OUTCOME OF STRENGTHENING EXERCISE AMONG YOUNG ATHLETES WITH ANKLE SPRAIN AT BANGLADESH KRIRA SHIKKHA PROTISHTAN (BKSP)

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Outcome of strengthening exercise among young athletes with ankle sprain at Bangladesh Krira Shikkha Protishtan (BKSP)

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Declaration

I declare that the work presented here is my own. All source used have been cited appropriately. Any mistakes or inaccuracies are my own. I also declare that for any publication, presentation or dissemination of the study. I would be bound to take written consent from my supervisor and Head of the Department of Physiotherapy, Bangladesh Health Professions Institute.

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Acronyms

ATFL	Anterior Talofibular Ligament
BHPI	Bangladesh Health Professions Institute.
BMRC	Bangladesh Medical Research Council
CAI	Chronic Ankle Instability
CAIT	Cumberland Ankle Instability Tool
CFL	Calcaneofibular Ligament
CRP	Center for the Rehabilitation of the Paralysed
IRB	Institution of Review Board
NCAA	National Collegiate Athletic Association
NSAIDs	Nonsteroidal Anti-inflammatory Drugs
PTFL	Posterior Talofibular Ligament
RTP	Return to Play
SEBT	Star Excursion Balance Test
VAS	Visual Analogue Scale
WHO	World Health Organization

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Abstract

Purpose: The Purpose of this study, to assess the therapeutic effectiveness of strengthening exercise among young athletes with conventional physiotherapy treatments among patients with ankle sprain. Objectives: To assess the effect on pain after introducing strengthening exercise in ankle sprain, to measure the severity of pain by using Visual analogue scale (VAS), To find out the effect of pain at rest, after introducing strengthening exercise. To identify the severity of pain during standing, after introducing strengthening exercise, To identify the severity of pain during long time walking (more than 10 minute), after introducing strengthening exercise, To find out the effect of pain at 6 minute running, after introducing strengthening exercise. Methodology: The study was an experimental design. Total 10 samples were selected conveniently then randomly assigned to two different groups for this study from inpatient of Exercise Physiology Department, of Bangladesh Krira Sikkha Protisthan (BKSP), Savar, Dhaka. Visual analogue scale (VAS) was used to assess pain intensity of the patients. Experimental Group received combination therapy of strengthening exercise with Conventional Physiotherapy while Control Group received Conventional Physiotherapy only. Result: The finding of the study was carried out by using non-parametric unrelated "**t"** test to compare the Experimental and Control Group and analyzed by interpreting the probability level of significance of t value. The results were found to be significant for t value at probability level 0.05.Conclusion: The study concluded as the strengthening is significantly capable of producing beneficial effects on pain reduction, pain related symptoms minimization in patients with ankle sprain. Keywords: Chronic Ankle Sprain, strengthening exercise of ankle joint, conventional physiotherapy.

CHAPTER-I INTRODUCTION

1.1 Background Information

Ankle sprain represents one of the most common injuries sustained during sporting activities. It is caused by the stretching of fibers or of the collagen of the ankle ligaments, whereby the fibers are partially or completely disrupted (Quigley, 2012). Three-quarters of ankle injuries involve the lateral ligament us complex, comprised of the anterior talofibular ligament (ATFL), the calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL), with an equal incidence between males and females (Garrick, 2009).

Some evidence suggests that previous injuries or limited joint flexibility may contribute to ankle sprains. Lateral ankle sprain being the most frequent type of sprain. The mechanism of injury is when the foot is in an inverted position combined with plantar flexion which usually does damage to the lateral complex of the ankle (Morrison et al., 2007).

Recurrent ankle sprains can lead to functional instability and loss of normal ankle kinematics and proprioception, which can result in recurrent injury, chronic instability, early degenerative bony changes, and chronic pain. Ankle sprain can results inability to participate in sports (Chunget al., 2010).

After ankle sprain, there is evidence for the use of functional support and non-steroidal anti-inflammatory drugs. Physical therapy may lead to positive short term effect which reduce the occurrence of recurrent ankle sprains and may be effective in managing chronic ankle instability (Chung et al., 2010). Therapy for ankle sprains focuses on controlling pain and swelling. PRICE (Protection, Rest, Ice, Compression, and Elevation) is a well-established protocol for the treatment of ankle injury.

In Bangladesh sports physiotherapy is also flourishing now days. The aim of physiotherapy is to treat and fully rehabilitate the athlete of post injury, to prevent further injury and to return the athlete to sport in the shortest possible time (Chung et al., 2010).

For this the athletes need proper rehabilitation through physiotherapy. So it is necessary to know the prevalence, influencing factors, in which type of sports it

occurs most, its management and preventative measure. We only can store information about above mentioned factors through researching (Fong et al., 2009).

Ankle sprains are among the most common injuries seen in athletic participation with reinjure rate for athletes with lateral ankle sprains as high as 70% to 80%, leading to the development of chronic ankle instability (CAI). Clinicians are faced with many factors that need to be addressed after lateral ankle sprains, including muscle weakness, postural-control deficits, decreased range of motion, and the frequent occurrence of reinjury. With the goal of returning patients to high levels of function in a limited time frame, clinicians are challenged to find .Approaches that will improve ankle stability and prevent re injury (Chung et al., 2010).

1.2 Rationale

Ankle sprain is one of the most common injuries among athletics population and can result in significant rates of recurrence, time lost of injury, and further long term of squeal.

Ankle ligaments provide mechanical stability, proprioceptive information, and directed motion for the joint. Recurrent ankle sprains can lead to functional instability and problem in proprioception, which can result in chronic instability, early degenerative bony changes, and chronic pain. Acute ankle sprains can result in inability to participate in sports.

There is an important role of physiotherapist to support an athlete and to adjust with sports related activities.

The findings of the study will help physiotherapists to be updated with management of those ankle sprains as well as help the athletes to be aware of the preventative measures about those injuries.

The problems with sports like ankle sprain can be minimized by proper physiotherapeutic intervention specially strengthening exercise.A physiotherapist can restore athletic performance and rehabilitate the athletes so that athletes can return to the sports.

Sports physiotherapy is an emerging area in perspective of Bangladesh where physiotherapist can work to gather information about percentage, prevalence, severity, risk factors, mechanism of injury, prevention, management of ankle sprain among athletes. So the service is greatly needed in Bangladesh for instances for sports related ankle sprain.

Research on this area can help to understand ankle sprain, which is the most common acute sport trauma, accounting for 14% of all sport-related injury. This study also can show the need to establish the skills of physiotherapist and be a base for expanding the future prospect of this profession in sports sector in Bangladesh.

1.3 Aim

Identify the effectiveness of strengthening exercise with conventional physiotherapy for ankle sprain.

1.4 Objectives

a. General objective

To identify the effectiveness of Strengthening exercises for chronic ankle sprain.

b. Specific objective

To evaluate the effect of pain at ankle strengthening exercises for chronic ankle sprain young athletes patients using pre and post test assessment.

To identify the improvement of range of motion for chronic ankle sprain patients.

1.5 Hypothesis

Strengthening exercises along with conventional physiotherapy is better than only conventional physiotherapy for the treatment of ankle sprain athlete patients.

1.6 Null hypothesis

Strengthening exercises along with conventional physiotherapy are no more effective then only conventional physiotherapy for the treatment of ankle sprain young athlete patients.

1.7 Operational Definition

1.7. a. Ankle sprain

An injury that occurs when the ankle rolls, twists, or turns in an awkward way.It is caused by the stretching of fibers or of the collagen of the ankle ligaments, whereby the fibers are partially or completely disrupted.

1.7.b. Strengthening exercise of ankle

Some programmed systemic exercises performed for enhancing injuries involve the lateral ligamentous complex, comprised of the anterior talofibular ligament (ATFL), the calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL). rhythm and joint mobility along with strengthen the muscles performing particular joint play.

1.7. c. Conventional physiotherapy

Physiotherapeutic interventions that are widely accepted and commonly practiced by medical community.

1.8 List of variable

- **Independent variable**: Strengthening exercise of ankle joint.
- **Dependent variable:** Pain, ligament sprain, range of motion.

CHAPTER-II LITERATURE REVIEW

Ankle sprains are one of the most common musculoskeletal injuries. In all sports injuries, the rate of ankle sprains ranges from 15 to 20 %.The most common injury mechanism is a combination of inversion and adduction of the foot in plantar flexion (supination). This injury mechanism can cause damage to the lateral ankle ligaments. Injury of the anterior talofibular ligament with intact medial ligaments leads to anterolateral rotary instability. Additional transection of the calcaneofibular ligament adds a tilting of the talus (Petersen et al., 2013).

Ankle sprains are the most common injury to the ankle joint, accounting for up to 2 million injuries per year. Annual incidence is estimated at 52.7 per 10,000 individuals. Ankle injuries are very common in younger and active individuals, second only to the knee in the annual incidence of lower extremity sports-related injuries.(Davenport et al.,2013).Among high school athletes in the United States, sprains account for 50% of all lower extremity injuries with the ankle joint most commonly affected. In one sample of individuals with non-athletic mechanisms of injury, sprains accounted for over 40% of reported injuries with the ankle joint .Certain sports and work activities may result in an even higher incidence and risk for injury (Davenport et al., 2013).

Ankle sprains account for 85% of all ankle injuries, and they occur when the ligaments holding the anklebones in place tear or excessively stretch. Ankle Sprain accounts for up to 40% of all athletic injuries and is most commonly seen in athletes participating in football, cricket, tennis, hockey, basketball, soccer, running, . Up to 53% of basketball injuries and 29% of soccer injuries can be attributed to ankle injuries and 12% of time lost in football is due to ankle injuries (Keith et al, 2011). Patients presenting with ankle sprains comprise 10% of emergency room visits in the United States with an incidence of 30,000 ankle sprains a day (Keith et al., 2011).

The ankle joint is where the foot and the leg segments meet. It comprises of three major articulations: the talocrural joint, the subtler joint, and the distal tibiofibularsyndesmosis.The talocrural joint is also termed the tibiotalar joint or the mortise joint, and is formed by the articulation of the dome of talus, the tibial plafond, the medial malleolus and the lateral malleolus (Peterson et al.,2011).

This joint, in isolation, behaves rather like a hinge joint that allows mainly plantar flexion and dorsiflexion. The fibula extends further to the lateral malleolus than the tibia does to the medial malleolus, thus creating a block to eversion. Such body feature mainly allows larger range of inversion than eversion, thus, inversion sprains are more common than eversion ones (Fong et al., 2009).

The talocrural joint is supported by several main ligaments, namely the anterior talofibular ligament (ATFL), the calcanaeo-fibular ligament (CFL) and the posterior talofibular ligament (PTFL) at the lateral aspect, and the deltoid ligament in the medial aspect of the ankle (Keith et al., 2011).

Among the lateral ligaments, the ATFL is the weakest as it has the lowest ultimate load, approximately 138.9N, which is about half of that of PTFL, that is, 261.2N, and one-third of that of CFL, that is, 345.7N. These values were obtained from mechanical test on ligaments of fresh human ankles (Keith et al., 2011).

ATFL is approximately 20–25 mm long, 7– 10 mm wide and 2 mm thick. It originates from the anterior-inferior border of the fibular and inserts to the neck of the talus. It prevents anterior displacement and internal rotation of the talus, especially when the talocrural joint is plantar flexed. Due to its low ultimate load and the anatomical positions of origins and insertions, the ATFL is most commonly injured in a lateral ankle sprain (Fong et al., 2009).

An ankle joint is formed by calcaneum,talus,cuboid,navicular,three cuniform and five metatarsal bones. Anterior end is formed by the heads of the first, second and third metatarsals, posterior end are formed by the radial tubercle of the calcaeneum.

Ligaments are involved in articulation of an ankle joints. Those ligaments are anterior talofibular ligament, posterior telofibular ligament, calcaneofibular ligament, talocalcaener ligament, calcaenocuboid ligament,cuiboidonavicular ligament, calcaenonavicular ligament, metatarsophalangeal ligament (Hartal et al., 2013).

Ankle sprain mainly occur in lateral ankle sprain. There are mainly involve in lateral sided ligament of ankle.Significant discrepancies are found with regard to whether or not height, weight, limb dominance, ankle joint laxity, anatomical alignment, muscle strength, muscle reaction time, and postural sway are risk factors for ankle sprain injury (McCriskin et al., 2015).

Risk factors are ex, a foot size with increased width, an increased ankle eversion to inversion strength, plantar flexion strength and ratio between dorsiflexion and plantar flexion strength, and limb dominance could increase the risk of ankle sprain (Keith et al., 2011).

The foot type, indication of ankle instability, and high general joint laxity are identified not to be risk factors. In 2002, Beynnon, Murphy and Alosa conducted another comprehensive literature review and reported a consensus that gender, general joint laxity and foot type were not risk factors for ankle sprain injury. (Chnag et al., 2010). In 2007, Morrison and Kaminski suggested that the cavovarus deformity, increased foot width, and increased calcaneal eversion range of motion were related to the occurrence of lateral ankle sprain injury (Fong et al., 2009).

If the center of plantar pressure deviated medially to the subtalar joint axis, a greater moment along the subtler joint axis achieves and thus the subsequent increased supination moment to initiate sudden explosive ankle supination. Wright and coworkers conducted a computational forward dynamic simulation study and reported that increased touchdown plantar flexion caused increased ankle sprain occurrences (Hartalet al., 2013). When a foot was plantarflexed during touchdown, the contact to the ground was made with the forefoot, thus increased the moment arm among the subtalar joint axis and also the resultant joint torque to cause sudden explosive twisting motion and ankle sprain injury (Fong et al., 2009).

