	8-10	12-15	15-20	15-20
0098	5-6	5-6	8-10	10-12	10-12	10	15-20	15-18	20-22	18-20	22-25	20-25
0099	4-5	6-8	7-8	10-12	8-10	8-10	-	-	15-18	15-18	20	18-20
0100	10	12	10-15	8-10	12-15	15-18	15-18	20-25	25-28	22-25	28-30	25-30
0101	7-8	4-5	8-10	10	8-10	15	12-15	15-18	20	18-20	22-25	24-25
0102	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0103	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0104	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0105	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0106	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0107	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0108	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0109	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0110	10	7-8	7-8	6-7	8-10	8-10	10-15	20-22	25	22-25	28-30	28-30
0111	4-5	4-5	7-8	10-12	7-8	12-15	12-15	15-18	15-18	14-15	18-20	18-20
0112	15-18	14-15	20-22	22	21-22	22-25	25-28	25-30	30-32	35-38	40	38-40
0113	15	8-10	12-15	11-12	14-15	12-15	20-22	25-30	28-30	25-30	25-30	25-30
0114	7-8	-	-	4-5	15-20	15-18	15	20-22	20-25	18-20	22-25	25
0115	12-15	12-15	10-15	8-10	15-18	15-20	15-20	25-30	25-30	19-20	25-30	25-30

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0116	-	-	10	12	10	8-10	8-10	15-18	20	22	22-25	25
0117	11-12	11-12	15-16	13-14	15-20	22-25	25-30	15-18	22-23	25-28	30	30
0118	15	10-12	15	15-16	0	12-15	18-20	18-20	22-25	22-25	25-28	25-30
0119	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25
0120	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40
0121	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20
0122	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0123	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0124	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0125	15-18	20-22	18-22	15-20	25-28	25-28	30	24-25	24-25	25-30	25-30	25-30
0126	10-11	14-15	13-14	13-14	15-18	12-15	25-28	25-30	25-30	24-25	28-30	25-30
0127	15-20	14-15	25-28	18-20	25-28	25-30	35	30-35	30-32	25-30	35	35
0128	18-20	25-30	25-30	35-40	35-40	38-40	28-30	35-36	38-40	40	40	40
0129	0	0	15	20-25	20-25	15-25	20	25	25-30	25-30	30	30-35
0130	10	10-15	20	20	20	15-20	25-30	25-30	15-20	20-25	35-40	40
0131	0	0	10	10-15	10-15	20	10-15	12-15	15-20	20	20	20
0132	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0133	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0134	-	15	12-15	15-20	20	15-20	20	20	10-15	20-25	20-25	30-35
0135	5-10	5-10	10-15	5-15	15-20	15-20	15-20	18-20	15-20	20-25	25-30	25-30
0136	10	12-15	12-15	10-15	15	20	20	15-20	20-25	15-20	25-30	30-35
0137	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0138	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0139	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0140	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0141	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0142	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0143	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0144	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0145	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0146	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0147	8-10	5-8	4-5	10	10-12	10	15-20	15-20	12-15	20-25	20	20-25
0148	5	5-8	5	10	12-15	15-18	15	20	12-15	20-25	20-25	25
0149	5	5	-	-	5	10-12	15	15-18	15-20	20	25	20-25
0150	10	10	15	15	10-15	15-18	15	20-22	15-20	20-25	25	25-30
0151	5	5	5	5	-	-	15	15-18	18-20	20-22	20-22	20-25
0152	10	10	-	10	15-20	15-20	20-25	22-25	25-30	25-28	25-30	25-30
0153	15-20	15-20	12-15	15-18	12-18	15-18	15-18	20-22	22-25	25-28	25-30	30
0154	5	10-12	5-10	8-10	12-15	10-12	15-20	12-15	15-18	15-20	15-20	20
0155	8-10	12-15	12-15	15	12-15	15-20	20-22	25-30	25	25-28	30-40	40
0156	10	10	12-15	12-15	15	15-18	15-18	20	20	15-20	25	25
0157	5-8	5-8	10	10-15	11-12	15-18	14-15	15-16	20	22-25	22-25	22-25
0158	4-5	4-5	7-8	5-6	8-10	15-18	12-15	14-15	12-15	18-20	20	20
0159	20	22-25	20-25	20	15	15-20	25-35	30-35	30	28-30	35-40	35-40
0160	4-5	5-10	5-10	8-10	12-15	15-20	10-15	-	-	14-15	15-18	20
0161	14-15	14-15	20-22	25-26	14-15	35	35-36	35-40	40	36-37	40	40
0162	15-16	14-15	17-18	25-30	25-30	32-35	35-38	40	35-40	35	35-40	36-40
0163	10-12	15-16	15-16	14-15	18-20	22-25	25	24-25	25	24-25	23-24	25
0164	14-15	20	22-25	24-25	25	25-26	28-30	24-25	22-23	24-25	25-30	30
0165	20	22	22-25	40	15	0	0	30	32-33	35-40	35-40	40
0166	8-10	8-10	-	-	15	12-13	14-15	14-15	25	24-25	24-25	25
0167	14-15	15	15-16	24-25	22-25	25-26	30	30-35	32	32-35	35	34-35
0168	20-25	20-25	-	-	30	32-33	35-36	45	45	45-48	50	50
0169	15-16	15-16	14-15	18-20	25-30	25-30	25-26	24-25	30	28-30	25-30	25-30
0170	15-20	15-20	25-26	24-25	35-36	40	35-36	35-38	40	38-40	40	40
0171	15	15-16	17-18	17-18	20	20	25-30	25-30	30	29-30	30	30
0172	20	22-25	24-25	24-25	25-26	30	32	33	35	35	35	35
0173	25	25	28-30	28-30	30	35	40	35-38	40	40	40	40

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0174	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25
0175	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40
0176	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20
0177	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0178	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0179	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0180	5-10	5-10	10-15	5-15	15-20	15-20	15-20	18-20	15-20	20-25	25-30	25-30
0181	10	12-15	12-15	10-15	15	20	20	15-20	20-25	15-20	25-30	30-35
0182	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0183	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0184	10	10-15	20	20	20	15-20	25-30	25-30	15-20	20-25	35-40	40
0185	15-20	15	20	25-26	24-25	22-23	28-30	25-30	24-25	30	28-30	30
0186	12-13	15-16	20	25-26	30	30	30	30	30	30	30	30
0187	25	25	25	40	35	-	-	45	50	50	50	50
0188	25	25-30	25-30	35	35	40	35-38	35-38	40	40	40	40
0189	10	10	-	-	25	25	20-25	25	25-28	30	30	28-30
0190	30	35	35	32-35	35-40	42-45	45	45-48	45-50	50	50	48-50
0191	15-20	15-20	18-20	20	20	30-32	35-36	38-40	40	40	38-40	40
0192	20-25	25	25-26	30-35	35-36	35-36	40	38-40	40	40	40	40
0193	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0194	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0195	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0196	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0197	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0198	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0199	8-10	5-8	4-5	10	10-12	10	15-20	15-20	12-15	20-25	20	20-25
0200	5	5-8	5	10	12-15	15-18	15	20	12-15	20-25	20-25	25
0201	5	5	-	-	5	10-12	15	15-18	15-20	20	25	20-25
0202	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0203	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0204	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0205	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0206	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0207	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0208	11-12	11-12	15-16	13-14	15-20	22-25	25-30	15-18	22-23	25-28	30	30
0209	15	10-12	15	15-16	0	12-15	18-20	18-20	22-25	22-25	25-28	25-30
0210	15-20	15-20	12-15	15-18	12-18	15-18	15-18	20-22	22-25	25-28	25-30	30
0211	5	10-12	5-10	8-10	12-15	10-12	15-20	12-15	15-18	15-20	15-20	20
0212	8-10	12-15	12-15	15	12-15	15-20	20-22	25-30	25	25-28	30-40	40
0213	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25
0214	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40
0215	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20
0216	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0217	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0218	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0219	8-10	12-13	14-15	8-10	12-13	14-15	18-20	22-25	22-25	25	24-25	24-25
0220	14-15	14-15	10-12	15-16	14-15	18-20	18-20	-	24-25	25-26	30	28-30
0221	12-13	15-16	14-15	15-20	15-20	22-25	24-25	22-25	25-30	25-30	28-30	25-30
0222	14-15	14-15	-	-	20-25	25	25	28-30	25-28	30	30	30
0223	15-16	20-22	25	22-25	25-28	30	24-25	24-25	25-28	30	30	28-30
0224	20	22-25	23-24	24-25	24-25	28-30	25-26	25-26	30	35	35-40	40
0225	2-3	4-5	5	8-10	10	12-15	15-18	10-12	8-10	12-15	15-20	15-20
0226	5-6	5-6	8-10	10-12	10-12	10	15-20	15-18	20-22	18-20	22-25	20-25
0227	4-5	6-8	7-8	10-12	8-10	8-10	-	-	15-18	15-18	20	18-20
0228	10	12	10-15	8-10	12-15	15-18	15-18	20-25	25-28	22-25	28-30	25-30
0229	7-8	4-5	8-10	10	8-10	15	12-15	15-18	20	18-20	22-25	24-25
0230	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0231	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0232	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0233	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0234	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0235	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0236	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0237	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0238	10	7-8	7-8	6-7	8-10	8-10	10-15	20-22	25	22-25	28-30	28-30
0239	4-5	4-5	7-8	10-12	7-8	12-15	12-15	15-18	15-18	14-15	18-20	18-20
0240	15-18	14-15	20-22	22	21-22	22-25	25-28	25-30	30-32	35-38	40	38-40
0241	15	8-10	12-15	11-12	14-15	12-15	20-22	25-30	28-30	25-30	25-30	25-30
0242	7-8	-	-	4-5	15-20	15-18	15	20-22	20-25	18-20	22-25	25
0243	12-15	12-15	10-15	8-10	15-18	15-20	15-20	25-30	25-30	19-20	25-30	25-30
0244	-	-	10	12	10	8-10	8-10	15-18	20	22	22-25	25
0245	11-12	11-12	15-16	13-14	15-20	22-25	25-30	15-18	22-23	25-28	30	30
0246	15	10-12	15	15-16	0	12-15	18-20	18-20	22-25	22-25	25-28	25-30
0247	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25
0248	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40
0249	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20
0250	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0251	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0252	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0253	15-18	20-22	18-22	15-20	25-28	25-28	30	24-25	24-25	25-30	25-30	25-30
0254	10-11	14-15	13-14	13-14	15-18	12-15	25-28	25-30	25-30	24-25	28-30	25-30
0255	15-20	14-15	25-28	18-20	25-28	25-30	35	30-35	30-32	25-30	35	35
0256	18-20	25-30	25-30	35-40	35-40	38-40	28-30	35-36	38-40	40	40	40
0257	0	0	15	20-25	20-25	15-25	20	25	25-30	25-30	30	30-35
0258	10	10-15	20	20	20	15-20	25-30	25-30	15-20	20-25	35-40	40
0259	0	0	10	10-15	10-15	20	10-15	12-15	15-20	20	20	20
0260	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0261	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0262	-	15	12-15	15-20	20	15-20	20	20	10-15	20-25	20-25	30-35
0263	5-10	5-10	10-15	5-15	15-20	15-20	15-20	18-20	15-20	20-25	25-30	25-30
0264	10	12-15	12-15	10-15	15	20	20	15-20	20-25	15-20	25-30	30-35
0265	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0266	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0267	10	10	-	-	15	10	20-25	15-20	18-20	19-20	25-30	25-30
0268	8-10	10	15-18	12-15	15	15	10	15-20	20-25	20	25	25
0269	5-10	10	10-15	12-15	15	12-15	15-18	20-25	15-20	20	20-25	25
0270	15	15	10	12-15	15	14-15	15-18	20	18-20	20	25-30	30
0271	5-10	5-10	15	15-20	15-20	20	20-25	15-25	12-15	15	18-20	25
0272	1-2	1-2	0	0	2-5	5-8	5-8	10-12	10-15	15	8-10	15
0273	5-10	5-10	10-15	10-15	10	15	20	10-15	15	20	12-15	20
0274	5	5-10	5-10	15	15-20	20	20-25	15-20	10-15	20-25	25	25
0275	8-10	5-8	4-5	10	10-12	10	15-20	15-20	12-15	20-25	20	20-25
0276	5	5-8	5	10	12-15	15-18	15	20	12-15	20-25	20-25	25
0277	5	5	-	-	5	10-12	15	15-18	15-20	20	25	20-25
0278	10	10	15	15	10-15	15-18	15	20-22	15-20	20-25	25	25-30
0279	5	5	5	5	-	-	15	15-18	18-20	20-22	20-22	20-25
0280	10	10	-	10	15-20	15-20	20-25	22-25	25-30	25-28	25-30	25-30
0281	15-20	15-20	12-15	15-18	12-18	15-18	15-18	20-22	22-25	25-28	25-30	30
0282	5	10-12	5-10	8-10	12-15	10-12	15-20	12-15	15-18	15-20	15-20	20
0283	8-10	12-15	12-15	15	12-15	15-20	20-22	25-30	25	25-28	30-40	40
0284	10	10	12-15	12-15	15	15-18	15-18	20	20	15-20	25	25
0285	5-8	5-8	10	10-15	11-12	15-18	14-15	15-16	20	22-25	22-25	22-25
0286	4-5	4-5	7-8	5-6	8-10	15-18	12-15	14-15	12-15	18-20	20	20
0287	20	22-25	20-25	20	15	15-20	25-35	30-35	30	28-30	35-40	35-40
0288	4-5	5-10	5-10	8-10	12-15	15-20	10-15	-	-	14-15	15-18	20
0289	12	12	-	-	15-18	15-18	10-12	0	0	25	22-25	21-25

