# IMMEDIATE EFFECT OF MULLIGAN'S MOBILIZATION ALONG WITH DYNAMIC TAPING VS MULLIGAN'S MOBILIZATION IN ACUTE LOW BACKACHE IN PROFESSIONAL SWIMMERS – A SINGLE BLINDED RANDOMIZED CONTROLLED TRIAL

By

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**Under the Guidance of**

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**2023-2025**

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# LIST OF ABBREVIATIONS USED

ADIQ – Athlete's Disability Index Questionnaire

CROCS – Contraindications, Repetitions, Overpressure, Communication, Knowledge and sustained glide

DT – Dynamic-Tape

KT – Kinesiology-Tape

MWM's – Movement with Mobilization

NAG'S – Natural Apophyseal Glides

NPRS – Numeric Pain Rating Scale

NSCLBA/LBA – Non-specific chronic low backache

ODI – Oswestry Disability Index

PILL – Pain-free, immediate result, Long-lasting

ROM – Range of Motion

SMWLM – Spinal Mobilization with Limb Movement

SNAGs – Sustained Natural Apophyseal Glides

## ABSTRACT

**Background:** Most common injuries in professional swimmers are due to overuse, i.e. Shoulder, Spine and knee. The spine is the second most commonly affected region, which consists of 21-24% of total injuries. Specifically, Butterfly stroking constitutes around 33.9% while breast stroking is around 22.2%. The L5-S1 region is the most affected in the spine; it accounts for around 30% of whole back injuries. Mulligan's mobilization is not a new concept, mainly SNAG & MWM, which are beneficial in managing acute LBA, while Dynamic taping is relatively a new concept which with limited evidence for its application. The aim of this was to investigate the additive effect of the application of dynamic taping along with Mulligan's mobilization in comparison to Mulligan's mobilization alone in professional swimmers.

**Methodology:** A Total of 42 subjects were randomized in 3 different groups, i.e. Dynamic taping + Mulligan's mobilization (DT+M), n=14, Mulligan's mobilization alone (M), n=14 and conventional treatment for the control group (n=14). Each group is provided with 10 minutes of warm-up, followed by performing a painful activity with recording pre-intervention scoring, then provided with group-specific intervention, followed by 15 minutes of rest before re-performing the painful activity for post-intervention scoring.

**Results:** In this study, between group analysis revealed statistically significant reduction in pain(NPRS), with **p-value-0.04** but no significant improvement was seen in disability(ODI) with **p-value-0.117** but ADI showed statistically significant improvement in disability with **p-value-<0.001.**

Within group comparison revealed statistically significant improvement of pain(NPRS) and disability(ADIQ) with **p-values - <0.001 respectively** for both and DT+M Group also showed significant reduction in pain and improvement in disability(ADIQ) with

**p-value- 0.003 and 0.02** respectively but control group didn’t showed any significant improvement in disability either in ODI or ADIQ.

**Conclusion:** The results indicated that both the Mulligan's mobilization group and the DT+M group demonstrate improvements in pain and disability. But only Mulligan’s Group showed significant favorable results as an intervention with respect to the variables (p-value - <0.05). However, the addition of dynamic tape to Mulligan's mobilization did not yield any additional benefits compared to Mulligan's mobilization alone.

**Keyword:** Back Injuries, Lumbar Vertebrae, Pain, Professional, Shoulder

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# INTRODUCTION

## INTRODUCTION

Swimming is a sport that demands immense physical endurance, precise technique, with a touch of elegance. It's both a competitive discipline and a lifelong skill, practiced in pools and open water across the globe [1].

Swimming has become one of the most practiced and popular sports worldwide, due to its peculiarity of being in an aquatic environment, and the multitude of benefits that it brings to health.

Evidence of swimming dates back to 2500 BCE in Egypt, with mentions in Greek and Roman civilizations, where it was part of military training and education. In 19th-century England, competitive swimming took its first strokes, with the inaugural indoor pool opening in 1828 and organized races beginning in 1837. It was included in the first modern Olympic Games in 1896 for men and 1912 for women [1].