Therefore, foot positioning during touchdown was identified as etiology of ankle sprain injury. This also supported the suggestion that ankle taping or bracing corrected ankle joint positioning at landing rather than provided mechanical support to the ankle joint (Hartal et al., 2010). Another etiology of ankle sprain injury is the delayed reaction time of the peroneal muscles at the lateral aspect of the ankle. Ashton-Miller and coworkers suggested that an ankle sprain injury occurred in 40 milliseconds (ms), as the vertical ground reaction force peaked at about 40 ms when landing from a jump (Peterson et al., 2012). At the lateral aspect of the human ankle, the peroneal muscles, including the peroneallongus and peronealbrevis, function (Fong et al., 2009).

Approximately 30% of those who suffer a first-time ankle sprain develop chronic ankle instability. An athlete's sex, foot type, and generalized joint laxity may affect

his or her risk of ankle injury. Limited ankle dorsiflexion in children may increase the risk of ankle injury (Patrick et al., 2007).

Recent epidemiological studies in high school athletes have found ankle sprains to be the most prevalent soccer injury amongst boys and girls (16% and 20%, respectively). Ankle ligament sprains were also the most common injury pattern in basketball, usually occurring from jumping and landing, being stepped on, and rotation around a planted foot (Keith et al., 2011).

In addition, ankle injuries have been reported to be a major cause of early development of osteoarthritis, recurrent injury, chronic instability and pain. Based on this information, ankle instability represents a major obstacle to the health and well-being of the physically active athletes (Patrick et al., 2007).

Ankle Sprain accounts for up to 40% of all athletic injuries and is most commonly seen in athletes participating in football, cricket, tennis, hockey, basketball, soccer, running, . Up to 53% of basketball injuries and 29% of soccer injuries can be attributed to ankle injuries and 12% of time lost in football is due to ankle injuries. (Keith W. Chan et al., 2011). Patients presenting with ankle sprains comprise 10% of emergency room visits in the United States with an incidence of 30,000 ankle sprains a day (Keith et al., 2011).

Lateral ankle sprain has been documented to be themost common lower extremity injury sustainedduring sport participation. Approximately 85% ofall ankle sprains result from an inversion mechanism anddamage to the lateral ligamentous complex of the ankle.Injury to the lateral ligamentous complex at the ankle jointresults in pain, swelling, and limited osteokinematics. Aloss of normal ankle dorsiflexion usually is observed at thetalocrural joint after lateral ankle sprain (Patrick et al., 2007).

The amount of available ankle dorsiflexion plays a keyrole in the cause of lower extremity injuries .Limitation of dorsiflexion may be a predisposition tore injury of the ankle and several future lower limbinjuries, including plantar fasciopathy,lateral anklesprains, iliotibial band syndrome, patellofemoralpain syndrome, patellar tendinopathy and medial tibialstress syndrome (Terada et al., 2013).

A common mechanism for a high ankle sprain is excessive external rotation accompanied by ankle inversion. One can diagnosis a high ankle sprain when pain is

elicited by externally rotating the ankle with the knee flexed to 90 degree (Petric et al., 2009). Another examination maneuver for high ankle sprains is the squeeze test, where one squeezes the tibia and fibula together proximally, which applies tension to the interosseus membrane, and thus is painful in syndesmotic injuries. When ordering radiographs for a high ankle sprain, one should order ankle mortise views. Unstable high ankle sprains warrant surgical evaluation (Cohen et al., 2005).

Achilles tendonitis can occur in basketball players because of the frequent concentric loading (when jumping) and eccentric loading (when landing) that occurs while playing. It typically begins as an inflammatory reaction around the Achilles tendon and paratenon (Meeuwissue et al., 2003). The paratenon surrounds the tendon but is not a true synovial sheath. If not treated, micro tears, mucoid degeneration, longitudinal fissuring, and scarring can develop. The etiology is multifactorial, with overuse being the most common cause (Jozsa et al., 2010).

Knee injuries account 10.8% to 20% of basketball injuries, but up to 66% of missed games. High school–aged girls have 44% more knee injuries than do high school–aged boys. Although knee injuries are second to ankle injuries in frequency, more days are lost from knee injuries (18.25 And 5.47 days, respectively) (Meeuwisse et al., 2003).

One of the most common and devastating injuries to the knees of basketball players is disruption of the ACL. For example, the National Collegiate Athletic Association (NCAA) surveyed collegiate athletes and found that the incidence of ACL injuries was 27 per 100,000 female athletes and 8 per 100,000 male athletes. Of these ACL injuries, 85.3% to 87.5% were caused by noncontact mechanisms, typically the result of improper landing or other such positioning activities (Agel et al., 2005).

The ACL functions by providing stability, limiting hyperextension, and limiting anterior translation or internal rotation of the tibia (Cohen et al., 2005).ACL injuries most commonly occur after a hyperextension injury or from a significant valgus or rotational force to the knee. In general, ACL injuries do not heal, although there are rare reports of spontaneous healing (Fujimoto et al., 2009).

Lateral ankle and midfoot injuries account for 80-85% of all sprains. The most common mechanism of injury for ankle sprains involves plantarflexion and inversion

of the ankle and foot, which places excessive load on the anterior talofibular ligament. With failure of this ligament, secondary restrain to inversion occurs by way of the calcaneofibular and posterior talofibular ligaments, placing them at similar risk for injury. The anteromedial joint capsule and anterior fibers of the deltoid ligament may be secondarily injured due to excessive eversion of the ankle and foot that may occur during recoil from maximal inversion. Anklesprains areassigned grades I to III, ordered from least severe to most severe ligament damage (Davenportet al., 2013).

Pain is a specific sensation brought about by damage or threat of damage. Although of causes there is no outside form of energy called pain. International Association of the Study of Pain (ASP) defines as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in term of such damage. It states explicitly that pain always has a subjective component. It is both of physiologic sensation and an emotional reaction to that sensation" (Komald & Kanner, 2012). Pain is a sensation plus is action to that sensation either physical or psychological issue is at play in suffering and pain may be only a small component In the concept of (Komald & Kanner, 2008). Defining pain is somewhat difficult. Pain has been described as the perception of noxious stimuli or the distressing sensations that result from tissue damage. Perhaps the most useful definition is that suggested by Margo mccaffery, pain is "Whatever the experiencing person says it is and exists whenever he says it does" (Wallace, 2010).
The report of the Quebec Task Force recommends the adoption of a revised formula for classifying acuteness of spinal disorders (Mckenzie, 2009). Acute pain is usually temporary, of sudden onset and localized (Fritz, 2007). Acute pain present for less than seven days. Sub acute pain present for seven days to seven weeks. Chronic pain is pain present for longer than seven weeks (Mckenzie, 2009).

When pain lasts for a long time, it is called chronic pain (ANS, 2005). Chronic pain is that persists or recurs for indefinite periods, usually for longer than 6 months(Fritz, 2007). Others say that pain is often of less intensity than acute pain but is of long duration (Wallace, 2010). Chronic pain can take away our strength and sprit and can put relationships with the people closest to you at risk. Chronic pain is a major health problem for appropriately 25% of the population (ANS, 2005).

Chronic pain is defined as “Pain lasting for long periods of time and commonly persists beyond the time of healing of an injury and frequently there may not be any clearly identifiable cause” (Ready & Edwards, 2009).

Today, chronic pain is one of the most critical healthcare issues in the world. In the United States alone, more than 100 million people suffer with some type of chronic pain. More than half of these chronic pain sufferers are particularly or totally disabled. In fact, chronic pain disables more people than cancer or heart disease. Chronic pain takes its tools on personal lives, healthcare resources and the economy. This has led to the United States Congress to declare this decade the “Decade of Pain Control and Research” (ANS, 2005).

Pain is produced either by chemical or mechanical stimulus of free nerve ending. Chemical, mechanical trauma, tissue damage and deformation, postural stress and abnormal forces are causes pain (Mckenzie, 2009).

Ankle sprains occur when ligaments that connect the bones in the foot, ankle, and lower leg stretch or tear. There are different types of ankle sprains.

An inversion injury, the most common cause of ankle sprains, occurs when the ankle rolls outward and the foot turns inward. It results in stretching and tearing of the ligaments on the outside of the ankle. In an eversion injury, the ankle rolls inward and the foot turn outward, damaging the ligaments at the inside of the ankle (Jozsa et al., 2009).

In a "high" ankle sprain, a less common type of injury, ligaments that join the two lower leg bones together above the ankle, called the syndesmosis, are injured. This usually happens if the foot is forced up, or if the leg is forcefully twisted while the foot is planted. This injury can occur either by itself or with an inversion or eversion sprain. If the ligaments of the syndesmosis are injured, the sprain is more severe and takes longer to heal (Terada et al., 2013).

Damage to the ligament varies from simply stretched or slightly torn to completely torn. Your doctor will grade ankle sprain accordingly.

Ankle ligament sprains are usually graded on the basis of severity.

Grade I(mild)is a mild stretching of the ligaments without macroscopic rupture or joint instability with mild tenderness, swelling, and stiffness. The ankle feels stable, and it is usually possible to walk with minimal pain.

Grade II (moderate) is a partial rupture of the ligament with moderate pain and swelling, mild tenderness and stiffness. The ankle feels stable, and it is usually possible to walk with minimal pain (Davenport et al., 2013).There are functional limitations and a slight to moderate instability. Typically, patients present with problems in weight bearing. Walking is painful.

Grade III (severe) is a complete ligament rupture with marked pain, swelling, rising, hematoma and pain. In grade III injuries, there is a marked impairment of function with instability. Walking is usually not possible, because the ankle gives out and there is intense pain, although initial pain may quickly subside (Petersen et al., 2013).

Most common sign symptom of ankle sprains are: Mild tenderness, swelling, stiffness, pain, hematoma, Bruising, Walking difficulty, Initial pain may be quickly subside, Joint instability, Functional limitation (Fong et al., 2009).

People usually feel immediate pain at the site of an ankle sprain. Often the ankle starts to swell immediately and may develop bruising. The affected area is usually tender to touch and may feel "wobbly" or unstable.

In a mild sprain, swelling usually goes down within a few days.

The severity of symptoms usually depends on how much tearing has occurred. In more severe sprains, you are often not able to walk or even put weight on your foot, and your ankle may feel unstable. One usually have extreme pain at first, but some people start to feel better fairly soon. You may also hear and/or feel a tearing sensation and a pop or a snap (Petric et al., 2007).

If a sprain does not heal correctly, your ankle joint may be more likely to be injured again or the pain may not go away. This often occurs with even a slight trauma, such as stepping off a curb or walking on uneven pavement. Some people complain of persistent pain and swelling (Petersen et al., 2013).

Several other causes have been reported in association with FI following apparent Lateral Ankle Sprain. These include split lesions of the peonies brevis tendon, osteoid

osteoma of the cuboid bone, fibular osteochondroma, sural nerve entrapment, false aneurysm of the peroneal artery, superior peronealretinacular laxity and osteochondral lesions of the tibial plafond. While these conditions are rare,they should be considered in cases of FI which do not respond to conservative scare (Hartalet al., 2014).

Sprains and strains are the most common types of injuries, accounting for 55.1% of injuries in one study and 49.2% in another. Other common injuries include soft tissue injuries and lacerations (18.9%) and fractures and dislocations (17.7%– 28%). Less common injuries include overuse syndromes (9.5%), embedding of foreign bodies, and dental injuries. Most cases (71.2%–82.7%) can be fully treated with return to play within a 1 to 2 week time frame. Of injuries requiring more than 1 week of missed play, ankle injuries are the most common cause (42.5%) (Cohen et al., 2005).

Ankle injuries Ankle injuries are the most common of all basketball injuries, with an incidence of 0.4% to 8.9%. Falls accounted for most of these injuries (54%). The average time loss for ankle injuries was 5.47 days per injury in one series, whereas in another series, 45.9% of athletes missed 1 week or more with the injury. Ankle sprains are more common in female athletes, although this applies mostly to mild grade I ankle sprains; the incidence of more severe ankle sprains is similar in male and female players, and the incidence of ankle fractures is higher in male players(Powell, 2009).

The factors responsible for the high risk of reinjury are not fully understood. Several investigators have identified previous injury as a strong predictor of these injuries. A loss of ankle dorsiflexion has also been implicated as a risk factor for recurrent ankle sprain, however, investigation of the relationship between heel cord flexibility and ankle sprains has been limited (Denegar et al., 2010).

Dorsiflexion range of motion can potentially be limited by tightness in the muscles that plantar flex the ankle, particularly the gastrocnemius and soleus, capsular and soft tissue restrictions, loss of normal posterior glide of the talus in the mortise, and loss of other accessory motions at the tibiofibular, subtalar, and mid tarsal joints (Hartalet al., 2014).

Leanderson et al., reported that dorsiflexion range of motion did not differ between injured and uninjured ankles of basketball players, but that basketball players had

significantly less dorsiflexion range of motion than a group of physically active subjects without history of ankle sprain.Green et al., reported that early (less than 72 hours after injury) posterior talocrural joint mobilization in the treatment of lateral ankle sprains resulted in more rapid restoration of dorsiflexion range of motion and normal walking gait than conventional treatment (e.g., ice, compression, elevation, and crutch use) (Deneger et al.,2010).These investigators did not, however, assess the amount of posterior talar glide in the patients they treated with or without joint mobilization at the completion of the rehabilitation regimen.Nor was the mechanism by which mobilization of the talus improved dorsiflexion range of motion clearly identified (Green et al.,2007).