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0290	15-20	15-20	20-22	15-20	25-28	25-28	30-35	-	28-30	35-40	38-40	40
0291	-	-	-	-	4-5	4-5	10-12	15	15-16	18-20	18-20	20
0292	8-10	8-10	15-20	15-18	12-15	15-16	20-22	25	24-25	20	25	25
0293	11-12	11-12	14-15	-	14-15	20-22	25	22-25	24-25	25	25	25
0294	10-12	8-10	15-18	20-22	25-30	25-30	28-30	25-30	-	-	30	30
0295	5-10	5-10	10-15	5-15	15-20	15-20	15-20	18-20	15-20	20-25	25-30	25-30
0296	10	12-15	12-15	10-15	15	20	20	15-20	20-25	15-20	25-30	30-35
0297	5-10	5-10	15-20	15	20	18-20	15-18	20	15-20	25-30	30	30
0298	15	12-15	8-10	15	10	15-18	15-20	22-25	20	24-25	22-25	25
0299	10	10-15	20	20	20	15-20	25-30	25-30	15-20	20-25	35-40	40

Appendix 8: Knee mobilization exercise and hot pack for 10 minute for 2 time per day for 12week

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0001	40	45	45-50	45-50	55	55	55-60	45-50	55-65	65	65-70	70
0002	42	45-46	45-46	60	50-52	55-56	47-48	58-60	60	60	60	60
0003	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0004	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0005	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0006	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0007	45	45	52	55	55	58	60	65	65-70	70	70	70
0008	45	40-45	45-48	50-52	45-46	60-62	65	65-68	70	70	70	70
0009	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0010	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0011	35-38	40-42	44-45	44-45	50-52	55-60	60-65	55-65	65	65-70	70	68-70
0012	45-48	50-52	45-48	48-50	55-60	60-65	75-78	60-65	80	75-80	80	80
0013	40-45	40-45	42-50	45-50	50-53	50-55	70-75	70-75	65-75	75-80	80	78-80
0014	35-40	45-50	65-70	50-55	25-30	45-54	55-60	58-60	60	60	60	60
0015	48-50	50	55-60	55-60	65-70	59-60	62-65	65	50-60	65-60	56-60	60
0016	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0017	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0018	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0019	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0020	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0021	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0022	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0023	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0024	35-38	35-40	40-42	42-45	45-48	50-55	55-58	60	-	-	60	60
0025	40-45	40-45	45-48	48-50	0	0	50-52	50-58	50-55	60-65	70	70
0026	25	28-30	25-30	45-50	45-58	-	-	-	50-52	50-55	55-60	100
0027	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0028	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0029	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0030	40-42	42-450	50-52	52-50	45-50	45-50	30	50-55	60-65	58-65	60-65	30-70
0031	50	52	50	55	58	57	55	67	65-70	65-70	70	75-80
0032	45-50	50-15	50-55	50-52	60-65	70	65-75	70-72	65-70	730	85-85	70
0033	42-45	45-48	45-48	50-52	52-55	55-58	60	55-58	55-60	58-60	58-60	58-60
0034	40-45	40-45	-	-	45-50	40-45	50-52	52-55	55-60	55-60	55-60	55-60
0035	-	-	-	-	-	-	-	-	-	-	-	-
0036	50-52	52-55	52-55	55-58	58-60	62-65	65-68	65-70	70	70	70	65-70
0037	40-45	40-45	42-50	45-50	50-53	50-55	70-75	70-75	65-75	75-80	80	78-80
0038	35-40	45-50	65-70	50-55	25-30	45-54	55-60	58-60	60	60	60	60
0039	48-50	50	55-60	55-60	65-70	59-60	62-65	65	50-60	65-60	56-60	60
0040	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0041	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0042	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0043	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0044	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0045	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0046	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0047	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0048	50	55	53	52	58	60	62	65	65	70	65-70	68-70
0049	45-48	48-50	50	50	55	55-58	58-60	62-65	65-70	70	65-70	65-70
0050	50	52	52-55	52-55	55-58	58-60	60-62	65-70	70-75	75-80	75-80	75-80
0051	45-48	45-48	50-52	52-55	55-58	58-60	60	60-62	62-65	65-70	65-70	65-70
0052	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0053	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0054	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0055	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0056	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0057	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-62	62-65	60-65	65-70	70
0058	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0059	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0060	45-50	50-55	55-58	58-60	62-65	65-68	68-70	65-70	70	58-60	65-70	65-70
0061	50-55	55-60	60-62	62-65	65-68	68-70	70-72	72-75	75-78	78-80	80	80
0062	45	48	50	55	58	60	6	65	68	70	65	70
0063	42	45	48	45	50	52	55	58	62	65	68	70
0064	40-42	45-48	48-50	50-52	52-55	55-58	58-60	60	60-65	65-70	70	70
0065	35-40	40-45	45-50	40-45	40-45	50-55	50-55	55	55-60	55-60	65-70	65-70
0066	40-42	42-45	45-48	48-52	52-55	55-58	58-60	60-65	65-70	70-75	75-80	75-80
0067	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0068	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0069	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0070	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0071	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0072	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0073	50	55	53	52	58	60	62	65	65	70	65-70	68-70
0074	45-48	48-50	50	50	55	55-58	58-60	62-65	65-70	70	65-70	65-70
0075	50	52	52-55	52-55	55-58	58-60	60-62	65-70	70-75	75-80	75-80	75-80
0076	45-48	45-48	50-52	52-55	55-58	58-60	60	60-62	62-65	65-70	65-70	65-70
0077	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0078	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0079	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0080	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0081	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70
0082	-	-	-	-	-	-	-	-	-	-	-	-
0083	50	52	55	58	62	65	68	70	72	75	80	78
0084	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0085	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0086	40-42	45-48	50	52	55	56	60	62	66	70	68	70
0087	45	45	52	55	55	58	60	65	65-70	70	70	70
0088	45	40-45	45-48	50-52	45-46	60-62	65	65-68	70	70	70	70
0089	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0090	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0091	35-38	40-42	44-45	44-45	50-52	55-60	60-65	55-65	65	65-70	70	68-70
0092	45-48	50-52	45-48	48-50	55-60	60-65	75-78	60-65	80	75-80	80	80
0093	40-42	42-45	45-48	48-50	52-55	55-58	58-60	60-65	65-68	68-70	70-75	70-75
0094	35	38	42	45	48	50	52	55	58	60	60	60
0095	45	42-45	45-48	48-50	52-55	55-58	58-60	60-65	65-68	68-70	70	70
0096	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	70-75	75-78	78-80	75-80
0097	48	50	45	60	65	55	62	55	65	70	75-80	75-80
0098	35-40	40-45	45-48	48-50	50-55	55-58	58-60	60-65	65-68	70-75	75-80	75-80
0099	40-42	42-45	45-48	50-55	55-58	58-60	65-70	70-75	75-78	80	80	80
0100	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0101	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0102	50	55	53	52	58	60	62	65	65	70	65-70	68-70
0103	45-48	48-50	50	50	55	55-58	58-60	62-65	65-70	70	65-70	65-70
0104	50	52	52-55	52-55	55-58	58-60	60-62	65-70	70-75	75-80	75-80	75-80
0105	45-48	45-48	50-52	52-55	55-58	58-60	60	60-62	62-65	65-70	65-70	65-70
0106	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0107	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0108	45	48	50	52	55	58	60	65	68	65	70	70
0109	45-48	48-50	62	65	65	68	68	70	75	80	80	80
0110	50	55	60	60-65	65-70	70-75	75-80	80-85	80-85	80-85	80-85	80-85
0111	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0112	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0113	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0114	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0115	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0116	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0117	41-42	42-45	45-48	50-52	52-55	55-58	60-58	58-70	70-75	75-78	80	80
0118	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0119	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0120	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0121	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0122	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70
0123	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-62	62-65	60-65	65-70	70
0124	40-45	40-45	42-45	45-48	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0125	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0126	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0127	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0128	40-42	45-48	50	52	55	56	60	62	66	70	68	70
0129	42-45	45-48	45-48	50-52	52-55	55-58	60	55-58	55-60	58-60	58-60	58-60
0130	40-45	40-45	-	-	45-50	40-45	50-52	52-55	55-60	55-60	55-60	55-60
0131	35	40	40	-	-	45	48	50	55	58	60	60
0132	50-52	52-55	52-55	55-58	58-60	62-65	65-68	65-70	70	70	70	65-70
0133	40-45	40-45	42-50	45-50	50-53	50-55	70-75	70-75	65-75	75-80	80	78-80
0134	35-40	45-50	65-70	50-55	25-30	45-54	55-60	58-60	60	60	60	60
0135	48-50	50	55-60	55-60	65-70	59-60	62-65	65	50-60	65-60	56-60	60
0136	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0137	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0138	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0139	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0140	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0141	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0142	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0143	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0144	50	55	53	52	58	60	62	65	65	70	65-70	68-70
0145	45-48	48-50	50	50	55	55-58	58-60	62-65	65-70	70	65-70	65-70
0146	50	52	52-55	52-55	55-58	58-60	60-62	65-70	70-75	75-80	75-80	75-80
0147	45-48	45-48	50-52	52-55	55-58	58-60	60	60-62	62-65	65-70	65-70	65-70
0148	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0149	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0150	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0151	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0152	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70
0153	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-62	62-65	60-65	65-70	70
0154	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0155	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0156	45-50	50-55	55-58	58-60	62-65	65-68	68-70	65-70	70	58-60	65-70	65-70
0157	50-55	55-60	60-62	62-65	65-68	68-70	70-72	72-75	75-78	78-80	80	80
0158	45	48	50	55	58	60	6	65	68	70	65	70
0159	42	45	48	45	50	52	55	58	62	65	68	70
0160	40-42	45-48	48-50	50-52	52-55	55-58	58-60	60	60-65	65-70	70	70
0161	40	45	45-50	45-50	55	55	55-60	45-50	55-65	65	65-70	70
0162	42	45-46	45-46	60	50-52	55-56	47-48	58-60	60	60	60	60
0163	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0164	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0165	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0166	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0167	45	45	52	55	55	58	60	65	65-70	70	70	70
0168	45	40-45	45-48	50-52	45-46	60-62	65	65-68	70	70	70	70
0169	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0170	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0171	35-38	40-42	44-45	44-45	50-52	55-60	60-65	55-65	65	65-70	70	68-70
0172	45-48	50-52	45-48	48-50	55-60	60-65	75-78	60-65	80	75-80	80	80