Swimming boasts 16 pool events, making it one of the largest sports featured. Races vary in distance and format, including individual medleys and relays. Olympic events are held in 50-meter pools, with open water races like the 10 km marathon also featured. Competitive swimmers have specific anthropometry compared with other athletes because of their Physiological adaptations to enhance their performance. Some anthropometric characters are being considered by the swimmers, which can certainly influence their performance, such as body height, Lean body mass, and upper extremity length. These somatic attributes are largely inherited and determine the body type's structure & their techniques to a higher degree. The sport features four main strokes—freestyle, backstroke, breaststroke, and butterfly—each with distinct techniques and rules [2].

Elite swimmers cover 60-80 Km weekly, with a daily average of 6-10 Km for 5-7 days/week, often training twice/daily. This demanding schedule entails around 30,000 strokes with around 2500 shoulder revolutions and considerable stress on the Lumbar spine [3].

Swimming requires a very high training load at some level, which makes the athletes much prone to various pathologies, such as Joint pathologies, most commonly, Shoulder joint Pathologies, Spine Pathologies, Hip joint Pathologies, and Knee joint Pathologies.

Studies indicate that overuse is the primary cause of injuries, with musculoskeletal and ligamentous injuries being the most prevalent types [4].

Other less frequent pathologies involve Respiratory illnesses, dermal conditions, and Ear conditions [4].

Following the Shoulder joint, the spine is the second most commonly affected region in the swimmer population. It accounts for approximately 21-24% of total injuries [2].

Specifically, Butterfly strokes account for the largest percentage of injuries-33.9% and Breaststroke accounts for 22.2% respectively. One study shows that, L5-S1 region is the most affected in the lower back, accounting for almost 30% of total back injuries [1].

MULLIGAN'S MOBILIZATION - Manual therapy has undergone significant evolution in recent decades, with increasing emphasis on techniques that promote pain-free movement and functional restoration. Among these, the Mulligan Concept, developed by New Zealand physiotherapist Brian Mulligan in the 1980s, stands out for its unique integration of manual mobilization with active patient movement. The Mulligan concept proposes that injuries can lead to positional faults in joints, resulting in restricted physiological movement. Techniques like NAGS, MWMs, SNAGS, and

SMWLM are used to address these issues, applying accessory glides in the plane of the facet joint during active movement in a weight-bearing position [5].

These techniques involve sustained mobilizations with active movement and are based on principles like PILL and CROCKS [6].

The therapeutic goal is to rapidly reduce pain and enhance the range of motion, potentially through the correction of positional faults at the facet joints. When SNAG results in an increased range of motion, it is thought to be primarily due to correction of faulty joint alignment, especially the facet joint, with the added benefit of influencing the entire spinal function unit. Some studies also proposed other theories as an explanation for its effects, which is primarily a neuropsychological mechanism [7],[8],[10].

Clinical research has demonstrated the effectiveness of Mulligan mobilisation in treating a wide range of musculoskeletal conditions, including cervical and lumbar dysfunctions, lateral epicondylitis, and shoulder impingement. Its application in athletic and rehabilitative settings has shown promising outcomes in terms of pain reduction, functional gains, and neuromuscular re-education [11],[12].

Taping is a valuable therapeutic tool used by physical therapists and rehabilitation teams to prevent and manage sports injuries, clinical conditions, and disorders [13].

Traditionally, methods such as rigid athletic taping and Kinesio taping have been employed to provide structural support, proprioceptive feedback, and pain modulation[13],[14],[15]. However, the evolution of taping science has introduced Dynamic Taping (DT)—a novel, biomechanically driven approach that transcends conventional paradigms. Various types of tape, including Kinesio tape (KT), Dynamic tape (DT), Rigid tape, Micropore tape, and Athletic tape, are available, each

with its own application method and underlying philosophy[14],.

DT is a revolutionary taping technique that combines visco-elastic nylon and Lycra blend material with strong resistance and elastic recoil. Characteristics which make DT separate from other tapes are its ability to stretch up to 200% in four directions with no rigid endpoint. It is designed to assist movement patterns, reduce load on injured tissues, which ultimately helps in improving functional performance, making it an ideal adjunctive treatment for musculoskeletal injuries, especially in sports and rehabilitation settings [16]. Recent studies have highlighted DT's efficacy in improving functional outcomes in conditions such as lateral epicondylitis, patellofemoral pain syndrome, and shoulder impingement. Its application in athletic populations has shown promise in enhancing agility, power, and neuromuscular control, positioning it as a versatile tool in both clinical and sports settings [15].