It is possible that because the talus lacks muscular attachments, it has a propensity towards anterior subluxation following disruption of the ligaments which attach to it. Following injury to the anterior talofibular ligament, the talus may be allowed to subluxate anteriorly and remain malpositioned until it is passively returned to its ‘‘normal’’ position (Denegar et al., 2010).

While the concepts of positional faults and restricted arthrokinematics are accepted in manual therapy circles, there is a clear lack of empirical evidence from clinical investigations to support these hypotheses of joint dysfunction. Given the high rate of reinjury, the limited research on range-of-motion restrictions following lateral ankle sprain, and the implication of restricted posterior talar glide following injury, there is a need for greater understanding of motion restrictions following lateral ankle sprains (Hartal et al., 2014).

The objective of this study was to measure ankle dorsiflexion range of motion and the amount of posterior talar glide of athletes who had suffered a unilateral ankle sprain, completed a rehabilitation program, and returned to competition. We also assessed talocrural and subtalar joint stability to ascertain whether the examined ankles demonstrated patterns of joint laxity similar to those found in previous reports on the sequelae of lateral ankle sprain (Deneger et al., 2010).

Ankle sprains are among the most common injuries seen in athletic participation, with reinjury rate for athletes with lateral ankle sprains as high as 70% to= 80%,leading to the development of chronic ankle instability (CAI). Clinicians are faced with many factors that need to be addressed after lateral ankle sprains, including muscle

weakness, postural-control deficits, decreased range of motion, and the frequent occurrence of reinjure. With the goal of returning patients to Chronic Ankle Instability high levels of function in a limited time frame, clinicians are challenged to find approaches that will improve ankle stability and prevent injury (McGuine et al., 2005).

The ankle is one of the most commonly injured the purpose of this systematic review is to evalujoint in sports.In particular, lateral ankle sprains ate the clinical trials involving conservative exercise consist of 85% of all ankle injuries. Despite con- interventions in FAI and examine the changes enervative programmes to treat ankle sprains, many deuced by the exercise treatments to the various patients develop chronic ankle instability (CAI).The results of the present CAI can be classified into mechanical and/or function- review might help to determine optimal treatment tonal instability. Mechanical instability is defined approach for FAI. As movement beyond the ankle's normal range of motion and may be caused by ligament laxity (Klugel et al., 2010).

Ankle sprain reinjure frequency of each group was collected at the end of the session. An ankle sprain recurrence was defined as any ankle inversion sprain occurring during a scheduled match or practice session. The injury diagnosis was made within 1 hour of the injury event by 1 of the medical practitioners. Intervention options included proprioceptive training, strength training, orthotics, and no intervention (control group). The subjects were individually and randomly assigned to 4 study groups. The first group (n=20) followed the proprioceptive training using the ankle disk each day, minutes a day. The athlete is instructed to stand on the ankle disk on the injured leg and shift his or her weight, causing the disk's edge to follow a continuous circular path. Progression is to move from eyes open to eyes closed and from firm surfaces to soft and moving surfaces (Mohammodi, 2007).

The second group (n=20) followed a preventive program that consisted of specific strength training of evertor muscles. Strength training begins with isometric exercises performed against an immovable object and progresses to dynamic resistive exercises using ankle weights and resistance bands. Resistance was applied for 10 sets of 20 repetitions, with hold duration of 9 seconds. Controlling the time that a maximal

contraction was maintained ensured that the targeted musculature was being maximally loaded in a pain-free arc.

In the third group (n=20), the subjects used a Sport- Stirrup (AircastInc, Summit, NJ) orthosis. It is structured as a stirrup of thermoplastic material and incorporates inflatable air cells on its inner surfaces at the level of the medial and lateral malleoli (Klugel et al., 2010).

In the first phase, use ice and compression in combination with rest and elevation. Non-steroidal anti-inflammatory drugs (NSAIDs) have beneficial short-term outcomes for acute ankle sprains. A short period of plaster immobilization or similar rigid support facilitating a rapid decrease of pain and swelling can also be helpful in the acute phase. Thereafter, functional treatment for 4 to 6 weeks is preferable to immobilization (Denegar et al., 2010).

Balance or neuromuscular training prevents recurrence of ankle injuries in athletes up to 12 months post injury, is recommended to commence within 12 months after injury and should be included into regular (McGuine et al., 2005).

Cryotherapy should be applied to acute ankle sprains to reduce pain, minimize swelling formation, and decrease secondary injury.

Compression should be applied to acute ankle sprains to minimize swelling.

The limb with the acute ankle sprain should be elevated to minimize swelling.

Nonsteroidal anti-inflammatory drugs (NSAIDs), administered orally or topically, reduce pain and swelling and improve short-term function after ankle sprains.

Functional rehabilitation is more effective than immobilization in managing grade I and II ankle sprains.

Grade III sprains should be immobilized for at least 10 days with a rigid stirrup brace or below-knee cast and then controlled therapeutic exercise instituted.

Electrical stimulation can be used as an adjunct to minimize swelling during the acute phase of injury. Clinicians should refrain from thermotherapy during the acute and sub acute phase of injury due to lack of evidence and the potential to exacerbate the injury.

Cryokinetics can be used to reduce pain and thereby allow early rehabilitative exercises.

Rehabilitation should include comprehensive ROM, flexibility, and strengthening of the surrounding musculature.

Balance training should be performed throughout rehabilitation and follow-up management of ankle sprains to reduce reinjury rates.

Passive joint mobilizations and mobilizations with movement should be used to increase ankle dorsiflexion and improve function.The patient's perception of function should be included inany return-to-play (RTP) decision making. Several instruments (e.g., Lower Limb Task Questionnaire and Cumberland Ankle Instability Tool [CAIT]) may be used to help identify the patient's perception of function and aid in the RTP decision process.

Functional performance testing should be a component of the RTP decision making. Several tests (e.g., single-legged hop for distance, Star Excursion Balance Test [SEBT]) may be used to help determine the patient's ability to RTP.

Before the patient returns to sport-specific tasks, the injured limb's functional performance should measure at least 80% of the uninjured limb.

Athletes with a history of previous ankle sprains should wear prophylactic ankle supports in the form of ankle taping or bracing for all practices and games.

Both lace-up and semi rigid ankle braces and traditional ankle taping are effective in reducing the rate of recurrent ankle sprains treatment (Kaminski et al., 2013).

Clinicians working with athletes should implement a multi-intervention injury-prevention program lasting at least 3 months that focuses on balance and neuromuscular control to reduce the risk of ankle injury. Athletes with a history of ankle injury may benefit more from this type of training.

Addressing the strength of the leg muscles (averters, invertors, dorsiflexors, and plantar flexors) and hip extensors and abductors may be an ankle injuryprevention strategy.

Clinicians should consider assessing dorsiflexion ROM in at-risk athletes. If dorsiflexion ROM is limited, clinicians should incorporate techniques to enhance arthrokinematic and osteokinematic motion for possible prevention of ankle injury (Hartal et al., 2014).

Athletes who sustain an ankle sprain will want to incorporate a strengthening program as part of their rehabilitation. Strengthening can help to relieve the symptoms of an ankle sprain. As a general rule, the ankle should not hurt. There should be a gentle pulling sensation of the muscle, but this should not be painful.

CHAPTER- III METHODOLOGY

3.1 Study Design

The study was conducted by using a quantitative randomized control trial design with two different subject groups.

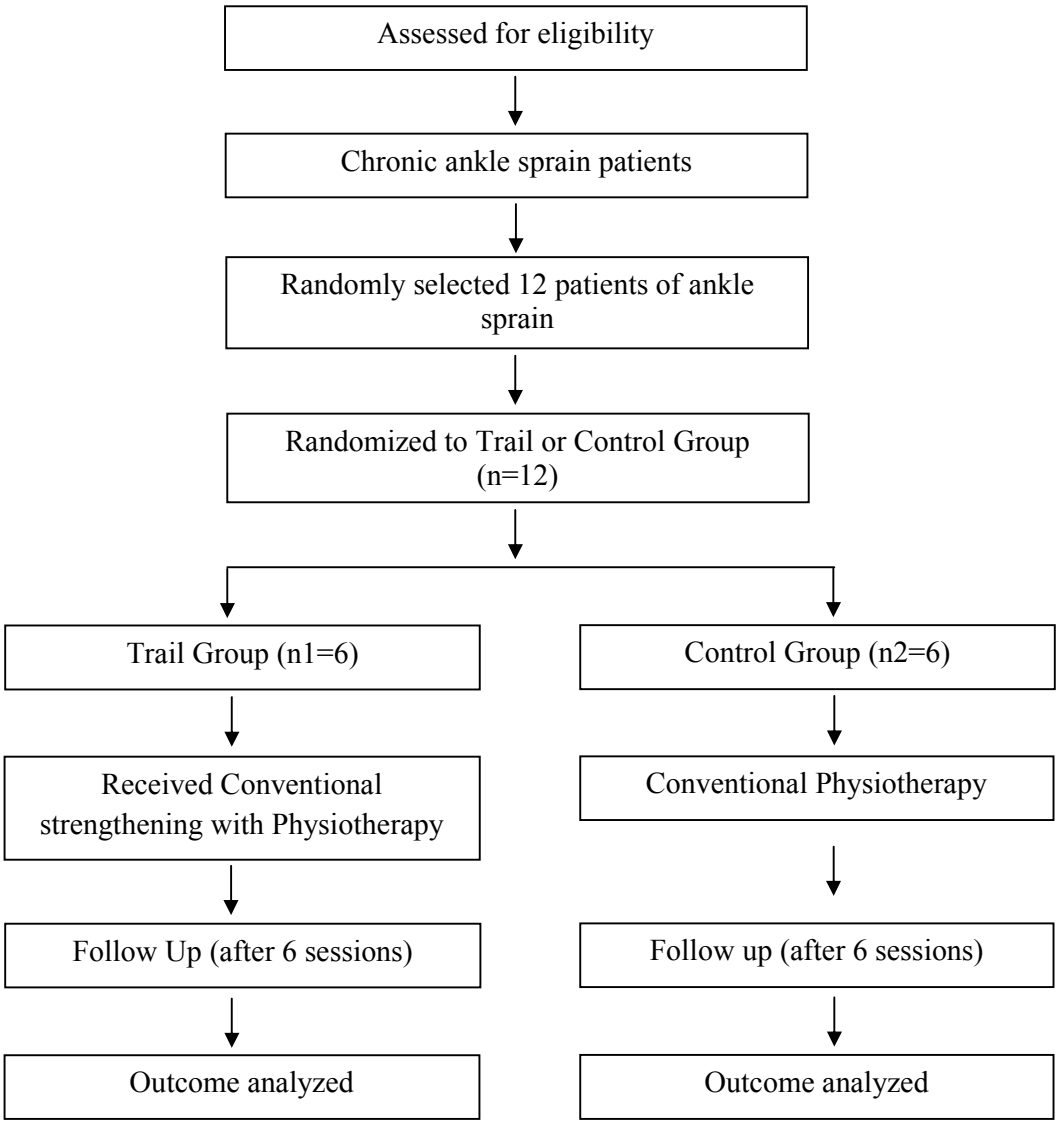
The study was randomized control trial between different subject designs. Both groups received a common treatment regimen except one intervention. Only the experimental group received the strengthening exercises while in control group only conventional physiotherapy treatment program was given.

A pre test (before intervention) and post test (after intervention) was administered with each subject of both groups to compare the pain effects before and after the treatment. The design could be shown by-

R Q_1 x Q_2 (Experimental group)

R Q_1 Q_2 (Control group)

Flowchart of the phases of randomized controlled trial:-



A flowchart for a randomized controlled trial of a treatment program including conventional physiotherapy with strengthening exercise of ankle joint for patient with ankle sprain.

3.2 Study area

Bangladesh Krira Shikkha Protisthan (BKSP)

3.3 Study Population

A population refers to the entire group of people or items that meet the criteria set by the researcher. The populations of this study were the ankle sprain young athlete patients.

3.4 Study Duration

May to August, 2015 (4 months).

3.5 Sample Size

Sample size was 12 participants. 6 participants were in experimental group and 6 participants in control group.

3.6 Sample Selection

Subjects, who met the inclusion criteria, will take as sample in this study. Twelve patients with ankle sprain will select from BKSP. From the outdoor patients with chronic ankle sprain, 12 patients randomly select from outdoor. The samples was gave numerical number C1, C2, C3 etc for the control and E1, E2, E3 etc for experimental group. Total 12 samples included in this study, among them 6 patients will select for the experimental group and rest 6 patients will select for control group (conventional physiotherapy only).

3.7 Inclusion criteria

- The participants were those individuals who continued physiotherapy treatment and completed at least six sessions.

Patients with all age range.

Both sexes.

Voluntary participants.

Participants with having ankle sprain.

Any ankle sprain patients with dysfunction.

3.8 Exclusion criteria

Subjects who had not completed six session of physiotherapy treatment.

The participants had any experienced of recent trauma.

Any Contraindication are found

Bone infections

- Fracture
- Joint irritability
- Osteoporosis
- Osteopenia

Hypertension

Structural abnormality or any deformity.

Subject who had the history of taking oral NSAIDs, muscles relaxants or corticosteroid injection previously.

Any pathological lesion on ankle joint.