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0173	40-45	40-45	42-50	45-50	50-53	50-55	70-75	70-75	65-75	75-80	80	78-80
0174	35-40	45-50	65-70	50-55	25-30	45-54	55-60	58-60	60	60	60	60
0175	48-50	50	55-60	55-60	65-70	59-60	62-65	65	50-60	65-60	56-60	60
0176	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0177	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0178	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0179	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0180	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0181	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0182	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0183	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0184	35-38	35-40	40-42	42-45	45-48	50-55	55-58	60	-	-	60	60
0185	40-45	40-45	45-48	48-50	0	0	50-52	50-58	50-55	60-65	70	70
0186	25	28-30	25-30	45-50	45-58	-	-	-	50-52	50-55	55-60	100
0187	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0188	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0189	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0190	40-42	42-450	50-52	52-50	45-50	45-50	30	50-55	60-65	58-65	60-65	30-70
0191	50	52	50	55	58	57	55	67	65-70	65-70	70	75-80
0192	45-50	50-15	50-55	50-52	60-65	70	65-75	70-72	65-70	730	85-85	70
0193	35-40	40-45	45-50	40-45	40-45	50-55	50-55	55	55-60	55-60	65-70	65-70
0194	40-42	42-45	45-48	48-52	52-55	55-58	58-60	60-65	65-70	70-75	75-80	75-80
0195	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0196	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0197	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0198	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0199	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0200	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0201	50	55	53	52	58	60	62	65	65	70	65-70	68-70

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0202	45-48	48-50	50	50	55	55-58	58-60	62-65	65-70	70	65-70	65-70
0203	50	52	52-55	52-55	55-58	58-60	60-62	65-70	70-75	75-80	75-80	75-80
0204	45-48	45-48	50-52	52-55	55-58	58-60	60	60-62	62-65	65-70	65-70	65-70
0205	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0206	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0207	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0208	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0209	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70
0210	40	42-45	45-48	48-50	52-55	55-58	58-60	60-65	65-70	70-75	75-80	75-80
0211	50	52	55	58	62	65	68	70	72	75	80	78
0212	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0213	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0214	40-42	45-48	50	52	55	56	60	62	66	70	68	70
0215	45	45	52	55	55	58	60	65	65-70	70	70	70
0216	45	40-45	45-48	50-52	45-46	60-62	65	65-68	70	70	70	70
0217	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0218	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0219	35-38	40-42	44-45	44-45	50-52	55-60	60-65	55-65	65	65-70	70	68-70
0220	45-48	50-52	45-48	48-50	55-60	60-65	75-78	60-65	80	75-80	80	80
0221	40-42	42-45	45-48	48-50	52-55	55-58	58-60	60-65	65-68	68-70	70-75	70-75
0222	35	38	42	45	48	50	52	55	58	60	60	60
0223	45	42-45	45-48	48-50	52-55	55-58	58-60	60-65	65-68	68-70	70	70
0224	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	70-75	75-78	78-80	75-80
0225	42-45	45-48	45-48	50-52	52-55	55-58	60	55-58	55-60	58-60	58-60	58-60
0226	40-45	40-45	-	-	45-50	40-45	50-52	52-55	55-60	55-60	55-60	55-60
0227	-	-	-	-	-	-	-	-	-	-	-	-
0228	50-52	52-55	52-55	55-58	58-60	62-65	65-68	65-70	70	70	70	65-70
0229	40-45	40-45	42-50	45-50	50-53	50-55	70-75	70-75	65-75	75-80	80	78-80
0230	35-40	45-50	65-70	50-55	25-30	45-54	55-60	58-60	60	60	60	60

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0231	48-50	50	55-60	55-60	65-70	59-60	62-65	65	50-60	65-60	56-60	60
0232	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0233	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0234	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0235	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0236	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0237	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0238	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0239	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0240	50	55	53	52	58	60	62	65	65	70	65-70	68-70
0241	45-48	48-50	50	50	55	55-58	58-60	62-65	65-70	70	65-70	65-70
0242	50	52	52-55	52-55	55-58	58-60	60-62	65-70	70-75	75-80	75-80	75-80
0243	45-48	45-48	50-52	52-55	55-58	58-60	60	60-62	62-65	65-70	65-70	65-70
0244	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0245	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0246	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0247	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0248	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70
0249	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-62	62-65	60-65	65-70	70
0250	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0251	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0252	45-50	50-55	55-58	58-60	62-65	65-68	68-70	65-70	70	58-60	65-70	65-70
0253	50-55	55-60	60-62	62-65	65-68	68-70	70-72	72-75	75-78	78-80	80	80
0254	45	48	50	55	58	60	6	65	68	70	65	70
0255	42	45	48	45	50	52	55	58	62	65	68	70
0256	40-42	45-48	48-50	50-52	52-55	55-58	58-60	60	60-65	65-70	70	70
0257	40	45	45-50	45-50	55	55	55-60	45-50	55-65	65	65-70	70
0258	42	45-46	45-46	60	50-52	55-56	47-48	58-60	60	60	60	60
0259	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0260	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0261	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0262	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0263	45	45	52	55	55	58	60	65	65-70	70	70	70
0264	45	40-45	45-48	50-52	45-46	60-62	65	65-68	70	70	70	70
0265	50	50-55	45-50	52-55	55-60	60-62	62-65	65-68	70	68-70	70	70
0266	50-55	55-58	48-50	60-65	60-65	70-72	65-70	70-75	75-78	80	78-80	80
0267	35-38	40-42	44-45	44-45	50-52	55-60	60-65	55-65	65	65-70	70	68-70
0268	45-48	50-52	45-48	48-50	55-60	60-65	75-78	60-65	80	75-80	80	80
0269	40-45	40-45	42-50	45-50	50-53	50-55	70-75	70-75	65-75	75-80	80	78-80
0270	35-40	45-50	65-70	50-55	25-30	45-54	55-60	58-60	60	60	60	60
0271	48-50	50	55-60	55-60	65-70	59-60	62-65	65	50-60	65-60	56-60	60
0272	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0273	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0274	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0275	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0276	40-45	45-48	45-48	50-52	50-52	55-60	55-58	60-62	65-70	65-70	65-70	65-70
0277	40-45	40-45	-	-	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0278	35-40	30-33	35-40	40-42	42-45	45-48	48-50	48-50	50	45-50	48-50	50
0279	55-60	65-70	65-70	70-75	75-78	80-85	90-95	100	90-95	100	100	100
0280	35-38	35-40	40-42	42-45	45-48	50-55	55-58	60	-	-	60	60
0281	40-45	40-45	45-48	48-50	0	0	50-52	50-58	50-55	60-65	70	70
0282	25	28-30	25-30	45-50	45-58	-	-	-	50-52	50-55	55-60	100
0283	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0284	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0285	40-42	45-48	50	52	55	56	60	62	66	70	-	70
0286	40-42	42-450	50-52	52-50	45-50	45-50	30	50-55	60-65	58-65	60-65	30-70
0287	50	52	50	55	58	57	55	67	65-70	65-70	70	75-80
0288	45-50	50-15	50-55	50-52	60-65	70	65-75	70-72	65-70	730	85-85	70