Unlike traditional rigid or kinesiology tapes, dynamic tape acts more like a spring, offering resistance and recoil to assist or restrict motion as needed. DT's primary mode of action is mechanical (deceleration of eccentric work, load absorption, and assistance of movement), while the secondary mode of operation is centered on neurophysiological factors [15],[16].

Dynamic taping is a cutting-edge biomechanical taping technique designed to support movement, reduce load on injured tissues, and enhance functional performance—especially in sports and rehabilitation settings. Unlike traditional rigid or kinesiology tapes, dynamic tape behaves more like a spring, offering resistance and recoil that can assist or restrict movement patterns as required[13],[14].

NEED OF THE STUDY: This study aims to explore the synergistic impact of Dynamic Taping and Mulligan mobilization for treating acute low back pain in professional Swimmers. With increased training sessions, athletes are more susceptible to injuries, and the potential benefits of incorporating Dynamic Tape are still unclear. The research aims to provide valuable insights for refining treatment protocols for this specific group of athletes.

# AIM & OBJECTIVES

# AIM AND OBJECTIVE OF THE STUDY

## AIM

The study aims to assess whether Dynamic Taping applied in conjunction with Mulligan's Mobilization provides superior therapeutic effects compared to Mulligan Mobilization alone in the treatment of acute low backache conditions in professional swimmers.

## OBJECTIVES

1. To observe the immediate effect of conservative management in acute Low Backache conditions among professional swimmers.
2. To observe the immediate effect of Mulligan's Mobilization individually in Acute Low Backache among professional swimmers
3. To observe the immediate effect of Mulligan's Mobilization with Dynamic Tapping in acute Low Backache among professional swimmers
4. To compare the effect of Mulligan's Mobilization along with Dynamic Tapping to the Immediate effect of Mulligan's Mobilization alone and conservative management in acute Low Backache among professional swimmers.

# HYPOTHESIS OF THE STUDY

## HYPOTHESIS OF THE STUDY

**Null Hypothesis ($H_0$):** There will be no significant difference between the effect of Mulligan Mobilization with Dynamic tapping and Mulligan's Mobilization individually in Acute Low backache conditions in Professional swimmers

**Alternate Hypothesis ($H_1$):** There will be a significant difference between the effects of Mulligan Mobilization with Dynamic tapping and Mulligan's Mobilization individually in acute low backache conditions in Professional swimmers.

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

## SECTION-1: LITERATURE REGARDING EPIDEMIOLOGY OF INJURIES AND BIOMECHANICS OF COMPETITIVE SWIMMING

1. A review published in 2012 was done by Florian Wanivenhaus, MD, Alice J. S. Fox, MSc, Salma Chaudhury, MD, PhD and Scott A. Rodeo, MD on Epidemiology of injuries and preventive strategies in competitive swimming. The objective of this study was to discuss the epidemiology of injuries along with strategies that can be useful in prevention or rehabilitation. The result of the study found that the spine mainly lumbar region is significantly involved in injuries of spine injuries. L5- S1 levels are more frequently involved in elite swimmers. Capaci et al concluded that 33.3% of butterfly swimmers and 22.2% of breaststroke swimmers experienced low-back pain. Mutoch found a 37% incidence of pain for butterfly swimmers, while Drori et al reported a 50% incidence of pain for butterfly swimmers and 47% for breaststroke swimmers.
2. A study done in 2020 by Lfonso Trinidad, Higinio Gonzalez, Alejendro L Valenciano on Epidemiology of injuries and prevention strategies in competitive swimmers. The primary aim of the study was to investigate the epidemiology of swimming injuries. The study showed a high prevalence of injuries to the Shoulder, knee & lower back in adult swimmers, but the injury pattern is insufficient due to methodological limitations.
3. A study done in 1999 by John P Troup on the physiology and biomechanics of competitive swimming. The purpose of this article is to provide an overview of the applied swimming sciences as a reference guide to practitioners involved in

the sport. Although current information (post-1985) in physiology and biomechanics is discussed in this article. Results showed that Physiology and biomechanics are the present tools used by sports scientists to determine which factors are important to fast swimming and, subsequently, to determine how the swimmer may maximize these factors to improve performance.