Surgery to the ankle.

3.9 Survey a conventional physiotherapy

Survey is a preliminary run of the main study to highlight any problems which can then be corrected and it is important always to run some pilot study before beginning the experiment. So, the researcher performed a survey before beginning the main study and the aim of this survey was to define the list of conventional physiotherapy treatment is provided by physiotherapist of BKSP. Researcher took one week for survey and visited the BKSP and consulted with relevant qualified physiotherapist to identify the conventional physiotherapy used for ankle sprain. The researcher formulated a list of evidence based physiotherapy interventions of ankle sprain and provided those to the physiotherapist to make the interventions commonly used as conventional physiotherapy for ankle sprain. After finishing the survey, researcher became able to find out the conventional physiotherapy interventional used for ankle sprain and their frequency of use, with the consent of eight clinical physiotherapists.

List of the conventional Physiotherapy treatment for ankle sprain:-

1) Mechanical directional movements,

2) DTFM,

3) Ultrasound Therapy,

4) Accessory movement,

5) Stretching,

6) Strengthening,

7) Transient ischemic pressure,

8) Tapping,

9) Needing,

10) Oral NSAID were the second most commonly used interventions and the frequency was 75-99%.

3.10 Method of data collection

3.10.1 Data collection tools

A written questionnaire, pen, paper, therabend and Goniometer will use as data collection tools in this study.

3.11 Measurement tool

3.11.1 Visual Analogue Scale (VAS)

In this study researcher used visual analogue scale for measuring the intensity of pain. The VAS is a simple and accurate way of subjectively assessing pain along a continuous visual spectrum. VAS consists of a straight line on which the individual being assessed marks the level of pain. The ends of the straight line are the extreme limits of pain with 0 representing no pain and 10 representing the worst pain ever experienced. According to Myles (1999: 1517), the visual analog scale (VAS) is a tool widely used to measure pain and a change in the visual analog scale score represents a relative change in the magnitude of pain sensation. In this study researcher used Goniometer for measuring the Range of Movement (ROM) of planter flexion, dorsiflexion, inversion, and eversion. The Goniometer is a simple and accurate way of objective assessment of ROM.

3.11.2 Goniometer

In this study researcher use Goniometer for measuring the Range of Movement (ROM) of ankle planterflexion, dorsiflexion, inversion and eversion. The Goniometer is a simple and accurate way of objective assessment of ROM.

3.12 Data collection procedure

The study procedure was conducted through assessing the patient, initial recording, treatment and final recording. After screening the patient at department, the patients will assess by qualified physiotherapist. Six sessions of treatment will provided for every subject. Twelve subjects were chosen for data collection according to the inclusion criteria. The researcher divide all participants into two groups and coded C1 (6) for control group and E1 (6) for experimental group. Experimental group received conventional physiotherapy with ankle strengthening exercises and control group received only conventional physiotherapy.

Data was gathered through a pre-test, intervention and post-test and the data was collected by using a written questionnaire form which was formattedby the researcher. Pre test was performed before beginning the treatment and the intensity of pain was noted with VAS score on questionnaire form. The same procedure was performed to take post-test at the end of six session of treatment. Researcher give the assessment form to each subject before starting treatment and after four session of treatment and instructed to put mark on the line of VAS according to their intensity of pain. The researcher collects the data both in experimental and control group in front of the qualified physiotherapist in order to reduce the biasness.

At the end of the study, specific test was performed for statistical analysis.

3.13 Intervention protocol (Trial Group)

A common intervention program was execute for both groups as conventional physiotherapy, it includes-Mechanical directional movements, tapping, needing, accessory movement, Ultrasound therapy, Transient ischemic pressure which are the most frequently, used interventions. In this study, the experimental group was treated with strengthening exercises in addition with conventional physiotherapy. Strengthening exercises and conventional physiotherapies both was given by clinical physiotherapist. Each group got 6 sessions of treatment, where the experimental group was provide with strengthening exercises for 6 times along with conventional physiotherapy treatment.

Repetitionfor strengthening - 10 times in 1 time and gradually increased 15-20 times and 3 times per day.

3.14 Ethical consideration

The whole process of this research project was done by following the Bangladesh Medical Research Council (BMRC) guidelines, World Health Organization (WHO) and Institution of Review Board (IRB). Research proposal was submitted for approval to the administrative bodies of ethical committee of BKSP. Again before beginning the data collection, researcher was obtained the permission from the concerned authorities ensuring the safety of the participants. In order to eliminate ethical claims, the participants were set free to receive treatment for other purposes as usual. Each participant will inform about the study before beginning and given written consent.

3.15 Data Analysis

In order to ensure that the research have some values, the meaning of collect data had to be presented in ways that other research workers can understand. In other words the researcher had to make sense of the results. As the result come from an experiment in this research, data analysis was done with statistical analysis. All participants were code according to group to maintain participant's confidentiality. All subjects of both experimental and control group score their pain intensity on visual analogue scale before starting treatment and after completing treatment. Reduction of pain intensity for both groups is the difference between pre-test and post-test score.

Experimental studies with the different subject design where two groups are used and each tested in two different conditions and the data is interval or ratio should be analyzed with unrelated "t" test. As it was experimental and had unmatched groups of different subjects, who was randomly assign to conventional physiotherapy with strengthening exercises and only conventional physiotherapy group and the measurement of the outcome came from collecting VAS score, with considering interval or ratio data, so the parametric unrelated 't' test will use in this study to calculate the level of significance. Unrelated 't' test and mean difference was calculated to test the hypothesis on the basis of following assumptions-

- Data will ratio
- Two different set of subjects in two conditions

3.16 Questionnaire

The questionnaire was developed under the advice and permission of the supervisor following certain guidelines. There were six close ended questions with visual analogue scale (VAS) and 4 another questions for measuring range of motion of ankle in different directional movement. First 6 questions were formulated to identify the change of pain with each activity and 6 another question for range of motion measurements. All questions were related to pain, functional activity and range of motion of ankle.

CHAPTER-IV RESULTS

Twelve patients with ankle pain were enrolled in the study. 6 in the ankle strengthening exercises with conventional physiotherapy treatment group (experimental group) and 6 in the only conventional physiotherapy treatment group (control group). The all subjects of both experimental and control group scored their pain on visual analogue scale before and after completing treatment.

Mean age of the participants

Experimental group		**Control group**	
Subjects	**Age(Year)**	**Subjects**	**Age(Year)**
E1	17	C1	15
E2	15	C2	11
E3	12	C3	14
E4	14	C4	12
E5	16	C5	18
E6	12	C6	15
Mean Age	**14.3 Year**	**Mean Age**	**14.16Year**

Table 01: Mean age of the participants of experimental and control group

Sex of the participants

12 patients with ankle sprain were included as sample of the study, among them almost 50% (n=6) were male and about 50% (n=6) were female.

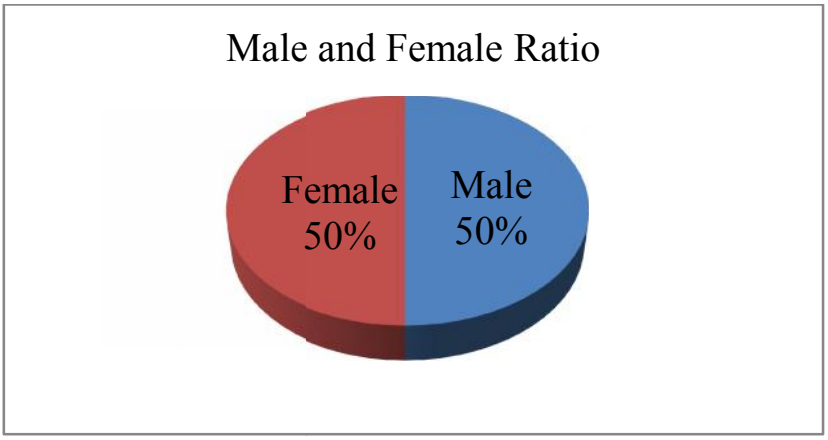


Figure 01: Sex of participants

Table no 02

Variables in the study statistically significance at the following level of significance:

No	Variables	Observed 't' value	Tabulated 't' value	Observed P value	Significant level
1.	Planterflexion	0.37	1.372	>0.10	Not significant
2.	Dorsiflexion	0.18	1.372	>0.10	Not significant
3.	Inversion	0.03	1.372	>0.10	Not significant
4.	Eversion	0.08	1.372	>0.10	Not significant

CHAPTER-V DISCUSSION

The purpose of this study was to evaluate the effectiveness of strengthening exercise of ankle with conventional physiotherapy compare to only conventional physiotherapy for ankle sprain. In this experimental study 12 patients with ankle sprain were randomly assigned to the experimental group and to the control group. Among these 12 patients, 6 patients were included in the experimental group who received strengthening exercise of ankle muscles with conventional physiotherapy and the rest of the 6 patients were included in the control group, who received conventional physiotherapy only. Each group attended for 6sessions of treatment within two weeks in the Exercise Physiology department of BKSP, Savar in order to demonstrate the improvement. The outcome was measured by using visual analogue scale for pain intensity in different functional position, and goniometer for measuring ROM.

The result of this study reported that the combination of strengthening exercise and conventional physiotherapy is capable of producing beneficial effect for patients with ankle sprain. The combination technique used in experimental group may be beneficial for reducing pain, functional disability in the subjects with ankle sprain.

The experimental design employed in this study is mainly suitable for a comprehensive investigation of the management of participating subjects (Sambyal & Kumar., 2010). There were 12 participants in this study. They were distributed randomly in two groups of Experimental Group and Control Group. Experimental group received both strengthening exercise and conventional physiotherapy as a combination treatment technique and the Control group received only conventional physiotherapy for treatment of ankle sprain.

According to Kramer (2011), the syndromes affect equally in male and female. This also supports the male and female samples of my study. Because there was 50% male and 50% female participated in both control and experimental group in the study.

The outcome of the researched reveals significant improvement of pain. In Experimental group, Mean difference of reduction of resting pain was 4 which were 1.5 more than Mean difference in control group. Also there was significant improvement of pain in standing, walking ,running, planterflexion and dorsiflexion, as

the mean difference were consecutively 3.3, 3, 3.5, 3.17and 3 more than control group.

The subjects participated in this study fulfilled the symptomatic criteria for ankle pain and was found to meet the inclusion criteria and excluding the contraindications to the applied therapies (McKenzie & May., 2006).

The causes of pain due to ankle, its symptoms and signs was suggested to be trauma because of the types and distribution of the pain (McKenzie & May., 2006, Cowell & Philips., 2010).

The mean difference of pain reduction from both experimental and control group shows that the study was effective in reducing pain intensity and proves clinically significant. On the other hand, the mean difference of ankle disability reduction from both groups also shows that the study was beneficial in terms of reducing disability and proves clinically significant.

The analysis of significance was carried out by using unrelated *t* test to compare the effectiveness of strengthening exercise technique along with conventional physiotherapy as a combination therapy for management of pain and minimise disability of the patients with sprain in ankle as compared to other treatment approach alone.

By using an unrelated "t" test on the data the results were found to be significant ($p > 0.10$ for a one-tailed hypothesis). The null hypothesis can therefore be rejected. This means that strengthening exercise along with conventional physiotherapy is more effective than other treatment approach only for reducing pain and disability in patients with sprain in ankle.

Kumar (2010), found in his study, statistically significant in strengthening physiotherapy group and conventional physiotherapy group separately. The mean percentage of improvement in ankle for planterflexion and dorsiflexion. But the improvement of inversion and eversion was not significant.

In this study, Researcher found reduction of pain in both control group and experimental group. But the comparison of both groups show that, strengthening

exercise is more effective in reducing ankle pain and disability and improves functional ability.

(Docherty et al., 2009., Bergmann *et al*.,2005) did a research where planterflexion, dorsiflexion, inversion and eversion the intervention group (Group B) did not have as great an improvement during the treatment period as Group A (reference) did. Group B however, continued to improve after the treatment and during the follow-up period while the group was decreasing. Dysfunctions within the ankle equate to mechanical ankle pain and restricted movements (which when treated by improve considerably (Cassidy *et al*., 2009).

This could be a possible reason as to why Group A (reference) had improved results. The intervention group received this treatment however they were also dealing with the effects of teaching their muscles "new functioning". Muscle dysfunctions (pain, inhibition) may cause a decrease in range of motion (ROM) (Grieve, 2013., Gatterman, 2010., Kendall, 2011&Liebenson, 2008).

The researcher found in a study that planter flexion and dorsiflexion is significant in strengthening exercise. But in this study inversion and eversion is also significant and there is improvement by strengthening exercise but have not statistically found.

The main limitation of this study was its short duration. The study was conducted with 12 patients of chronic ankle pain, which was a very small number of samples in both groups and was not sufficient enough for the study to generalize the wider population of this condition.It is limited by the fact daily activities of the subject were not monitored which could have influenced. Researcher only explored the effect of strengthening exercise after 6 sessions, so the long term effect of treatment was not explored in this study. The research was carried out in BKSP, Savar such a small environment, so it was difficult to keep confidential the aims of the study for blinding procedure. Therefore, single blinding method was used in this study. There was no available research done in this area in Bangladesh. So, relevant information about ankle pain with strengthening exercises for Bangladesh was very limited in this study.