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0289	53-55	55-60	60-62	62-65	65-70	70-75	75-80	70-75	75078	78-80	78-80	78-80
0290	40-42	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-65	65-70	65-70	65-70
0291	40-45	45-50	50-52	52-55	55-58	58-60	60-62	62-65	65-68	68-70	68-70	68-70
0292	50	52-55	55-58	58-60	60-62	62-65	65-68	60-65	65-70	70	70	70
0293	40	45	42	48	45	42	51	52-55	55-58	60	65-70	65-70
0294	42-45	45-48	48-50	50-52	52-55	55-58	58-60	60-62	62-65	60-65	65-70	70
0295	40-45	40-45	42-45	45-48	50-55	50-55	52-55	60-62	60-62	65-70	65-70	65-70
0296	45	45-60	45-65	65-66	65-66	58-60	65-70	75	75	80	80	80
0297	40-42	42-45	50	54-55	56-58	60-62	65-66	58-60	68-70	70	70	68-70
0298	50	50	55-56	56-58	60-62	62-65	65-66	66-68	70	68-70	65-70	65-70
0299	40-42	45-48	50	52	55	56	60	62	66	70	68	70

Appendix 9: Deep Transverse Friction Massage (DTFM) and hot pack for 2 time per day for 12 week

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0001	60	65	65	70	75	75	75	80	85	90	95	100
0002	65	70	75	80	75	80	85	90	95	100	100	100
0003	50	60	65	55	68	70	65	70	75	80	90	100
0004	60	65	68	70	75	80	85	85	90	95	95	95
0005	60	62	65	68	70	75	78	82	85	90	90	90
0006	55	60	65	65	70	72	75	78	80	85	90	100
0007	60	65	65	70	78	80	85	90	95	100	100	100
0008	50	55	60	65	65	70	75	75	80	82	85	90
0009	45	45	50	50	50	60	65	70	75	80	85	90
0010	45	50	55	65	70	75	80	75	90	75	85	90
0011	60	65	70	75	85	90	95	90	90	100	100	100
0012	60	70	70	65	75	80	85	85	75	80	85	90
0013	65	65	70	75	75	85	85	90	90	95	95	95
0014	60	65	65	70	75	75	85	85	90	90	90	90
0015	50	50	55	65	65	70	75	70	80	85	90	90
0016	-	-	-	-	-	-	-	-	-	-	-	-
0017	60	60	65	70	75	75	85	85	90	95	95	95
0018	65	65	70	85	85	90	95	95	100	100	100	100
0019	60	70	70	75	80	80	85	85	95	95	95	95
0020	50	55	60	55	65	70	75	80	85	80	85	85
0021	65	65	70	75	75	80	85	85	95	95	95	95
0022	45	55	65	65	75	80	80	85	85	90	95	95
0023	60	65	65	70	70	75	78	75	80	90	95	100
0024	50	55	55	60	65	65	70	70	80	85	95	95
0025	60	60	65	65	65	70	70	75	75	80	90	95
0026	60	65	65	68	70	75	78	80	85	95	100	100
0027	75	75	80	85	88	90	95	92	98	100	100	100
0028	50	50	55	60	65	68	70	80	95	95	95	95

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0029	50	50	55	65	65	68	70	72	75	90	90	90
0030	65	65	70	70	78	80	82	85	90	95	95-100	100
0031	50	60	70	75	78	80	85	90	95	100	100	100
0032	65	65	70	75	70	78	80	85	90	95	95	95
0033	65	65	70	70	75	78	80	85	95	100	100	100
0034	58	60	65	68	70	80	85	90	95	95	95	95
0035	55	60	65	65	70	75	75	80	85	85	95	95
0036	50	55	60	65	70	70	78	85	90	95	95	95
0037	60	62	65	68	70	75	78	80	85	90	95	100
0038	65	65	75	75	85	85	100	95	98	100	100	100
0039	65	65	70	75	75	80	90	95	95	100	100	100
0040	70	75	75	80	88	85	90	98	100	100	95	100
0041	70	70	75	75	78	78	80	85	85	90	100	100
0042	50	50	58	60	55	65	70	75	80	90	95-100	95-100
0043	55	58	60	60	65	68	70	75	78	85-90	85-90	85-90
0044	65	65	70	85	85	90	95	95	100	100	100	100
0045	60	70	70	75	80	80	85	85	95	95	95	95
0046	50	55	60	55	65	70	75	80	85	80	85	85
0047	65	65	70	75	75	80	85	85	95	95	95	95
0048	45	55	65	65	75	80	80	85	85	90	95	95
0049	60	65	65	70	70	75	78	75	80	90	95	100
0050	50	55	55	60	65	65	70	70	80	85	95	95
0051	60	60	65	65	65	70	70	75	75	80	90	95
0052	60	65	65	68	70	75	78	80	85	95	100	100
0053	75	75	80	85	88	90	95	92	98	100	100	100
0054	65	65	70	75	78	80	85	90	95	95	95	95
0055	45	55	65	60	70	75	80	85	80	85	90	90
0056	55	55	65	60	68	70	75	78	80	82	85	90
0057	60	65	68	70	72	75	78	80	90	80	95	95

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0058	70	75	75	80	85	80	85	85-90	90-95	95-100	100	100
0059	65	65	70	70	75	78	80	85	88	90	95	100
0060	70	70	75	78	80	85	86	90	95	100	100	100
0061	75	75	80	85	88	90	85	90	95	100	100	100
0062	50	55	65	68	70	75	75	80	95	100	95	100
0063	80	85	85	80	95	90	85	90	90	95	100	100
0064	65	65	70	70	85	85	80	78	85	90	95	95
0065	65	65	75	75	85	85	100	95	98	100	100	100
0066	65	65	70	75	75	80	90	95	95	100	100	100
0067	70	75	75	80	88	85	90	98	100	100	95	100
0068	70	70	75	75	78	78	80	85	85	90	100	100
0069	50	50	58	60	55	65	70	75	80	90	95-100	95-100
0070	55	58	60	60	65	68	70	75	78	85-90	85-90	85-90
0071	65	65	70	85	85	90	95	95	100	100	100	100
0072	65	65	70	70	75	78	80	85	88	90	95	100
0073	70	70	75	78	80	85	86	90	95	100	100	100
0074	75	75	80	85	88	90	85	90	95	100	100	100
0075	50	55	65	68	70	75	75	80	95	100	95	100
0076	45	55	65	60	70	75	80	85	80	85	90	90
0077	55	55	65	60	68	70	75	78	80	82	85	90
0078	60	65	68	70	72	75	78	80	90	80	95	95
0079	70	75	75	80	85	80	85	85-90	90-95	95-100	100	100
0080	65	65	70	70	75	78	80	85	88	90	95	100
0081	70	70	75	78	80	85	86	90	95	100	100	100
0082	75	75	80	85	88	90	85	90	95	100	100	100
0083	50	55	65	68	70	75	75	80	95	100	95	100
0084	80	85	85	80	95	90	85	90	90	95	100	100
0085	60	65	65	70	70	75	78	75	80	90	95	100
0086	50	55	55	60	65	65	70	70	80	85	95	95

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0087	60	60	65	65	65	70	70	75	75	80	90	95
0088	60	65	65	68	70	75	78	80	85	95	100	100
0089	75	75	80	85	88	90	95	92	98	100	100	100
0090	50	50	55	60	65	68	70	80	95	95	95	95
0091	50	50	55	65	65	68	70	72	75	90	90	90
0092	65	65	70	70	78	80	82	85	90	95	95-100	100
0093	50	60	70	75	78	80	85	90	95	100	100	100
0094	50	55	55	65	75	85	90	88	75	90	90	90
0095	60	65	65	70	75	75	80	85	90	90	95	95
0096	55	60	65	70	78	80	85	90	95	85	95	95
0097	50	55	55	65	70	75	75	80	85	90	90	95
0098	55	60	65	65	70	65	75	75	80	95	95	95
0099	70	75	80	85	85	90	95	95	85	100	100	100
0100	80	80	85	85	90	95	95	90	85	95	95	95
0101	70	75	75	80	85	85	90	90	95	100	100	100
0102	65	65	70	75	70	78	82	85	88	95	95	95
0103	80	85	88	90	95	98	100	100	100	100	100	100
0104	50	55	65	65	70	78	80	85	95	100	95-100	100
0105	45	50	55	65	70	75	80	75	90	75	85	90
0106	60	65	70	75	85	90	95	90	90	100	100	100
0107	60	70	70	65	75	80	85	85	75	80	85	90
0108	65	65	70	75	75	85	85	90	90	95	95	95
0109	60	65	65	70	75	75	85	85	90	90	90	90
0110	50	50	55	65	65	70	75	70	80	85	90	90
0111	70	75	75	80	85	85	90	95	95	100	100	100
0112	65	65	70	75	80	85	85	95	95	100	100	100
0113	75	75	80	85	85	90	95	75	95	100	100	100
0114	80	80	85	85	95	98	95	85	95	100	100	100
0115	70	80	85	75	85	90	95	85	100	85	95	100

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0116	65	65	75	80	85	85	90	95	95	100	100	100
0117	65	65	75	85	80	95	85	100	100	100	95	100
0118	58	60	65	64	62	68	70	85	90	95	100	100
0119	60	65	70	75	80	85	90	90	95	100	95	100
0120	66	68	70	75	78	80	85	88	90	95	100	100
0121	50	55	58	60	70	75	80	85	90	95	95	95
0122	65	65	65	70	70	82	85	88	90	97	85	100
0123	70	75	75	78	80	85	88	90	95	95	95	95
0124	75	80	85	80	85	95	100	95	100	100	100	100
0125	65	65	70	75	80	85	90	95	100	95	88	100
0126	60	70	70	65	75	80	85	85	75	80	85	90
0127	65	65	70	75	75	85	85	90	90	95	95	95
0128	60	65	65	70	75	75	85	85	90	90	90	90
0129	65	65	75	75	85	85	100	95	98	100	100	100
0130	65	65	70	75	75	80	90	95	95	100	100	100
0131	70	75	75	80	88	85	90	98	100	100	95	100
0132	70	70	75	75	78	78	80	85	85	90	100	100
0133	70	75	75	80	85	80	85	85-90	90-95	95-100	100	100
0134	65	65	70	70	75	78	80	85	88	90	95	100
0135	70	70	75	78	80	85	86	90	95	100	100	100
0136	75	75	80	85	88	90	85	90	95	100	100	100
0137	50	55	65	68	70	75	75	80	95	100	95	100
0138	80	85	85	80	95	90	85	90	90	95	100	100
0139	45	45	50	50	50	60	65	70	75	80	85	90
0140	45	50	55	65	70	75	80	75	90	75	85	90
0141	60	65	70	75	85	90	95	90	90	100	100	100
0142	60	70	70	65	75	80	85	85	75	80	85	90
0143	65	65	70	75	75	85	85	90	90	95	95	95
0144	60	65	65	70	75	75	85	85	90	90	90	90