4. A systematic review done in 2012 by Trevor Gaunt, Nicola Maffulli on soothing suffering swimmers: a systematic review of the epidemiology, diagnosis, treatment and rehabilitation of musculoskeletal injuries in competitive swimmers. The objective was to review details of the examination, diagnosis, treatment and management of injuries encountered by competitive swimmers. Primarily, these involve the shoulder, the spine; however, the knee and hip can be involved. The results didn't provide significant details, as making comparisons and conclusions from the current literature is difficult, as many articles featured in this review report findings in different ways. Treatment and rehabilitation of swimming injuries should be based on a common methodology to assess success rates more effectively among injured swimmers.

## SECTION-2: LITERATURE REGARDING MULLIGAN'S MOBILIZATION

5. A study was done in 2001 by Exelby et.al. On The Mulligan Concept: Its application in management of spinal conditions. The study aimed to determine the efficiency of managing spinal conditions with Mulligan Mobilization as an intervention. Results concluded that it helps in correcting the positional faults, which improves the movement pattern, but the evidence is insufficient to claim its efficacy

6. An experimental study was done in 2015 by Anand Heggannavar, Ankita Kale on the immediate effect of modified lumbar snags in non-specific chronic low back patients. The study aimed to find out the immediate effect of modified lumbar SNAG on pain, range of motion and Back Performance Scale in non-specific chronic low back patients. Outcome measures used in the study were the Visual Analogue Scale (VAS), Lumbar flexion ROM & Back performance scale. Results of the study - Mean difference between pre and post treatment values for VAS, Lumbar flexion ROM and Back Performance Scale were 2.58±1.44, 0.26±0.19 and 4.4±1.71, respectively. All outcome measures were highly significant with p=0.0001. Conclusion: The results conclude that modified lumbar SNAG has an immediate effect on reducing pain and Back performance scale score, and an improvement in lumbar flexion ROM.
7. A review was done in 2006 by Bill Vicenzino, Aatit Paungmali, and Pamela Teys on Mulligan's mobilization with movement, positional fault and pain relief. The aim of the study was to find out the effectiveness of MWM in correcting positional faults and relieving pain. A total of 45 articles were selected, but 19 were included in the study. The results of the study showed the evidences are considered to be of low level, but they support the clinical claims of rapid ameliorative effect on pain and function.
8. A Randomized controlled trial was done in 2015 by Benjamin Hidalgo, Laurent Pitance, Toby Hall, and Henri Nielens on the Short-term effects of MWM on pain, disability and kinematic spinal movements in patients with NSLBP to determine the short-term and immediate effects of MWM- Lumbar SNAG on various variables. Outcome measures used were NPRS, ODI, and TAMPA scale. The results of the study concluded the evidence that lumbar spine SNAG

had short-term favorable effects on Pain, Disability & kinetic spinal Movements.

**9.** A study published in 2014 by Deepak B. Anap, Subhash Khatri, Zambre B.R on Effectiveness of SNAG and Maitland mobilization in Facet Joint Syndrome-single-blinded RCPS. The study aimed to investigate the effectiveness of SNAG & Maitland mobilization on Facet joint Syndrome. Outcome measures used were VAS, MODQ, and Sorensen test hold time. Results of the study showed SNAG significantly decrease Pain, Disability and improves back muscle endurance in lumbar facet syndrome.

**10.** A study was done in 2007 by Kika Konstantinou, Nadine Foster, Alison Rushton, David Baxter, and Alan Breen on the Flexion MWM technique: Immediate effect on ROM & Pain in subjects with LBP. The study aimed to determine the MWM technique and its immediate effect on ROM and Pain in subjects with LBP. Results concluded that MWM produced statistically significant but small immediate spinal mobility increase, but no pain reduction when compared with placebo.