CHAPTER-VICONCLUSION AND RECOMMENDATION

6.1 Conclusion

The result of this experimental study have identified the effectiveness of conventional physiotherapy with ankle strengthening exercises are better treatment than the conventional physiotherapy alone for reducing pain and increase range of motion of chronic ankle sprain patient. Participants in the conventional physiotherapy with ankle strengthening group showed a greater benefit than those in the only conventional physiotherapy group, which indicate that the conventional physiotherapy with ankle strengthening exercises can be an effective therapeutic approach for patient with ankle sprain.

Ankle strengthening exercises technique is used along with conventional physiotherapy that aims to reduce pain, increase functional activity and also increase range of motion of ankle, to facilitate rehabilitation program. It is a cost effective treatment alternative for many common injuries & overuse syndrome which is effective for restoring the joint play and for establishing proper structural alignment. So it may become helpful for patients with ankle sprain to determine ankle strengthening exercises with conventional physiotherapy as intervention for reducing the features of ankle sprain. From this research the researcher wishes to explore the effectiveness of ankle strengthening exercises along with conventional physiotherapy to reduce the features of patient with ankle sprain, which will be helpful to facilitate their rehabilitation and to enhance functional activities.

6.2 Recommendations

As a consequence of this researcher it is recommended to do further study including comparison of the conventional physiotherapy and ankle strengthening exercises with conventional physiotherapy alone to assess the effectiveness of these interventions with well-controlled blinding procedure. It is also is recommended to include the functional outcome assessment of patient and to identify the average number of sessions that are needed to be discharged from treatment to validate the treatment technique.

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APPENDIX 1: CONSENT FORM (English)

Verbal Consent Statement

(Please read out to the participants)

Assalamualaikum/Namasker,

My name is Mahmuda Afrin, I am conducting this study as a part of my academic work of B. Sc. in Physiotherapy under Bangladesh Health Professions Institute (BHPI), which is affiliated to University of Dhaka. My study title is **"Outcome of strengthening exercise among young athletes with ankle sprain."** I would like to know about some personal and other related information regarding sports injuries among young athletes. You will need to answer some questions which are mentioned in this form. It will take approximately 20-25 minutes.

I would like to inform you that this is a purely academic study and will not be used for any other purpose. The researcher is not directly related with this BKSP, so your participation in the research will have no impact on your present or future training session. All information provided by you will be treated as confidential and in the event of any report or publication it will be ensured that the source of information remains anonymous.

Your participation in this study is voluntary and you may withdraw yourself at any time during this study without any negative consequences. You also have the right not to answer a particular question that you don't like or do not want to answer during interview.

If you have any query about the study or your right as a participant, you may contact with me, and/or S.M. Ferdous Alam, Assistant Professor, Department of Physiotherapy, Bangladesh Health Professions Institute (BHPI), CRP, Savar, Dhaka-1343.

Do you have any questions before I start? Yes / No

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

Yes ☐ No ☐

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

Signature of the Interviewer …….Date …….

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

মৌখিক অনুমতিপত্রসম্মতিপত্র

(অংশগ্রহনকারীকে পড়ে শোনাতে হবে)

□ □□□□□□□□লাইকুম/ নমস্কার,

□ □□□□ □□□ □□□□□□□□ □ □□□□□, আমি এই গবেষণা প্রকল্পটি বাংলাদেশ হেলথ্ প্রফেশনস ইনষ্টিটিউট (□□□□□□□ □ □□)- □ □□□□□□□□□ □□□□ □□ □ □□□□ □র্থ বর্ষ বি এস সি ইন ফিজিওথেরাপী কোর্সের আধিভুক্ত□ □ □□□□ □□□□□□□□ □□□□□□□□□ □□- "গোড়ালী মচকানো ক্রীড়াবিদদের জন্য বলকারক ব্যায়াম এর ফলাফল"□ আমি এক্ষেত্রে আপনাকে কিছু ব্যক্তিগত এবং আনুষঙ্গিক প্রশ্ন গোড়ালী মচকানো সম্পর্কে করতে চাচ্ছি। এতে আনুমানিক ২০-৩০ □□□□ □□□ □□□□□□

আমি আপনাকে অনুগত করছি যে, এটা আমার অধ্যয়নের অংশ যা অন্য কোন উদ্দেশ্যে ব্যবহৃত হবে □□□ □□□□□ □□□□□□ □□কে.□□.পি এর সাথে সংযুক্ত নয়। সুতরাং আপনার অংশগ্রহণ এই গবেষণার বর্তমান এবং ভবিষ্যৎ প্রশিক্ষ সময়কে কোন প্রভাব ফেলবে না। আপনি যেসব তথ্য প্রদান করবেন তার গোপনীয়তা বজায় থাকবে এবং আপনার প্রতিবেদনের ঘটনা প্রবাহে এটা নিশ্চিত করা হবে যে এই তথ্যের উৎস অপ্রকাশিত থাকবে।

এই অধ্যয়নে আপনার অংশগ্রহণ স্বেচ্ছা প্রণোদীত এবং আপনি যে কোন সময় এই অধ্যয়ন থেকে কোন নেতিবাচক ফলাফল ছাড়াই নিজেকে প্রত্যাহার করতে পারবেন। এছাড়া কোন নির্দিষ্টপ্রশ্ন অপছন্দ হলে উত্তর দেয়ার এবংসাক্ষাৎকারের সময় কোন উত্তর না দিতে চাওয়ার অধিকার আপনার আছে।
এই অধ্যয়নে অংশগ্রহণকারী হিসেবে আপনার কোন প্রশ্ন থাকে তাহলে আপনি আমাকে অথবা/ এবং □□.□□. ফেরদৌস আলম, সহযোগী অধ্যাপক, □□□□□□□□□□ □□□□□, □□.□ □.□□, □□□□□, □□□□-□□□□-তে যোগাযোগ করতে পারেন।

সাক্ষাৎকার শুরু করার আগে আপনার কোন প্রশ্ন আছে?হ্যাঁ /□□

আমি আপনার অনুমতি নিয়ে এই সাক্ষাৎকার শুরু করতে যাচ্ছি।

হ্যাঁ ☐

□□ ☐

□□ অংশগ্রহণকারীর সাক্ষর..... □□□□.....

□□ সাক্ষাৎগ্রহকারীর সাক্ষর..... □□□□.....

□□ সাক্ষীর সাক্ষর..... □□□□.....

APPENDIX II: Questioner (English)

Data Collection Form

This questionnaire is developed for the patient with Ankle Sprain.

Code No:-

Name of Participant: Occupation:

Age: Address:

Sex: Date:

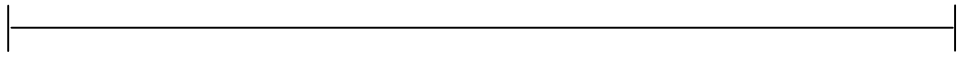
How long have you had ankle pain?

Year ……. Month …….. Day ……

This questionnaire is designed for chronic ankle sprain athlete patients who have ankle pain. Each question (QN 1- QN 6) has a long line presenting pain. Left hand end that is Zero (0) means no pain, as you move along the line the pain feel is increasing. At the right hand end that is Ten (10) means severe pain. Pain locates by circling on the line. The Answer of other questions (QN 7- QN 10) will be enlisted by examiner by using some measurement tools.

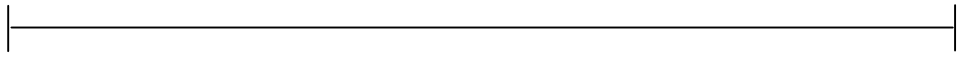
1. How severe is ankle pain at present?

Pre test



0 10

Post test



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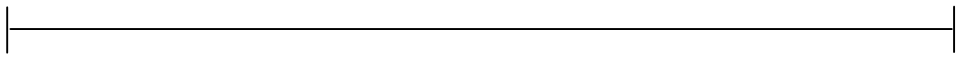
2. How severe is pain at ankle during standing?

Pre test



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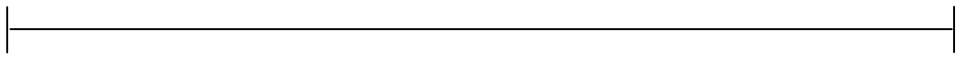
Post test



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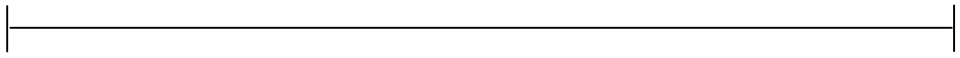
3. How severe is pain at ankle during walking?

Pre test



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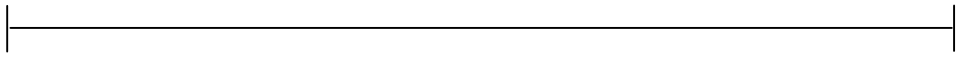

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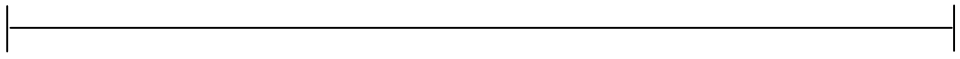
4. How severe is pain at ankle during running?

Pre test



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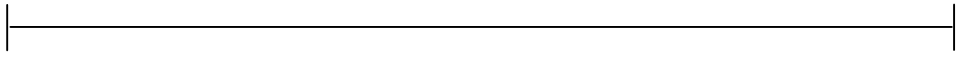
Post test



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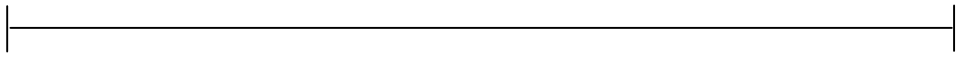
5. How severe is pain at ankle during planter flexion?

Pre test



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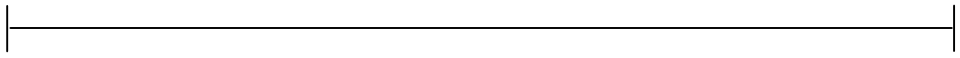

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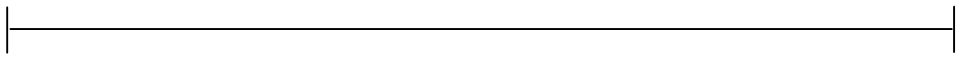
6. How severe is pain at ankle during dorsiflexion?

Pre test



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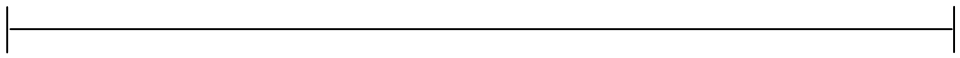
Post test



0 10

7. Passive ROM of planter flexion of ankle. (Measured by examiner)

Pre- treatment …….. Degrees

Post- treatment …….. Degrees

8. Passive ROM of dorsiflexion of ankle. (Measured by examiner)

Pre- treatment …….. Degrees

Post- treatment …….. Degrees

9. Passive ROM of inversion of ankle. (Measured by examiner)

Pre- treatment …….. Degrees

Post- treatment …….. Degrees

10. Passive ROM of eversion of ankle. (Measured by examiner)

Pre- treatment …….. Degrees

Post- treatment …….. Degrees

Mahmuda Afrin
B.S.c in Physiotherapy
Researcher

প্রশ্নাবলী

(এই প্রশ্নপত্র গোড়ালী মচকানো রোগীর জন্য প্রণীত)

□□□□□□ □□-

অংশগ্রহনকারীর নাম: পেশাঃ

□□□□ লিঙ্গঃ

ঠিকানা: □□□□□

আপনার গোড়ালীতে ব্যথা দীর্ঘকত দিন আগে থেকে?

□□□..... □□□..... □□□.....

এই প্রশ্নপত্র দীর্ঘস্থায়ী গোড়ালী মচকানো ক্রীড়াবিদদের জন্য প্রণীত। ১নং থেকে ৬নং প্রশ্ন রোগীর ব্যথা নির্দেশ করে। প্রতিটি প্রশ্নের শেষে লম্বা লাইন আছে। আপনার হাতের বামপাশ নির্দেশ করে ব্যথা নেই আর ডানপাশ নির্দেশ করে তীব্র ব্যথা। আপনি যতটুকু অনুভব করেন তা চিহ্নিত করুন। ৭নং থেকে ১০ নং প্রশ্নের উত্তর পরিক্ষক উপলব্ধি করবেন।

(□□□□□ □ মানে কোন ব্যথা নেই, ১০মানে তীব্র ব্যথা)

□□ বিশ্রামরত অবস্থায় আপনার গোড়ালীতে ব্যথার পরিমান কত?

চিকিৎসার পূর্বে

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□ □□

চিকিৎসার পরে

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□□ দাড়ানো অবস্থায় আপনার গোড়ালীতে ব্যথার পরিমান কত?

চিকিৎসার পূর্বে

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□□ □□□র সময় আপনার গোড়ালীতে ব্যথার পরিমান কত?

চিকিৎসার পূর্বে

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চিকিৎসার পরে

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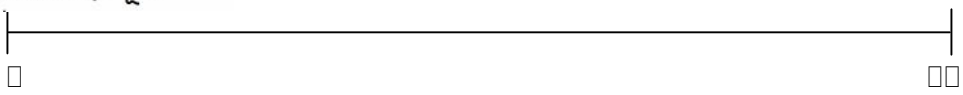
□□ দৌড়ানোর সময় আপনার গোড়ালীতে ব্যথার পরিমান কত?