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0145	50	50	55	65	65	70	75	70	80	85	90	90
0146	70	75	75	80	85	85	90	95	95	100	100	100
0147	65	65	70	75	80	85	85	95	95	100	100	100
0148	75	75	80	85	85	90	95	75	95	100	100	100
0149	80	80	85	85	95	98	95	85	95	100	100	100
0150	70	80	85	75	85	90	95	85	100	85	95	100
0151	65	65	75	80	85	85	90	95	95	100	100	100
0152	70	75	75	80	85	90	95	85	88	95	95	95
0153	85	85	90	95	-	-	85	95	100	100	100	100
0154	80	80	85	88	87	85	95	95	100	85	100	100
0155	78	80	80	85	85	95	90	95	98	65	75	80
0156	65	65	75	80	85	85	90	95	85	95	95	95
0157	70	70	75	78	75	80	83	85	84	90	95	95
0158	80	80	85	90	95	88	78	95	100	100	100	100
0159	50	55	65	68	70	75	75	80	95	100	95	100
0160	80	85	85	80	95	90	85	90	90	95	100	100
0161	50	55	55	65	70	75	75	80	85	90	90	95
0162	55	60	65	65	70	65	75	75	80	95	95	95
0163	70	75	80	85	85	90	95	95	85	100	100	100
0164	80	80	85	85	90	95	95	90	85	95	95	95
0165	70	75	75	80	85	85	90	90	95	100	100	100
0166	65	65	70	75	70	78	82	85	88	95	95	95
0167	80	85	88	90	95	98	100	100	100	100	100	100
0168	50	55	65	65	70	78	80	85	95	100	95-100	100
0169	45	50	55	65	70	75	80	75	90	75	85	90
0170	60	65	70	75	85	90	95	90	90	100	100	100
0171	60	70	70	65	75	80	85	85	75	80	85	90
0172	65	65	70	75	75	85	85	90	90	95	95	95
0173	60	65	65	70	75	75	85	85	90	90	90	90

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0174	50	50	55	65	65	70	75	70	80	85	90	90
0175	70	75	75	80	85	85	90	95	95	100	100	100
0176	65	65	70	75	80	85	85	95	95	100	100	100
0177	75	75	80	85	85	90	95	75	95	100	100	100
0178	80	80	85	85	95	98	95	85	95	100	100	100
0179	70	80	85	75	85	90	95	85	100	85	95	100
0180	65	65	75	80	85	85	90	95	95	100	100	100
0181	65	65	75	85	80	95	85	100	100	100	95	100
0182	58	60	65	64	62	68	70	85	90	95	100	100
0183	60	65	70	75	80	85	90	90	95	100	95	100
0184	66	68	70	75	78	80	85	88	90	95	100	100
0185	50	55	58	60	70	75	80	85	90	95	95	95
0186	65	65	65	70	70	82	85	88	90	97	85	100
0187	70	75	75	78	80	85	88	90	95	95	95	95
0188	75	80	85	80	85	95	100	95	100	100	100	100
0189	65	65	70	75	80	85	90	95	100	95	88	100
0190	60	70	70	65	75	80	85	85	75	80	85	90
0191	65	65	70	75	75	85	85	90	90	95	95	95
0192	60	65	65	70	75	75	85	85	90	90	90	90
0193	65	65	75	75	85	85	100	95	98	100	100	100
0194	65	65	70	75	75	80	90	95	95	100	100	100
0195	70	75	75	80	88	85	90	98	100	100	95	100
0196	70	70	75	75	78	78	80	85	85	90	100	100
0197	50	50	58	60	55	65	70	75	80	90	95-100	95-100
0198	55	58	60	60	65	68	70	75	78	85-90	85-90	85-90
0199	65	65	70	85	85	90	95	95	100	100	100	100
0200	65	65	70	70	75	78	80	85	88	90	95	100
0201	70	70	75	78	80	85	86	90	95	100	100	100
0202	75	75	80	85	88	90	85	90	95	100	100	100

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0203	50	55	65	68	70	75	75	80	95	100	95	100
0204	45	55	65	60	70	75	80	85	80	85	90	90
0205	55	55	65	60	68	70	75	78	80	82	85	90
0206	60	65	68	70	72	75	78	80	90	80	95	95
0207	70	75	75	80	85	80	85	85-90	90-95	95-100	100	100
0208	65	65	70	70	75	78	80	85	88	90	95	100
0209	70	70	75	78	80	85	86	90	95	100	100	100
0210	75	75	80	85	88	90	85	90	95	100	100	100
0211	50	55	65	68	70	75	75	80	95	100	95	100
0212	80	85	85	80	95	90	85	90	90	95	100	100
0213	60	65	65	70	70	75	78	75	80	90	95	100
0214	50	55	55	60	65	65	70	70	80	85	95	95
0215	60	60	65	65	65	70	70	75	75	80	90	95
0216	60	65	65	68	70	75	78	80	85	95	100	100
0217	75	75	80	85	88	90	95	92	98	100	100	100
0218	50	50	55	60	65	68	70	80	95	95	95	95
0219	50	50	55	65	65	68	70	72	75	90	90	90
0220	65	65	70	70	78	80	82	85	90	95	95-100	100
0221	50	60	70	75	78	80	85	90	95	100	100	100
0222	50	55	55	65	75	85	90	88	75	90	90	90
0223	60	65	65	70	75	75	80	85	90	90	95	95
0224	55	60	65	70	78	80	85	90	95	85	95	95
0225	65	65	70	70	75	78	80	85	95	100	100	100
0226	58	60	65	68	70	80	85	90	95	95	95	95
0227	55	60	65	65	70	75	75	80	85	85	95	95
0228	50	55	60	65	70	70	78	85	90	95	95	95
0229	60	62	65	68	70	75	78	80	85	90	95	100
0230	65	65	75	75	85	85	100	95	98	100	100	100
0231	65	65	70	75	75	80	90	95	95	100	100	100

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0232	70	75	75	80	88	85	90	98	100	100	95	100
0233	70	70	75	75	78	78	80	85	85	90	100	100
0234	50	50	58	60	55	65	70	75	80	90	95-100	95-100
0235	55	58	60	60	65	68	70	75	78	85-90	85-90	85-90
0236	65	65	70	85	85	90	95	95	100	100	100	100
0237	60	70	70	75	80	80	85	85	95	95	95	95
0238	50	55	60	55	65	70	75	80	85	80	85	85
0239	65	65	70	75	75	80	85	85	95	95	95	95
0240	45	55	65	65	75	80	80	85	85	90	95	95
0241	60	65	65	70	70	75	78	75	80	90	95	100
0242	50	55	55	60	65	65	70	70	80	85	95	95
0243	60	60	65	65	65	70	70	75	75	80	90	95
0244	60	65	65	68	70	75	78	80	85	95	100	100
0245	75	75	80	85	88	90	95	92	98	100	100	100
0246	65	65	70	75	78	80	85	90	95	95	95	95
0247	45	55	65	60	70	75	80	85	80	85	90	90
0248	55	55	65	60	68	70	75	78	80	82	85	90
0249	60	65	68	70	72	75	78	80	90	80	95	95
0250	70	75	75	80	85	80	85	85-90	90-95	95-100	100	100
0251	65	65	70	70	75	78	80	85	88	90	95	100
0252	70	70	75	78	80	85	86	90	95	100	100	100
0253	75	75	80	85	88	90	85	90	95	100	100	100
0254	50	55	65	68	70	75	75	80	95	100	95	100
0255	80	85	85	80	95	90	85	90	90	95	100	100
0256	65	65	70	70	85	85	80	78	85	90	95	95
0257	60	65	65	70	75	75	75	80	85	90	95	100
0258	65	70	75	80	75	80	85	90	95	100	100	100
0259	50	60	65	55	68	70	65	70	75	80	90	100
0260	60	65	68	70	75	80	85	85	90	95	95	95

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0261	60	62	65	68	70	75	78	82	85	90	90	90
0262	55	60	65	65	70	72	75	78	80	85	90	100
0263	60	65	65	70	78	80	85	90	95	100	100	100
0264	50	55	60	65	65	70	75	75	80	82	85	90
0265	45	45	50	50	50	60	65	70	75	80	85	90
0266	45	50	55	65	70	75	80	75	90	75	85	90
0267	60	65	70	75	85	90	95	90	90	100	100	100
0268	60	70	70	65	75	80	85	85	75	80	85	90
0269	65	65	70	75	75	85	85	90	90	95	95	95
0270	60	65	65	70	75	75	85	85	90	90	90	90
0271	50	50	55	65	65	70	75	70	80	85	90	90
0272	-	-	-	-	-	-	-	-	-	-	-	-
0273	60	60	65	70	75	75	85	85	90	95	95	95
0274	65	65	70	85	85	90	95	95	100	100	100	100
0275	60	70	70	75	80	80	85	85	95	95	95	95
0276	50	55	60	55	65	70	75	80	85	80	85	85
0277	65	65	70	75	75	80	85	85	95	95	95	95
0278	45	55	65	65	75	80	80	85	85	90	95	95
0279	60	65	65	70	70	75	78	75	80	90	95	100
0280	50	55	55	60	65	65	70	70	80	85	95	95
0281	60	60	65	65	65	70	70	75	75	80	90	95
0282	60	65	65	68	70	75	78	80	85	95	100	100
0283	75	75	80	85	88	90	95	92	98	100	100	100
0284	50	50	55	60	65	68	70	80	95	95	95	95
0285	50	50	55	65	65	68	70	72	75	90	90	90
0286	65	65	70	70	78	80	82	85	90	95	95-100	100
0287	50	60	70	75	78	80	85	90	95	100	100	100
0288	65	65	70	75	70	78	80	85	90	95	95	95
0289	65	65	75	75	85	85	100	95	98	100	100	100

Reg. No	1st week (%)	2nd week (%)	3rd week (%)	4th week (%)	5th week (%)	6th week (%)	7th week (%)	8th week (%)	9th week (%)	10th week (%)	11th week (%)	12th week (%)
0290	65	65	70	75	75	80	90	95	95	100	100	100
0291	70	75	75	80	88	85	90	98	100	100	95	100
0292	70	70	75	75	78	78	80	85	85	90	100	100
0293	50	50	58	60	55	65	70	75	80	90	95-100	95-100
0294	55	58	60	60	65	68	70	75	78	85-90	85-90	85-90
0295	65	65	70	85	85	90	95	95	100	100	100	100
0296	65	65	70	70	75	78	80	85	88	90	95	100
0297	70	70	75	78	80	85	86	90	95	100	100	100
0298	75	75	80	85	88	90	85	90	95	100	100	100
0299	50	55	65	68	70	75	75	80	95	100	95	100