**11.** A systematic review was published in 2017 by Mohammad Reza, Holakkoo Mohsenifar, Amirreza Aftabi & Ali Amiri on the Effectiveness of MWM on low back pain. The review aimed to assess the effectiveness of mobilization with movement on low back pain. A total of 20 studies with 693 patients were included in the study. Results concluded that the Current evidence was insufficient in supporting the benefits of the Mulligan technique on pain, disability, and ROM in low backache patients.

## SECTION-3: LITERATURE REGARDING TAPING

**12.** A study was done in 2024 by Meltem Koc et.al on the Immediate effects of Kinesio-taping and Dynamic taping on acromio-humeral distance in individuals with symptomatic rotator cuff tendinopathy. This study aimed to compare the immediate effects of Kinesio-taping and Dynamic taping on AHD in individuals with symptomatic Rotator Cuff Tendinopathy. The study demonstrated that both taping methods led to a significant increase in AHD at both neutral and 60° abduction. However, the increase in AHD with Dynamic taping was statistically greater than with Kinesio taping in both neutral ($p$ <0.05) and 60° abduction ($p$ < 0.001).

**13.** A randomised controlled trial was done in 2022 by Khalid A Alahamari, Kanagaraj, Ravi Shankar, Paul Silvian, Jaya Shankar, Irshad Ahmad on the immediate and short-term effect of dynamic taping on Pain, Endurance, Disability, Mobility, & Kinesio phobia in patients with chronic non-specific LBA. The study aimed to investigate the immediate and short-term effects of dynamic tapping in patients with CNSLBP. Outcome measures used were VAS, ODI, and the Tampa & Modified Schober test. The results of the study showed DT does not have a significant additional effect on Pain, Disability, Mobility and Kinesio phobia but improves muscle endurance. More studies are required to conclude the therapeutic benefits of Dynamic Taping.

**14.** A meta-analysis was done in 2019 by Carla Ventii, Lucia Bertozzi, Ivan Gardenghi, and Paolo Pillastrini on the Effect of Taping on Spinal Pain and Disability. This analysis aimed to review the Effect of taping on Spinal Pain and Disability; a total of 8 RCTs were included. Results showed that Different types of taping were investigated, but the study did not show any firm support for their effectiveness.

**15.** A study was done in 2017 by Mohammad Sidiq, Sai Jaya Prakash et.al on Dynamic Tape Cervical Offload Approach in Chronic Upper-Trapezius Myofascial-Trigger Point Pain. The study aimed to find out the effectiveness of Dynamic tape offloading with the MFR technique in the case of chronic neck pain. Results showed that dynamic tape offloads and myofascial release techniques appear to be most beneficial for improving neck pain and avoiding the adverse effects of central sensitization.

**16.** A study was done in 2003 by R.S Hinman, K.L. Benell, K.M. Crossley et.al on the immediate effect of taping on Pain and Disability in individuals with knee Osteoarthritis. The study aimed to investigate the immediate effect of taping in the population with OA knee. The results concluded that it does not provide any significant impact on reducing pain immediately, but shows results on 2-3$^{rd}$ week but along with conventional PT treatment

**17.** A randomized controlled trial was done in 2016 by Bayram Kelle, Rengin Guzel, and Hakkan Sakalli on the Effect of K-Tape application on acute non-specific low back pain. The study aimed to investigate the effectiveness of taping in acute NSLBA with a total sample size of 108. Outcome measures used were – NPRS, RMDQ, and Dynamometer. Results showed that K-Tape provide improvement in Pain & Disability, can be used as a complementary method to treat acute non-specific LBP.

**18.** A study was done in 2019 by Seyda Toprak Celenay, Derya Ozer Kaya on the immediate effect of Kinesio Taping on Pain and Postural stability in patients with chronic low backache. The study aimed to investigate the immediate effects of OM used were VAS & ODI, to check both components. Results

Showed that Kinesio-Tape may immediately improve postural stability and reduce pain in patients with CLBA

## SECTION-4: LITERATURE REGARDING SELECTION OF OUTCOME MEASURE

**19.** A study done in 2020 by Amit Garg, Hardik Pathak et, al-2020 on Low back pain: critical assessment of various scales. The aim of the study was to study the various pain assessment tools based on their psychometric properties and ease of use. Results concluded that among the LBP-specific tools, the Roland Morris Disability Questionnaire (RMDQ) and Oswestry Disability Index (ODI) have good construct validity and reliability, and responsiveness over short intervals.