চিকিৎসার পূর্বে



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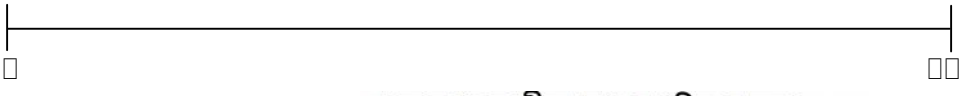
চিকিৎসার পরে



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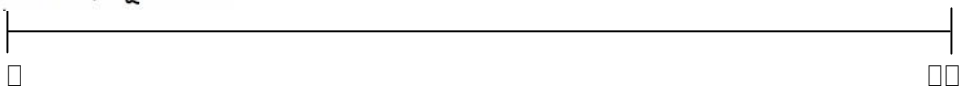
চিকিৎসার পূর্বে



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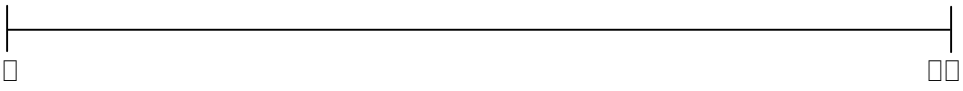

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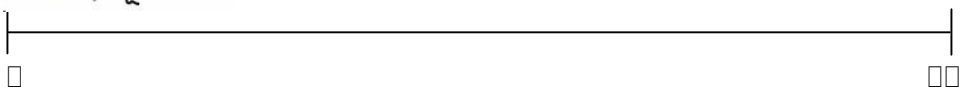
□□ পায়ের পাতা ভাজ করে উপরের দিকে উঠানোর সময় আপনার গোড়ালীতে ব্যথার পরিমান কত?

চিকিৎসার পূর্বে



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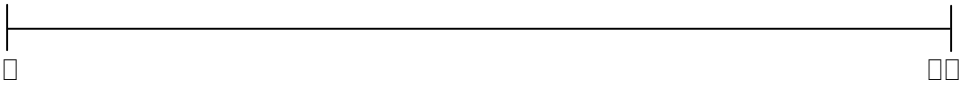

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□□ আক্রান্তগোড়ালীর পরোক্ষ রেঞ্জ অব মোশন।

চিকিৎসার পূর্বে..... ডিগ্রী

চিকিৎসার পরে..... ডিগ্র

□□ আক্রান্ত গোড়ালীর পায়ের পাতা উপরে ভাজ করার সময় পরোক্ষ রেঞ্জ অব মোশন।

চিকিৎসার পূর্বে..... ডিগ্রী

চিকিৎসার পরে..... ডিগ্রী

□□ আক্রান্ত গোড়ালীর পায়ের পাতা ভিতরের দিকের পরোক্ষ রেঞ্জ অব মোশন।

চিকিৎসার পূর্বে..... ডিগ্রী

চিকিৎসার পরে..... ডিগ্রী

□□□ আক্রান্ত গোড়ালীর □□□□□ □□□□ □□□□□□ □□□□□ পরোক্ষ রেঞ্জ অব মোশন।

চিকিৎসার পূর্বে..... ডিগ্রী

চিকিৎসার পরে..... ডিগ্রী

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APPENDIX III: Statistical Analysis

Pain at ankle resting position

Reduction of pain scores in conventional physiotherapy with ankle strengthening exercise of ankle muscles and only conventional physiotherapy group in the general pain intensity were differences between pre test and post test pain scores.

Control Group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test						n=2		n=1	n=2	n=1	
Post test						n=2	n=2		n=2		

*n=sample number

Table 03: Pain level percentage pre and post test during rest at control group

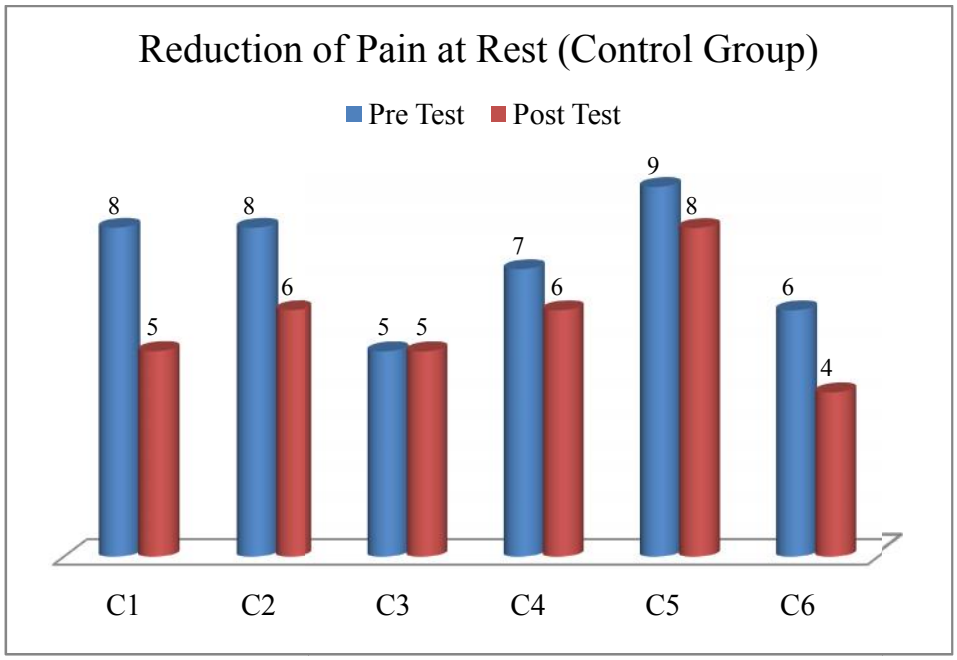


Figure 02: Comparison pre and post test pain level during rest (Control Group)

Experimental group

Pain Level at Vas Scale	0	1	2	3	4	5	6	7	8	9	10
Pre test							n=1	n=2	n=1	n=2	
Post test		n=1	n=2	n=2							

*n=sample number

Table 04: Pain level percentage pre and post test during rest at experimental group

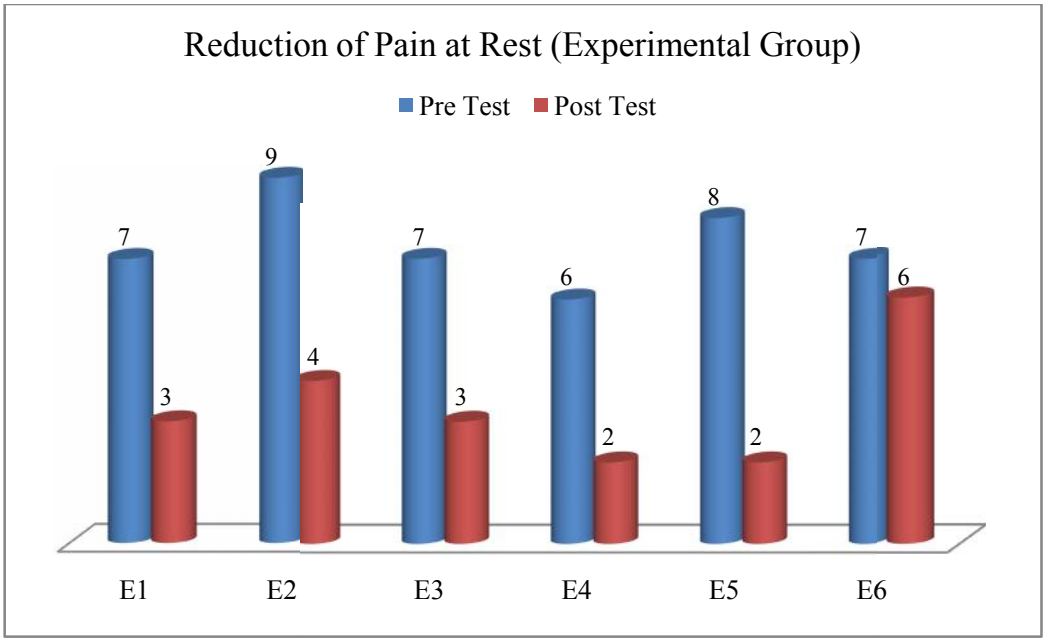


Figure 03: Comparison pre and post test pain level during rest (Experimental Group)

Pain at ankle during standing

Reduction of pain scores in conventional physiotherapy with ankle strengthening exercise of ankle muscles and only conventional physiotherapy group in the general pain intensity were differences between pre test and post test pain scores.

Control Group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test					n=2		n=1	n=2	n=1		
Post test					n=2		n=2	n=1	n=1		

*n=sample number

Table 05: Pain level percentage pre and post test during standing at control group

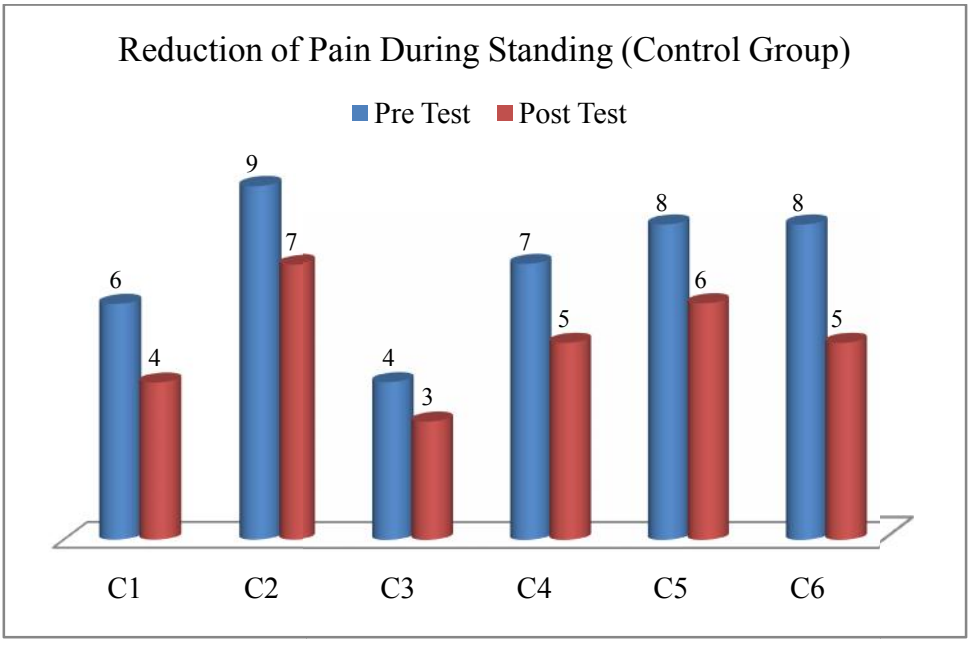


Figure 04: Comparison pre and post test pain level during standing (Control Group)

Experimental group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test						n=2	n=2	n=2			
Post test		n=2		n=2	n=2						

*n=sample number

Table 06: Pain level percentage pre and post test during standing at experimental group

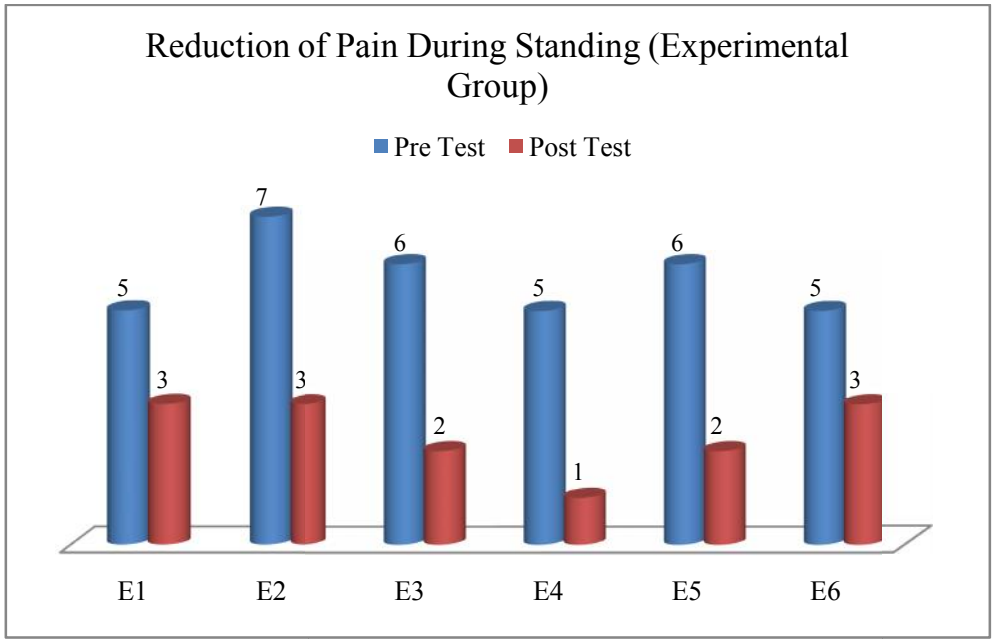


Figure 05: Comparison pre and post test pain level during standing (Experimental Group)

Pain at ankle during walking

Reduction of pain scores in conventional physiotherapy with ankle strengthening exercise of ankle muscles and only conventional physiotherapy group in the general pain intensity were differences between pre test and post test pain scores.