Appendix 10: Diagnostic Reports (X-Ray) on Knee OA Patients (n=299)

Appendix 10: Diagnostic Reports (X-Ray) on Knee OA Patients (n=299)


Reg. 001 Zamila/51yrs


Reg. 001 Reduce joint space


Reg. 002 Mahmuda/55Yrs


Reg. 002 Reduce joint space


Reg. 003 Ashraful/70Yrs


Reg. 003 Osteophytic change

Reg. 004 Obinash/55Yrs

Reg. 004 Osteophytic change

Reg. 005 Afroza/33Yrs

Reg. 005 Diminished joint space

Reg. 006 Amena/44Yrs

Reg. 006 Degenerative change

Reg. 007 Mofiz/47Yrs

Reg. 007 Reduce joint space

Reg. 008 Ashraf/60Yrs

Reg. 008 Reduce joint space

Reg. 009 Sofur/60Yrs

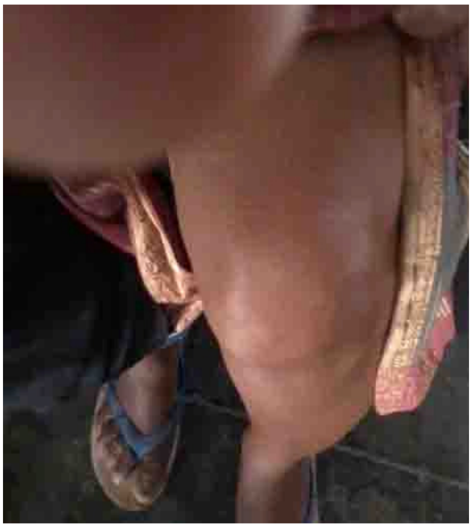
Reg. 009 Osteophytic change

Reg. 010 Sufia/70Yrs

Reg. 010 Reduce joint space

Reg. 011 Zafor/40Yrs

Reg. 011 Diminished joint space



Reg. 012Astura/49Yrs

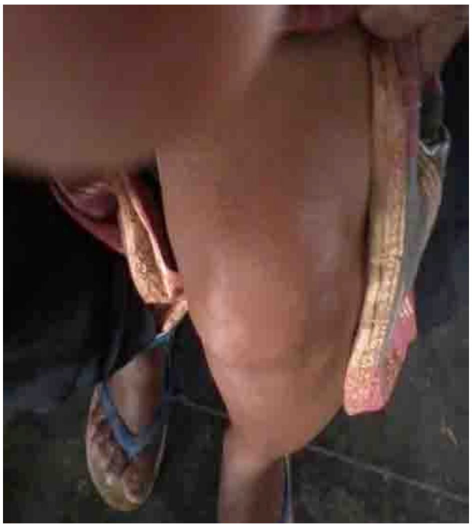
Reg. 012 Reduce joint space

Reg. 013 Johura/35Yrs

Reg. 013 Reduce joint space

Reg. 014 Kashem/72

Reg. 014 Reduce joint space



Reg. 015Rashida/50Yrs

Reg. 015 Reduce joint space


Reg. 016 Bilkis/40Yrs


Reg. 016 Osteophytic change


Reg. 017 Shahidul/30Yrs


Reg. 017 Diminished joint space


Reg. 018 Nila/58Yrs


Reg. 018 Reduce joint space

Reg. 019 Ayen Uddin/64Yrs

Reg. 019 Osteophytic change

Reg. 020 Aila/50Yrs

Reg. 020 Reduce joint space

Reg. 021 Meraj/69Yrs

Reg. 021 Reduce joint space


Reg. 022 Usma/60Yrs


Reg. 022 Osteophytes

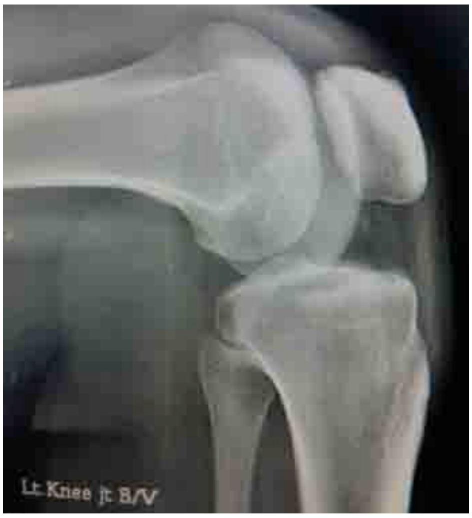

Reg. 023 Rubina/40Yrs


Reg. 023 Reduce joint space


Reg. 024 Anisur/60Yrs

Reg. 024 Diminished joint space

Reg. 025 Jahanara/50Yrs



Reg. 025 Reduce joint space

Reg. 026 Mahmuda/60Yrs

Reg. 026 Osteophytic change

Reg. 027 Osima/55Yrs

Reg. 027 Reduce joint space

Reg. 028 Bastul/62Yrs

Reg. 028 Diminished joint space

Reg. 029 Rahima/50Yrs

Reg. 029 Osteophytic change

Reg. 030 Asia/40Yrs

Reg. 030 Osteophytic change

Reg. 031 Shamsunnahar/40Yrs

Reg. 031 Reduce joint space

Reg. 032 Omishek/60Yrs

Reg. 032 Reduce joint space

Reg. 033 Solemon/45Yrs

Reg. 033 Reduce joint space


Reg. 034 Razia/68Yrs

Reg. 034 # with metal induces


Reg. 035 Anisur/65Yrs


Reg. 035 Osteophytic change


Reg. 036 Anser/42Yrs


Reg. 036 Diminished joint space

Reg. 037 Abdul Motaleb/45Yrs

Reg. 037 Reduce joint space

Reg. 038 Jamal/35Yrs

Reg. 038 Reduce joint space

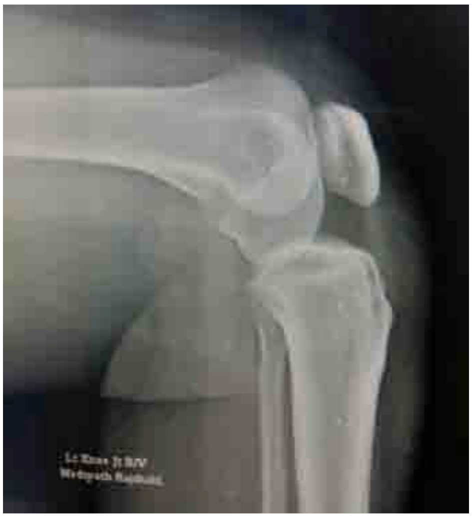
Reg. 039 Khodeja/25Yrs

Reg. 039 Osteophytic change

Reg. 040 Maekl/50Yrs

Reg. 040 Osteophytic change

Reg. 041Salam/31Yrs



Reg. 041 Osteophytic change

Reg. 042Rahim/50Yrs

Reg. 042 Osteophytic change

Reg. 043 Haider/65Yrs

Reg. 043 Reduce joint space

Reg. 044 Anju Begum/30Yrs

Reg. 044 Reduce joint space

Reg. 045 Asia/74Yrs

Reg. 045 Osteophytic change


Reg. 046 Rahima/65Yrs


Reg. 046 Osteophytic change


Reg. 047 Selina/45Yrs


Reg. 047 Reduce joint space


Reg. 048 Akkas/40Yrs


Reg. 048 Reduce joint space

Reg. 049 Moslema/60Yrs

Reg. 049 # with metal induces

Reg. 050 Seris/70Yrs

Reg. 050 # with metal induces

Reg. 051 Eazuddin/60Yrs

Reg. 051 Reduce joint space

Reg. 052 Rashid/50Yrs

Reg. 052 Osteophytic change

Reg. 053 Soleman/50Yrs

Reg. 053 Osteophytic change

Reg. 054 Amena/70Yrs

Reg. 054 Reduce joint space


Reg. 055 Momotaz/50Yrs


Reg. 055 Reduce joint space


Reg. 056 Shaheda/60Yrs


Reg. 056 Reduce joint space

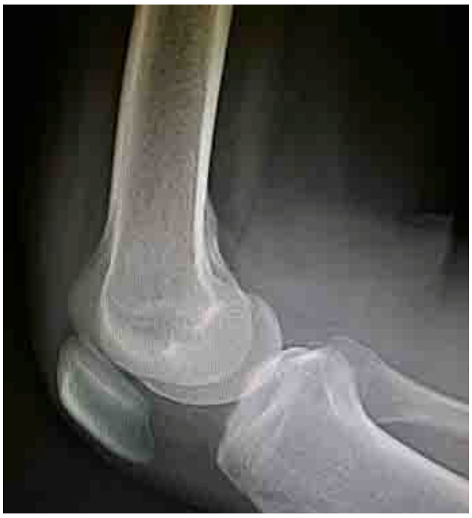

Reg. 057 Rashid/60Yrs


Reg. 057 Diminished joint space

Reg. 058 Jamal/53Yrs

Reg. 058 Osteophytic change

Reg. 059 Vori/52Yrs



Reg. 059 Diminished joint

Reg. 060 Zohura/42Yrs

Reg. 060 Reduce joint space


Reg. 061 Akkas/65Yrs


Reg. 061 Reduce joint space


Reg. 062 Hazera/60Yrs


Reg. 062 Reduce joint space


Reg. 063 Mosad/50Yrs


Reg. 063 Diminished joint space

Reg. 064 Monowar/60Yrs

Reg. 064 Reduce joint space

Reg. 065 Basir/65Yrs

Reg. 065 Osteophytic change

Reg. 066 Maaajeda/65

Reg. 066 Reduce joint space

Reg. 067 Moyez Uddin/60Yrs

Reg. 067 diminished joint

Reg. 068 surut/65Yrs

Reg. 068 Reduce joint space

Reg. 069 Rajon/57Yrs

Reg. 069 Reduce joint space

Reg. 070 Rubina/41Yrs

Reg. 070 Reduce joint space

Reg. 071 Anwar/55Yrs

Reg. 071 Osteophytic change

Reg. 072 Shahid/43Yrs

Reg. 072 Osteophytic change

Reg. 073 Sofura/53Yrs

Reg. 073 Reduce joint space

Reg. 074 Anisur/63Yrs

Reg. 074 # with metal induces

Reg. 075 Mehereun/55Yrs

Reg. 075 # with metal induces

Reg. 076 Kalam/43Yrs

Reg. 076 Reduce joint space

Reg. 077 Saleha/45Yrs

Reg. 077 Osteophytic change

Reg. 078 Asad/63Yrs

Reg. 078 Reduce joint space


Reg. 079 Monowara/40Yrs


Reg. 079 Diminished joint space


Reg. 080 Mohema/75Yrs


Reg. 080 Diminished joint space


Reg. 081 Jalal/30Yrs


Reg. 081 Reduce joint space

Reg. 082 Aklima/59Yrs

Reg. 082 Reduce joint space

Reg. 083 Zoges/60Yrs

Reg. 083 Reduce joint space

Reg. 084 Golap jan/40Yrs

Reg. 084 Reduce joint space

Reg. 085 Alek jan/60Yrs

Reg. 085 Reduce joint space

Reg. 086Seikh/40Yrs

Reg. 086 Osteophytic change

Reg. 087 Zannatun/50Yrs

Reg. 087 Reduce joint space

Reg. 088 Tara/30Yrs

Reg. 088 Reduce joint space

Reg. 089 Rupjan/60Yrs

Reg. 089 Osteophytic change

Reg. 090 Habibur/70Yrs

Reg. 090 Reduce joint space

Reg. 091 Israfil/50Yrs

Reg. 091 Osteophytic change

Reg. 092Khurshida/64Yrs

Reg. 092 Osteophytic change

Reg. 093 Shamsunnahar/70Yrs

Reg. 093 Reduce joint space

Reg. 094 Mortuza/50Yrs

Reg. 094 Diminished joint space

Reg. 095 Firoz/50Yrs

Reg. 095 Reduce joint space

Reg. 096 Atema/45Yrs

Reg. 096 Osteophytic change

Reg. 097 Anwara/50Yrs