**20.** A study was done in 2020 by Min Yao et.al. On Comparisons between the low back pain scales for patients with lumbar disc herniation: validity, reliability and responsiveness. The study aimed to find out which scale is the most suitable and reliable outcome measure to assess pain in patients with lumbar disc herniation. Results claim that the NPRS, ODI or RMDQ is related to LDH patients, while for quality of life is needed NPRS is more appropriate.

**21.** A study was done in 2017 by Pardis Noormohammadpour et.al on the Reliability and validity of the Athletes' Disability Index questionnaire. The purpose of this study was to evaluate the validity and reliability of a new proposed questionnaire for the assessment of functional disability in athletes with low back pain (LBP). The results concluded that the test–retest reliability was strong, and the interclass correlation value ranged between 0.74 and 0.94.

Alternatively, disability assessments by the ADI did not cluster at the mild level and ranged more broadly from mild to very high.

# METHODOLOGY
# &
# PROCEDURE

## METHODOLOGY & PROCEDURE

- **STUDY POPULATION:** Professional Swimmers
- **STUDY DESIGN:** Randomized Control Trial
- **SAMPLE SIZE**: 42
- **SAMPLING TECHNIQUE:** Purposive Sampling
- **STUDY SETTING:** Pt. Chiranjilal Sharma Govt. College and associated academies.
- **STUDY DURATION:** 1 Year
- **ETHICAL CLEARANCE:** 6 Months
- **SAMPLE SELECTION, DATA COLLECTION:** 4 Months
- **STATISTICAL ANALYSIS, RESULTS, DISCUSSION:** 2 Months
- **INCLUSION CRITERIA:**
    - Age – 18-30 years
    - Professional Swimmers with 2 years of competitive experience
    - Both Male and Female Athletes
    - Free from any physical limitations that restrict them (Congenital).
- **EXCLUSION CRITERIA:**
    - Athletes having any recent injury <6 months.
    - Athletes having backache >7days.
    - Any Recreational athletes.
    - Athletes who had undergone any kind of spinal surgery.
    - Athletes with any metabolic disorders – Osteoporosis.
    - Athletes with any spinal tumor.
    - Manipulation under anesthesia.

**MATERIALS USED:**

1. Mulligan Belt
2. Dynamic Tape
3. Sanitizer
4. Cotton
5. Gloves
6. Outcome Measure sheets, Pen & Paper
7. Assessment Form

**OUTCOME MEASURES AND INSTRUMENTS USED:**

1. Primary Outcome Measure-
2. Numeric Pain Rating Scale – Pain
3. Oswestry disability index – Disability
4. Secondary outcome Measure-
5. Athlete Disability Index – Athlete-specific disability

**NUMERIC PAIN RATING SCALE**

- NPRS is one of the most widely used outcome measures, which quantifies the subjective intensity of the pain. It's an 11-point scale, i.e. 0 means no pain while 10 means the worst pain.
- Patient selects a value that is most in line with the pain intensity that they have experienced.
- Williamson and Hoggar reported that NPRS has good sensitivity
- While producing data that can be statistically analyzed.
- It is a reliable tool that is recommended in acute cases, according to a study done by Raviwon Atisook in 2021. This scale accounts for a minimum percentage of incorrect

responses, which accounts for around 25% in comparison to other pain-related outcome measures like VAS, VRS-6, FPS-R.

- Studies show high test-retest reliability for this tool, i.e. (r=0.96 and 0.95, respectively).