Control Group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test						n=2	n=2	n=2			
Post test						n=2	n=2	n=1			

*n=sample number

Table 07: Pain level percentage pre and post test during walking at control group

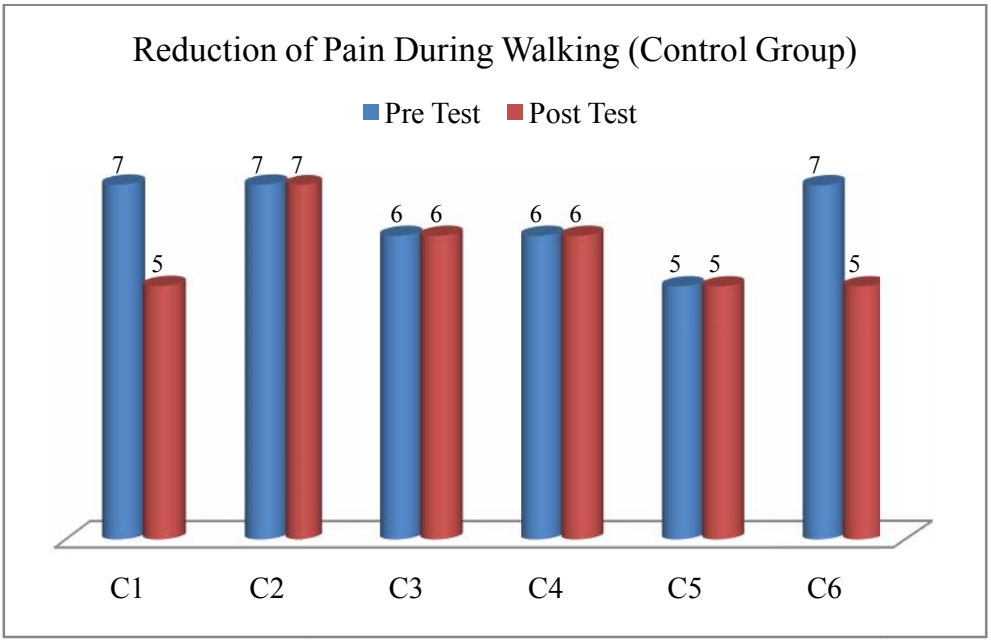


Figure 06: Comparison pre and post test pain level during walking (Control Group)

Experimental group

Pain Level at Vas Scale	0	1	2	3	4	5	6	7	8	9	10
Pre test						n=2	n=2	n=2			
Post test		n=2	n=2	n=2							

*n=sample number

Table 08: Pain level percentage pre and post test during walking at experimental group

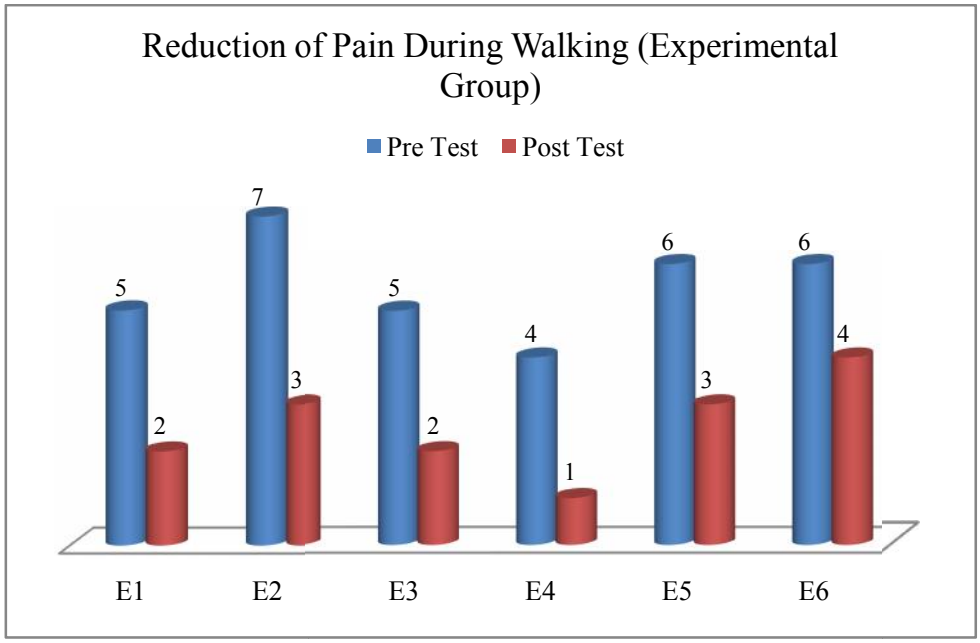


Figure 07: Comparison pre and post test pain level during walking (Experimental Group)

Pain at ankle during running

Reduction of pain scores in conventional physiotherapy with ankle strengthening exercise of ankle muscles and only conventional physiotherapy group in the general pain intensity were differences between pre test and post test pain scores.

Control Group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test					n=2	n=1		n=3			
Post test			n=1	n=1	n=2	n=2					

*n=sample number

Table 09: Pain level percentage pre and post test during running at control group

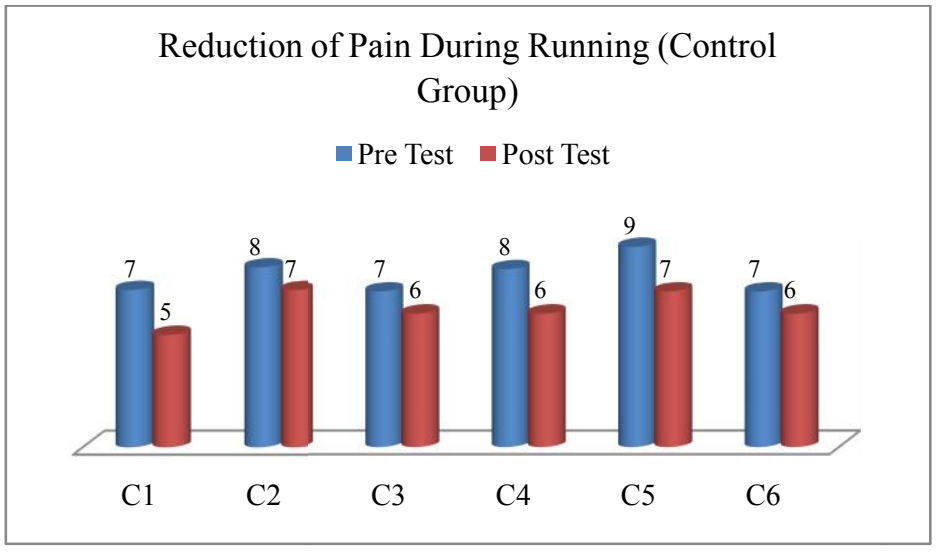


Figure 08: Comparison pre and post test pain level during running (Control Group)

Experimental group

Pain Level at Vas Scale	0	1	2	3	4	5	6	7	8	9	10
Pre test							n=2	n=2	n=2		
Post test				n=2	n=2	n=2					

*n=sample number

Table 10: Pain level percentage pre and post test during running at experimental group

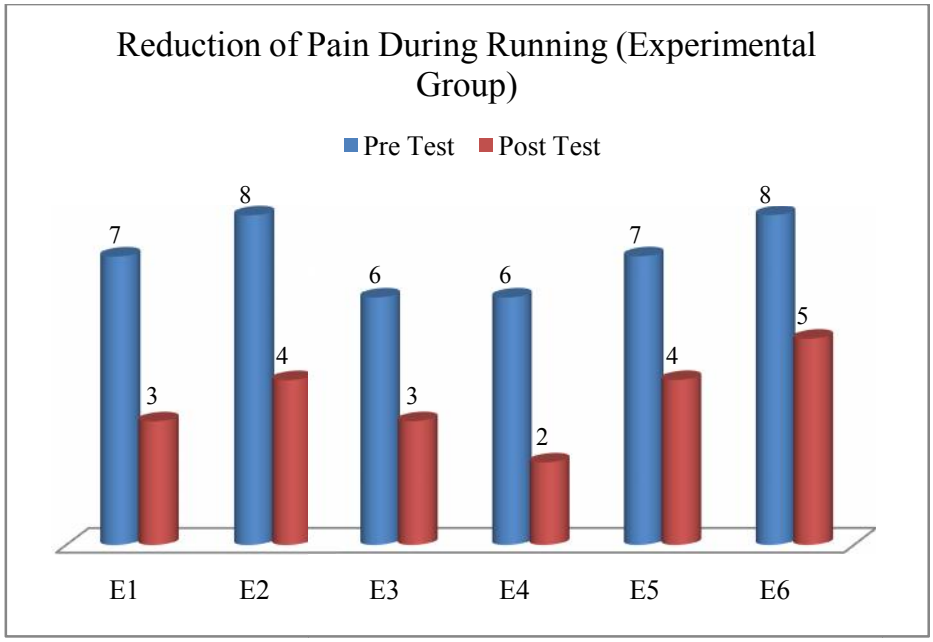


Figure 09: Comparison pre and post test pain level during running (Experimental Group)

Pain at ankle during planter flexion

Reduction of pain scores in conventional physiotherapy with ankle strengthening exercise of ankle muscles and only conventional physiotherapy group in the general pain intensity were differences between pre test and post test pain scores.

Control Group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test								n=2	n=2	n=2	
Post test					n=2	n=1		n=2	n=1		

*n=sample number

Table 11: Pain level percentage pre and post test during planter flexion at control group

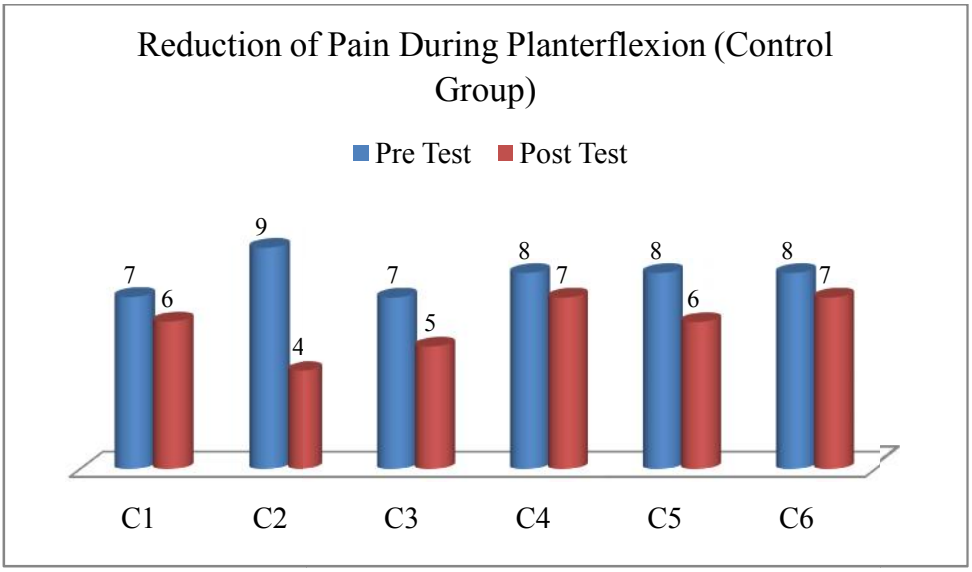


Figure 10: Comparison pre and post test pain level during Planter flexion (Control Group)

Experimental group

Pain Level at Vas Scale	0	1	2	3	4	5	6	7	8	9	10
Pre test						n=1	n=2	n=2	n=1		
Post test				n=1		n=2		n=2	n=1		

*n=sample number

Table 12: Pain level percentage pre and post test during planterflexion at experimental group

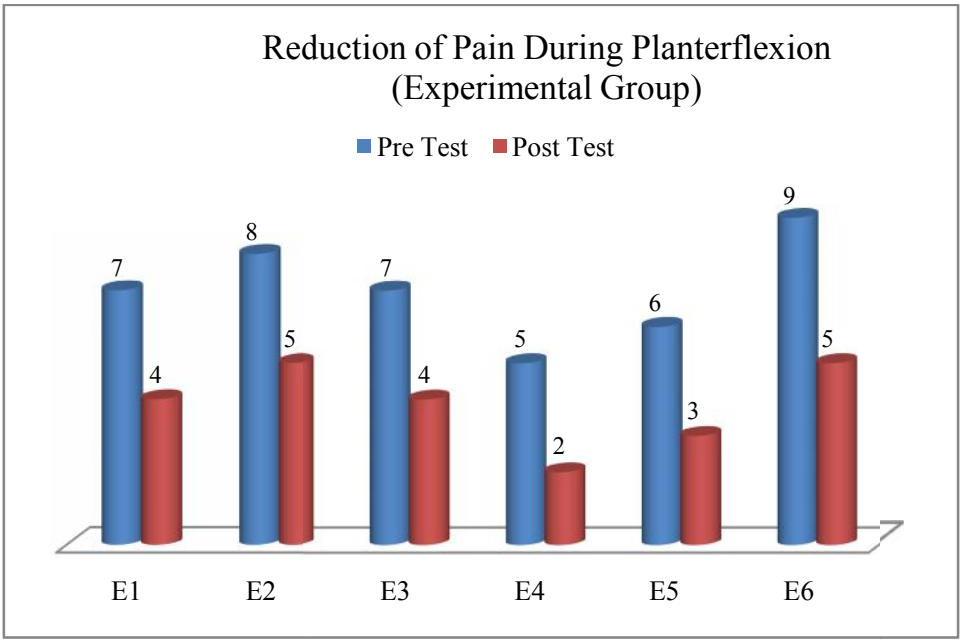


Figure 11: Comparison pre and post test pain level during Planter flexion(Experimental Group).

Pain at ankle during dorsiflexion

Reduction of pain scores in conventional physiotherapy with ankle strengthening exercise of ankle muscles and only conventional physiotherapy group in the general pain intensity were differences between pre test and post test pain scores.