Reg. 097 Reduce joint space

Reg. 098 Khadiza/40Yrs

Reg. 098 Reduce joint space

Reg. 099 Daresh32Yrs

Reg. 099 Reduce joint space

Reg. 100 Ersad/55Yrs

Reg. 100 Osteophytic change

Reg. 101 Shirina/35Yrs

Reg. 101 Diminished joint space

Reg. 102 Nasima/60Yrs

Reg. 102 Osteophytic change


Reg. 103 Ayesha/50Yrs


Reg. 103 Diminished joint space


Reg. 104Forid/60Yrs


Reg. 104 Reduce joint space


Reg. 105 Shorif/40Yrs

Reg. 105 Osteophytic change

Reg. 106 Sattar/65Yrs

Reg. 106 Osteophytic change

Reg. 107 Razzak/70Yrs

Reg. 107 Osteophytic change

Reg. 108 Morium/60Yrs

Reg. 108 Osteophytic change

Reg. 109 Wahab/60Yrs

Reg. 109 Reduce joint space

Reg. 110 Shamsul/39Yrs

Reg. 110 Osteophytic change

Reg. 111 Lirman/50Yrs

Reg. 111 Osteophytic change

Reg. 112 Afia/52Yrs

Reg. 112 Reduce joint space

Reg. 113 Ferdousi/52Yrs

Reg. 113 Reduce joint space

Reg. 114 Khadiza/53Yrs

Reg. 114 Reduce joint space

Reg. 115 Azia/66Yrs

Reg. 115 Osteophytic change

Reg. 116Saleha/55Yrs

Reg. 116 # with metal induces

Reg. 117 Mojid/43Yrs

Reg. 117 Osteophytic change

Reg. 118 Ssanwar/36Yrs

Reg. 118 Diminished joint space

Reg. 119 Rahima/50Yrs

Reg. 119 Normal

Reg. 120 Shorif/36Yrs

Reg. 120 Osteophytic change


Reg. 121 Sultan/55Yrs


Reg. 121 Osteophytic change


Reg. 122 Sokhina/60Yrs


Reg. 122 Reduce joint space


Reg. 123 Jalil/60Yrs


Reg. 123 Reduce joint space


Reg. 124 Shamin72Yrs


Reg. 124 Reduce joint space


Reg. 125 Rafiza/47Yrs


Reg. 125 Osteophytic change


Reg. 126 Golenoor/80Yrs


Reg. 126 Reduce joint space

Reg. 127Zulekha/50Yrs

Reg. 127 Osteophytic change

Reg. 128 Fahima/45Yrs

Reg. 128 Reduce joint space

Reg. 129 Rowshan ara/35Yrs

Reg. 129 Reduce joint space


Reg. 130 Salam/50Yrs


Reg. 130 Degenerative change


Reg. 131 Bilkis/38Yrs


Reg. 131 Reduce joint space


Reg. 132 Joygun/49Yrs


Reg. 132 Osteophytic change

Reg. 133 Abeda/60Yrs

Reg. 133 Osteophytic change

Reg. 134 Salema/50Yrs

Reg. 134 Reduce joint space

Reg. 135 Zamal/55Yrs

Reg. 135 Reduce joint space

Reg. 136 Momena/45Yrs

Reg. 136 Diminished joint space

Reg. 137 Atorjan/0Yrs

Reg. 137 Osteophytic change

Reg. 138 Sharifa/50Yrs

Reg. 138 Osteophytic change

Reg. 139 Amzad/60Yrs

Reg. 139 Osteophytic change

Reg. 140 Golezan/70Yrs

Reg. 140 Osteophytic change

Reg. 141 Quddus/33Yrs

Reg. 141 Osteophytic change


Reg. 142 Rubinaa/43Yrs


Reg. 142 Osteophytic change


Reg. 143Latifa/60Yrs


Reg. 143 Reduce joint space


Reg. 144 Liakot/60Yrs


Reg. 144 Osteophytic change

Reg. 145 Saleha/60Yrs

Reg. 145 Reduce joint space

Reg. 146 Sokhina/40Yrs

Reg. 146 Reduce joint space

Reg. 147 Momotaz/46Yrs

Reg. 147 Reduce joint space

Reg. 148 Rustom/52Yrs

Reg. 148 Reduce joint space

Reg. 149 Rahima/40Yrs

Reg. 149 Diminished joint space

Reg. 150 Maliha/53Ys

Reg. 150 Reduce joint space

Reg. 151 Lokman/65Yrs

Reg. 151 Osteophytic change

Reg. 152 Sefat Ullah/65Yrs

Reg. 152 Reduce joint space

Reg. 153 Moina/30Yrs

Reg. 153 Diminished joint space


Reg. 154 Rahela/64Yrs


Reg. 154 Osteophytic change


Reg. 155 Asif/60Yrs


Reg. 155 Reduce joint space


Reg. 156 Akkas/58Yrs


Reg. 156 Reduce joint space


Reg. 157 Habiba/50Yrs


Reg. 157 Osteophytic change


Reg. 158 Nurul/55Yrs


Reg. 158 Reduce joint space


Reg. 159 Moslema/52Yrs


Reg. 159 Osteophytic change

Reg. 160 Salma/69Yrs

Reg. 160 Diminished joint space

Reg. 161 Mostakima/54Yrs

Reg. 161 Osteophytic change

Reg. 162 Provat/40Yrs

Reg. 162 Osteophytic change


Reg. 163 Asia/60Yrs


Reg. 163 Reduce joint space


Reg. 164 Parul/35Yrs


Reg. 164 Reduce joint space


Reg. 165 Tohmina/60Yrs


Reg. 165 # with metal induces


Reg. 166 Karim/40Yrs


Reg. 166 #


Reg. 167 Halim/60Yrs


Reg. 167 Reduce joint space


Reg. 168 Romesh/40Yrs


Reg. 168 Osteophytic change


Reg. 169 Selina/40Yrs


Reg. 169 Reduce joint space


Reg. 170 Haris/40Yrs


Reg. 170 Osteophytic change


Reg. 171 Rajin/44Yrs


Reg. 171 Reduce joint space


Reg. 172 Sattar/54Yrs


Reg. 172 Osteophytic change


Reg. 173 Yusuf/45Yrs

Reg. 173 Reduce joint space


Reg. 174 Morzina/64Yrs


Reg. 174 Reduce joint space


Reg. 175 Kolimun/65Yrs


Reg. 175 Osteophytic change


Reg. 176 Alia/48Yrs


Reg. 176 Reduce joint space


Reg. 177 Rashida/45Yrs


Reg. 177 Osteophytic change


Reg. 178 Momena/57Yrs


Reg. 178 Osteophytic change


Reg. 179 Mahbuba/45Yrs


Reg. 179 Reduce joint space


Reg. 180 Jahanara/40Yrs


Reg. 180 Reduce joint space

Reg. 181 Barman/55Yrs

Reg. 181 Reduce joint space

Reg. 182 Nazrul/60Yrs

Reg. 182 Osteophytic change

Reg. 183 Altaf/65Yrs

Reg. 183 Reduce joint space


Reg. 184 Sajahan/49Yrs


Reg. 184 Osteophytic change


Reg. 185 Rokeya/53Yrs


Reg. 185 Reduce joint space


Reg. 186 Nurjahan/50Yrs


Reg. 186 Reduce joint space

Reg. 187 Jalal/67Yrs

Reg. 187 Reduce joint space

Reg. 188 kader/63Yrs

Reg. 188 Reduce joint space

Reg. 189 Alekjan/50Yrs

Reg. 189 Reduce joint space

Reg. 190 Roshida/55Yrs

Reg. 190 Osteophytic change

Reg. 191 Shahinur/38Yrs

Reg. 191 Reduce joint space

Reg. 192 Chand/45Yrs

Reg. 192 Diminished joint space

Reg. 193 Podo/75Yrs

Reg. 193 Reduce joint space

Reg. 194 Naimul/67Yrs

Reg. 194 Reduce joint space

Reg. 195 Zobair/40Yrs

Reg. 195 Reduce joint space

Reg. 196 Nurjahan/45Yrs

Reg. 196 Reduce joint space

Reg. 197 Majeda/50Yrs

Reg. 197 Diminished joint space

Reg. 198 Shamsunnahar/68Yrs

Reg. 198 Reduce joint space


Reg. 199 Daresh/52Yrs

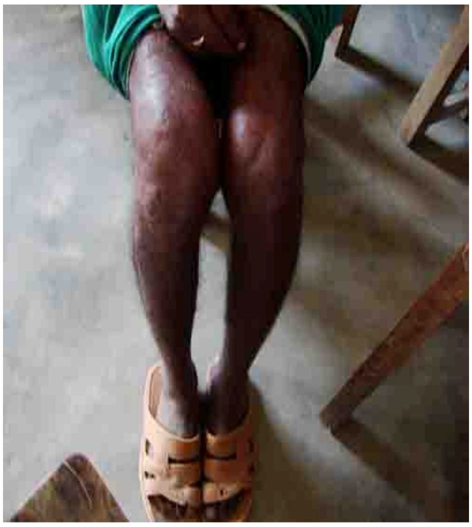