**OSWESTRY DISABILITY INDEX – ODI**

- The Oswestry Disability Index (aka the Oswestry Low Back Pain Disability Questionnaire) is an extremely important tool that researchers and disability evaluators use to measure a patient's functional disability. The test has been around since 1980 and is considered the 'gold standard' of low back pain functional outcome tools.
- For each question, there is a possible 5 points; 0 for the first answer, 1 for the second answer, etc. Add up the total for the 10 questions and rate them on the scale at right.
- If score ranges from:
    a. 0-4 = No disability
    b. 5-14 = Mild disability
    c. 15-24 = Moderate disability
    d. 25-34 = Severe disability
    e. 35-50 = completely disabled
- The internal consistency of the Oswestry Disability Index was found to be good, with an alpha of 0.87 (95% CL 0.86 to 0.88). The Oswestry Disability Index is a one-dimensional and internally consistent scale that can be used to assess the severity of disability in patients. During the last four decades, the Oswestry Disability Index (ODI) has become a well-researched gold standard for assessing the severity of disability caused by back pain. The ODI is the most commonly used PROM to assess the limitations of functioning in spinal conditions.
- A review of 16 studies reported an overall good internal consistency of the ODI, with a Cronbach's alpha of approximately 0.9.

**ATHELETE DISABILITY INDEX – ADI**

- It is an outcome measure which quantifies how low back pain is affecting your sport and daily activities.
- According to the study done in 2018 by Noor mohommad pour P. et.al., the test- retest reliability was strong, and the interclass correlation value ranged between

  0.74 and 0.94.
- The Cronbach alpha coefficient value of 0.91 ($P < 0.001$) demonstrated excellent internal consistency of the questionnaire. The ADI is a reliable and valid instrument for assessing disability in athletes with LBP. Compared with the available LBP disability questionnaires used in the general population, ADI can more precisely stratify the disability levels of athletes due to LBP.

## PROCEDURE

- The present study was reviewed and approved by the institutional ethical committee, Abhinav Bindra Sports Medicine and Research Institute (ABSMARI), Pahala, Bhubaneswar.
- The study conducts a pre-post interventional randomized controlled trial. A total of 57 samples were enrolled for the study, from which only 42 were selected based on inclusion and exclusion criteria. Subjects were divided into two experimental groups and a control group.
- Study protocol was explained to all the participants, i.e. Information regarding the intervention, which includes Mulligan's Mobilization and dynamic taping. Informed consents were obtained.
- The group allocation was done by using simple randomization by the chit method. There were 42 chits in which 14 of each group A, B, and C where A=

Dynamic Tapping + Mulligan's mobilization, B= Mulligan's mobilization & C= Control group.

- After the demographic data was obtained, participant was asked to pick one chit and they were allocated to the same group.
- All the participants were informed about the Outcome measures they had to score Pre-intervention and post-intervention.
- Pre & post-intervention scoring was done for Pain by using NPRS-Numeric Pain Rating scale and Disability by using ODI- Oswestry Disability Index and ADIQ- Athletic Disability Index questionnaire

**GROUP A - DYNAMIC TAPPING ALONG WITH MULLIGAN'S MOBILIZATION:**

First, Pre-Intervention scoring was done after assessment, followed by intervention to this specific group – Sustained mobilization with active movements (MWM, SNAG's and SMWLM) along with Dynamic Taping in Lumber region only. After the intervention, the rest period was 15 minutes, and then sport-specific activities were re-performed, and post-intervention scoring was done.