Control Group

Pain Level at Vas Scale	0	1	2	3	4	5	6	7	8	9	10
Pre test					n=2	n=1	n=2	n=1			
Post test				n=2	n=2	n=2					

*n=sample number

Table 13: Pain level percentage pre and post test during dorsiflexion at control group

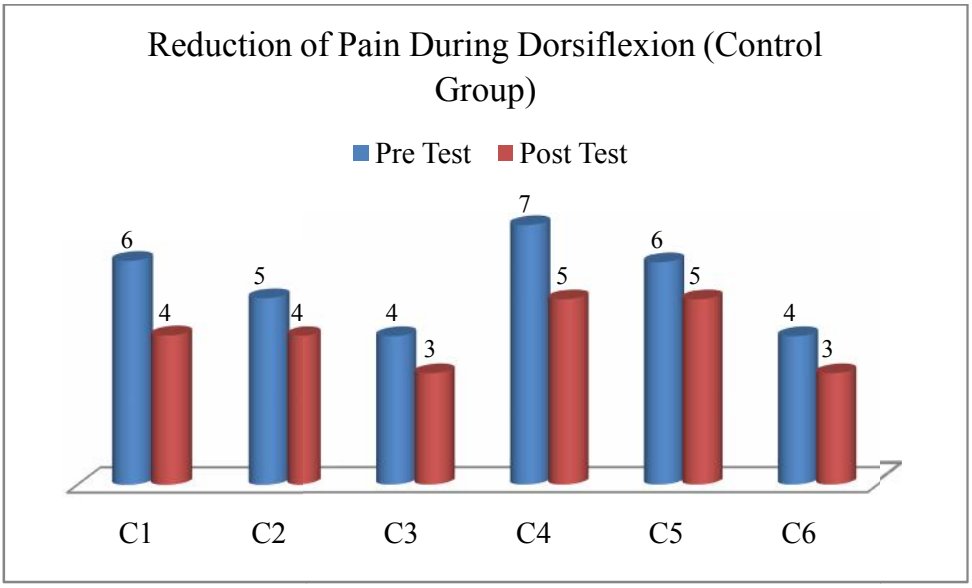


Figure 12: Comparison pre and post test pain level during dorsiflexion (Control Group)

Experimental group

Pain Level at Vas Scale	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Pre test					n=2	n=2	n=2				
Post test			n=3	n=3							

*n=sample number

Table 14: Pain level percentage pre and post test during dorsiflexion at experimental group

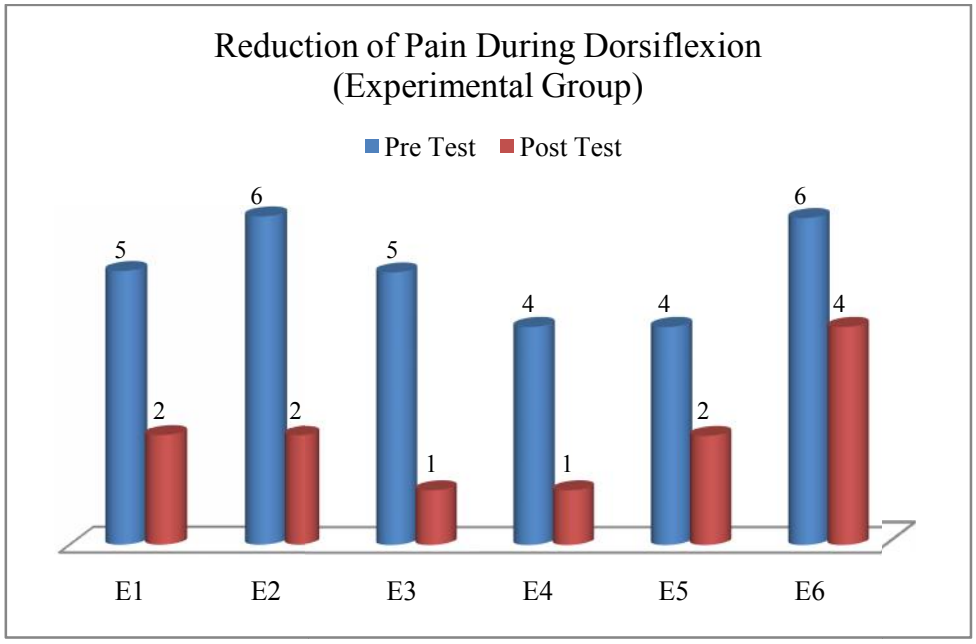


Figure 13: Comparison pre and post test pain level during Dorsiflexion (Experimental Group)

Subjects		Mean Difference of Pain Reduction in Control group											
		Resting		Standing		Walking		Running		Planterflexion		dorsiflexion	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	C1	8	5	6	4	7	5	7	5	7	6	6	4
	C2	8	6	9	7	7	7	8	7	9	4	5	4
	C3	5	5	4	3	6	6	7	6	7	5	4	3
	C4	7	6	7	5	6	6	8	6	8	7	7	5
	C5	9	8	8	6	5	5	9	7	8	6	6	5
	C6	6	4	8	5	7	5	7	6	8	7	4	3
Total		43	34	42	30	38	34	46	37	47	35	32	24
Mean		7.1	5.6	7	5	6.3	5.6	7.1	6.16	7.8	5.8	5.3	4
Mean difference		1.5		2		0.7		1.44		2		1.3	

Table 15: Mean difference of pain reduction in control group

Subjects		Mean Difference of Pain Reduction in Experimental group											
		Resting		Standing		Walking		Running		Planterflexion		Dorsiflexion	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	E1	7	3	5	3	5	2	7	3	7	4	5	2
	E2	9	4	7	3	7	3	8	4	8	5	6	2
	E3	7	3	6	2	5	2	6	3	7	4	5	1
	E4	6	2	5	1	4	1	6	2	5	2	4	1
	E5	8	2	6	2	6	3	7	4	6	3	4	2
	E6	7	9	5	3	6	4	8	5	9	5	6	4
Total		44	20	34	14	33	15	42	21	42	23	30	12
Mean		7.3	3.3	5.6	2.3	5.5	2.5	7	3.5	7	3.83	5	2
Mean difference		4		3.3		3		3.5		3.17		3	

Table 16: Mean difference of pain reduction in experimental group

Mean difference in pain reduction of both groups

Name of the variables	Experimental group	Control group
Pain during resting	4	1.5
Pain during standing	3.3	2
Pain during walking	3	0.7
Pain during running	3.5	1.44
Pain during planterflexion	3.17	2
Pain during dorsiflexion	3	1.3

Table17: Mean difference in pain reduction of both groups

Planter flexion: Increased range of motion scores in conventional physiotherapy with ankle strengthening exercises and only conventional physiotherapy group in planterflexion.

Conventionalphysiotherapywithanklestrengthening exercisegroup			Only conventional physiotherapygroup		
Subjects	ROM scores (X_1)	X_1^2	Subjects	ROM scores (X_2)	X_2^2
E1	10	100	C1	8	64
E2	7	49	C2	5	25
E3	10	100	C3	10	100
E4	8	64	C4	10	100
E5	10	100	C5	2	4
E6	5	25	C6	4	16
	$\sum X_1=50$	$\sum X_1^2=438$		$\sum X_2=39$	$\sum X_2^2=309$

$\overline{X_1}$= 8.33

$\sum X_1^2$= 438

$(\sum X_1)^2$= 2500

n_1= 6

$\overline{X_2}$=6.5

$\sum X_2^2$=309

$(\sum X_2)^2$= 1521

n_2=6

Calculating the degree of freedom from the formula

df = (n_1-1) + (n_2-1)

= (6-1) + (6-1) =10

Now't' formula-

$$t=\frac{\overline{x}_1-\overline{x}_2}{\sqrt{\frac{\left(\sum x_1^2-\frac{(\sum x_1)^2}{r_1}\right)+\left(\sum x_2^2-\frac{(\sum x_2)^2}{r_1}\right)}{(r_1-1)+(r_2-1)}\times\sqrt{\frac{1}{r_1}+\frac{1}{r_2}}}}$$

$$t=\frac{8.33-6.5}{\left[\sqrt{\frac{(438-416.6)+(309-253.5)}{(5)+(5)}}\times\sqrt{\frac{1}{6}+\frac{1}{6}}\right]}$$ t= 0.37

Dorsiflexion: Increased range of motionscores in conventional physiotherapy with ankle strengthening exercises group and only conventional physiotherapy group in dorsiflexion differences between pre-test and post-test ROM scores.

Conventionalphysiotherapywithanklestrengthening exercisegroup			Only conventional physiotherapy group		
Subjects	ROM scores (X_1)	X_1^2	Subjects	ROM scores (X_2)	X_2^2
E1	5	25	C1	4	16
E2	5	25	C2	6	36
E3	2	4	C3	5	25
E4	3	9	C4	5	25
E5	8	64	C5	2	4
E6	6	36	C6	4	16
	$\sum X_1=29$	$\sum X_1^2=163$		$\sum X_2=26$	$\sum X_2^2=122$

$\overline{X_1}=4.83$ $\overline{X_2}=4.3$

$\sum X_1^2=163$ $\sum X_2^2=122$

$(\sum X_1)^2=841$ $(\sum X_2)^2=676$

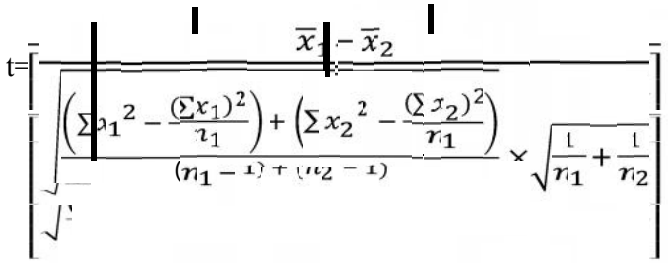
$n_1=6$ $n_2=6$

Calculating the degree of freedom from the formula

$df = (n_1-1) + (n_2-1)$

$= (6-1) + (6-1) =10$

Now‘t’ formula-



$$t=\frac{4.83-4.33}{\left[\sqrt{\frac{(163-140)+(122-112.6)}{(5)+(5)}}\times\sqrt{\frac{1}{6}+\frac{1}{6}}\right]}$$

t=0.18

Inversion: Increased range of motionscores in conventional physiotherapy with ankle strengthening exercises group and only conventional physiotherapy group in were differences between pre-test and post-test ROM scores.

Conventionalphysiotherapywithanklestrengthening exercisegroup			Only conventional physiotherapygroup		
Subjects	ROM scores (X_1)	X_1^2	Subjects	ROM scores (X_2)	X_2^2
E1	12	144	C1	10	100
E2	8	64	C2	8	64
E3	6	36	C3	6	36
E4	4	16	C4	4	16
E5	2	4	C5	5	25
E6	8	64	C6	6	36
	$\sum X_1=40$	$\sum X_1^2=328$		$\sum X_2=39$	$\sum X_2^2=277$

$\overline{X_1}$=6.66 $\overline{X_2}$=6.5

$\sum X_1^2$=328 $\sum X_2^2$=277

$(\sum X_1)^2$=1600 $(\sum X_2)^2$=1521

n_1=6 n_2=6

Calculating the degree of freedom from the formula

$df = (n_1-1) + (n_2-1)$

$= (6-1) + (6-1) = 10$

Now't' formula-

$$t=\frac{\overline{x}_1-\overline{x}_2}{\sqrt{\frac{\left(\sum x_1^2-\frac{(\sum x_1)^2}{n_1}\right)+\left(\sum x_2^2-\frac{(\sum x_2)^2}{n_1}\right)}{(n_1-1)+(n_2-1)}\times\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}}$$

$$t=\frac{6.66-6.5}{\sqrt{\frac{(328-266.6)+(277-253.5)}{(5)+(5)}\times\sqrt{\frac{1}{6}+\frac{1}{6}}}}$$ t=0.03

Eversion: Increased range of motionscores in conventional physiotherapy with ankle sprain strengthening exercises group and only conventional physiotherapy group in were differences between pre-test and post-test ROM scores.

Conventionalphysiotherapywithanklestrengthening exercisegroup			Only conventional physiotherapygroup		
Subjects	ROM scores (X_1)	X_1^2	Subjects	ROM scores (X_2)	X_2^2
E1	14	196	C1	12	144
E2	6	36	C2	10	100
E3	10	100	C3	8	64
E4	5	25	C4	6	36
E5	6	36	C5	5	25
E6	5	25	C6	4	16
	$\sum X_1=46$	$\sum X_1^2=418$		$\sum X_2=45$	$\sum X_2^2=385$

$\overline{X_1}=7.66$

$\sum X_1^2=416$

$(\sum X_1)^2=2116$

$n_1=6$

$\overline{X_2}=7.5$

$\sum X_2^2=385$

$(\sum X_2)^2=2025$

$n_2=6$

Calculating the degree of freedom from the formula

$$df = (n_1-1) + (n_2-1)$$
$$= (6-1) + (6-1) =10$$

Now‘t’ formula-

$$t=\frac{\overline{x}_1-\overline{x}_2}{\sqrt{\frac{\left(\sum x_1^2-\frac{(\sum x_1)^2}{n_1}\right)+\left(\sum x_2^2-\frac{(\sum x_2)^2}{n_1}\right)}{(n_1-1)+(n_2-1)}\times\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}}$$

$$t=\frac{7.66-7.5}{\left[\sqrt{\frac{(416-352.6)+(385-337.5)}{(5)+(5)}}\times\sqrt{\frac{1}{6}+\frac{1}{6}}\right]}$$

t = 0.08