Reg. 199 Osteophytic change


Reg. 200 Lalbanu/50Yrs


Reg. 200 Reduce joint space


Reg. 201 Mahmud/40Yrs


Reg. 201 Osteophytic change


Reg. 202 Shakedun/53Yrs


Reg. 202 Osteophytic change


Reg. 203 Gonesh/60Yrs


Reg. 203 Reduce joint space


Reg. 204 Papon/53Yrs


Reg. 204 Reduce joint space

Reg. 205 Minoti/60Yrs

Reg. 205 Diminished joint space

Reg. 206Triful/70Yrs

Reg. 206 Reduce joint space

Reg. 207 Mohini/70Yrs

Reg. 207 Reduce joint space

Reg. 208 Vanu/60Yrs

Reg. 208 Reduce joint space

Reg. 209 Rahman/40Yrs

Reg. 209 Diminished joint space

Reg. 210 Varoti/50Yrs

Reg. 210 Reduce joint space


Reg. 211 Zulekha/70Yrs


Reg. 211 Reduce joint space


Reg. 212 Saira/45Yrs


Reg. 212 Osteophytic change


Reg. 213 Nurjahan/45Yrs


Reg. 213 Reduce joint space

Reg. 214 Rina/51Yrs

Reg. 214 Reduce joint space

Reg. 215 Khorshed/50Yrs

Reg. 215 Osteophytic change

Reg. 216 Sattar/55Yrs

Reg. 216 Reduce joint space


Reg. 217 Rowshan/40Yrs


Reg. 217 Reduce joint space


Reg. 218 Nurjhan/40Yrs


Reg. 218 Diminished joint space


Reg. 219 Asia/45Yrs


Reg. 219 Osteophytic change


Reg. 220 Rahima/45Yrs


Reg. 220 Reduce joint space


Reg. 221 Mannan/46Yrs


Reg. 221 Reduce joint space


Reg. 222 Rahima/65Yrs


Reg. 222 Reduce joint space


Reg. 223 Kader/65Yrs


Reg. 223 Osteophytic change


Reg. 224Nehera/56Yrs


Reg. 224 Osteophytic change


Reg. 225 Zulekha/55Yrs


Reg. 225 Reduce joint space

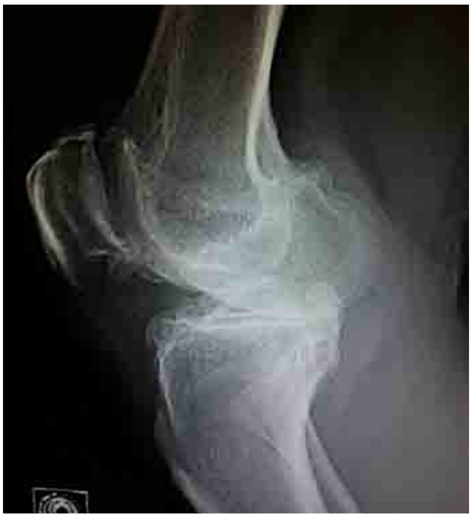
Reg. 226 Saima/57Yrs

Reg. 226 Reduce joint space

Reg. 227 Zulfar/71Yrs

Reg. 227 Osteophytic change

Reg. 228 Nasim/50Yrs



Reg. 228 Osteophytic change


Reg. 229 Sonavan/50Yrs


Reg. 229 Reduce joint space


Reg. 230 Momotaz/62Yrs


Reg. 230 Normal


Reg. 231 Aleya/62Yrs


Reg. 231 Osteophytic change


Reg. 232 Moslema/55Yrs


Reg. 232 Osteophytic change


Reg. 233 Laily/40Yrs


Reg. 233 Reduce joint space

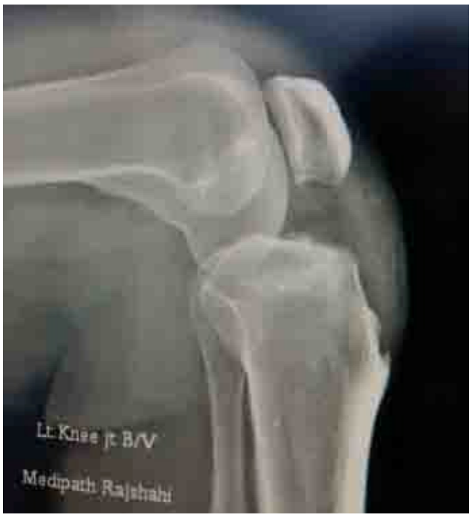

Reg. 234 Shamima/65Yrs


Reg. 234 Reduce joint space


Reg. 235 Sahar/50Yrs

Reg. 235 Reduce joint space


Reg. 236 Shahazada/50Yrs



Reg. 236 Osteophytic change


Reg. 237 Zahir/45Yrs


Reg. 237 Reduce joint space

Reg. 238 Shahid/45Yrs

Reg. 238 Reduce joint space

Reg. 239 Saleha/50Yrs

Reg. 239 Reduce joint space

Reg. 240 Khadiza/70Yra

Reg. 240 Osteophytic change


Reg. 241 Hasina/47Yrs

Reg. 241 Reduce joint space


Reg. 242 Sofeda/45Yrs

Reg. 242 Normal


Reg. 243 Sabera/65Yrs

Reg. 243 Osteophytic change

Reg. 244 Jamila/65Yrs

Reg. 244 Osteophytic change

Reg. 245 Sabina30Yrs

Reg. 245 Reduce joint space

Reg. 246 Zorina/60Yrs

Reg. 246 Diminished joint space

Reg. 247 Rahman/44Yrs

Reg. 247 Reduce joint space

Reg. 248 Rahim/80Yrs

Reg. 248 Osteophytic change

Reg. 249 Afsar/50Yrs

Reg. 249 Reduce joint space


Reg. 250 Zahidul/40Yrs


Reg. 250 Reduce joint space


Reg. 251 Monowara/60Yrs


Reg. 251 Reduce joint space


Reg. 252 Hosneara/45Yrs


Reg. 252 Reduce joint space

Reg. 253 Habiba/50Yrs

Reg. 253 Reduce joint space

Reg. 254 Tahera/45Yrs

Reg. 254 Reduce joint space

Reg. 255 Zinnath/70Yrs

Reg. 255 Osteophytic change


Reg. 256 Jahan/45Yrs


Reg. 256 Osteophytic change


Reg. 257 Shafiq/51Yrs


Reg. 257 Osteophytic change


Reg. 258 Momena/40Yrs

Reg. 258 Reduce joint space


Reg. 259 Shahida/50Yrs

Reg. 259 Reduce joint space


Reg. 260 Ismot/58Yrs


Reg. 260 Osteophytic change


Reg. 261 Romjan/60Yrs

Reg. 261 Knee replace

Reg. 262 Zahangir/61Yrs

Reg. 262 Knee replace

Reg. 263 Tokkel/70Yrs

Reg. 263 Reduce joint space

Reg. 264 Jahanara/45Yrs

Reg. 264 Reduce joint space


Reg. 265 Shahana/45Yrs

Reg. 265 Reduce joint space


Reg. 266 Toraf/65Yrs


Reg. 266 Osteophytic change


Reg. 267 Arjed/35Yrs

Reg. 267 Reduce joint space


Reg. 268 Alif/45Yrs


Reg. 268 Reduce joint space


Reg. 269 Badal/42Yrs


Reg. 269 Osteophytic change


Reg. 270 Razia/40Yrs


Reg. 270 Osteophytic change


Reg. 271 Rehena/61Yrs


Reg. 271 Osteophytic change


Reg. 272 Aleya/46Yrs


Reg. 272 Osteophytic change


Reg. 273 Hasina/70Yrs


Reg. 273 Osteophytic change

Reg. 274 Nasima/40Yrs

Reg. 274 Osteophytic change

Reg. 275 Shahid/40Yrs

Reg. 275 Reduce joint space

Reg. 276 Rozina/49Yrs

Reg. 276 # with metal induces


Reg. 277 Aleka/52Yrs


Reg. 277 Reduce joint space


Reg. 278 Jhorna/50Yrs


Reg. 278 Reduce joint space


Reg. 279 Rojina/42Yrs


Reg. 279 Reduce joint space

Reg. 280 Razia/53Yrs

Reg. 280 Reduce joint space

Reg. 281 Taslim/45Yrs

Reg. 281 # with metal induces

Reg. 282 Minara/40Yrs

Reg. 282 Reduce joint space

Reg. 283 Rokeya/45Yrs

Reg. 283 Osteophytic change

Reg. 284 Morzina/65Yrs

Reg. 284 Reduce joint space

Reg. 285 Asma/25Yrs

Reg. 285 Reduce joint space

Reg. 286 Altafun/76Yrs

Reg. 286 Reduce joint space

Reg. 287 Nazia/60Yrs

Reg. 287 Reduce joint space

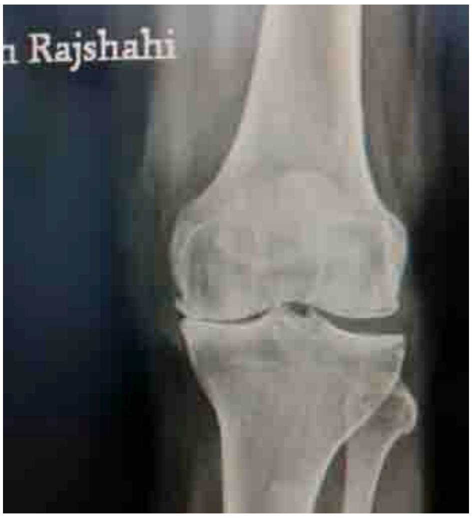
Reg. 288 Taslima/60Yrs

Reg. 288 # Osteophytic change


Reg. 289 Mahfuz/70Yrs


Reg. 289 Reduce joint space


Reg. 290 Shajeda/81Yrs



Reg. 290 Reduce joint space


Reg. 291 Lalbanu/45Yrs


Reg. 291 Osteophytic change


Reg. 292 Amena/70Yrs


Reg. 292 Reduce joint space


Reg. 293 Bozlu/68Yrs


Reg. 293 Reduce joint space


Reg. 294 Azabbar/55Yrs

Reg. 294 Reduce joint space


Reg. 295 Jahangir/66Yrs


Reg. 295 Reduce joint space


Reg. 296 Azob Ali/71Yrs


Reg. 296 Diminished joint space


Reg. 297 Shahid/58Yrs


Reg. 297 Osteophytic change


Reg. 298 Ansar Ali/70Yrs

Reg. 298 Osteophytic change


Reg. 299 Mrs. Ataur/66Yrs


Reg. 299 Reduce joint space