**GROUP B – MULLIGAN'S MOBILIZATION:**

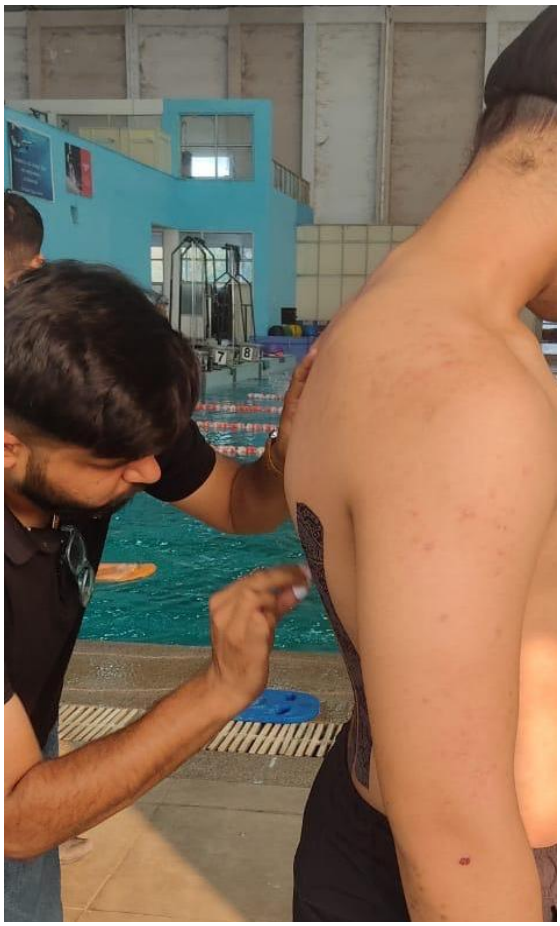
First Pre-Intervention scoring was done after assessment followed by intervention to this specific group – Sustained mobilization with active movements (MWM, SNAG's, and SMWLM) in Lumber region only. After the intervention, the rest period was 15 minutes, and then sport-specific activities were re-performed, and post-intervention scoring was done.

**GROUP C – CONTROL GROUP:**

First, Pre-Intervention scoring was done after assessment, followed by intervention to this specific group – Self- self-administered stretches and lower back strengthening exercises with placebo Mulligan's mobilization. After the Intervention, the rest period was 15 minutes, and then sport-specific activities were re-performed, and post-intervention scoring was done.

The whole procedure was done under the Therapist's observation. After the intervention, each participant rested for 15 minutes, and post-intervention scoring was done after re-performance of sport sport-specific painful activity.

All Pre- & Post- data were recorded, and an Excel sheet was maintained.

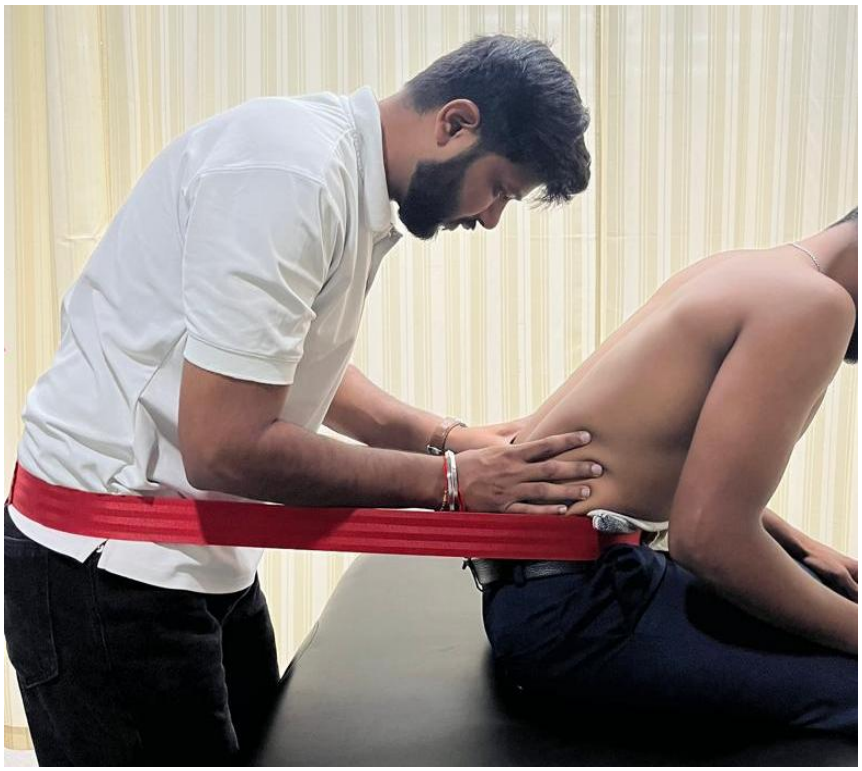


PICTURE-A

PICTURE-B

PICTURE SHOWING APPLICATION OF DYNAMIC TAPE (A) & (B).

PICTURE-C



PICTURE-D

PICTURE SHOWING APPLICATION OF MULLIGAN'S MOBILIZATION AT LUMABR REGION (C) & (D).

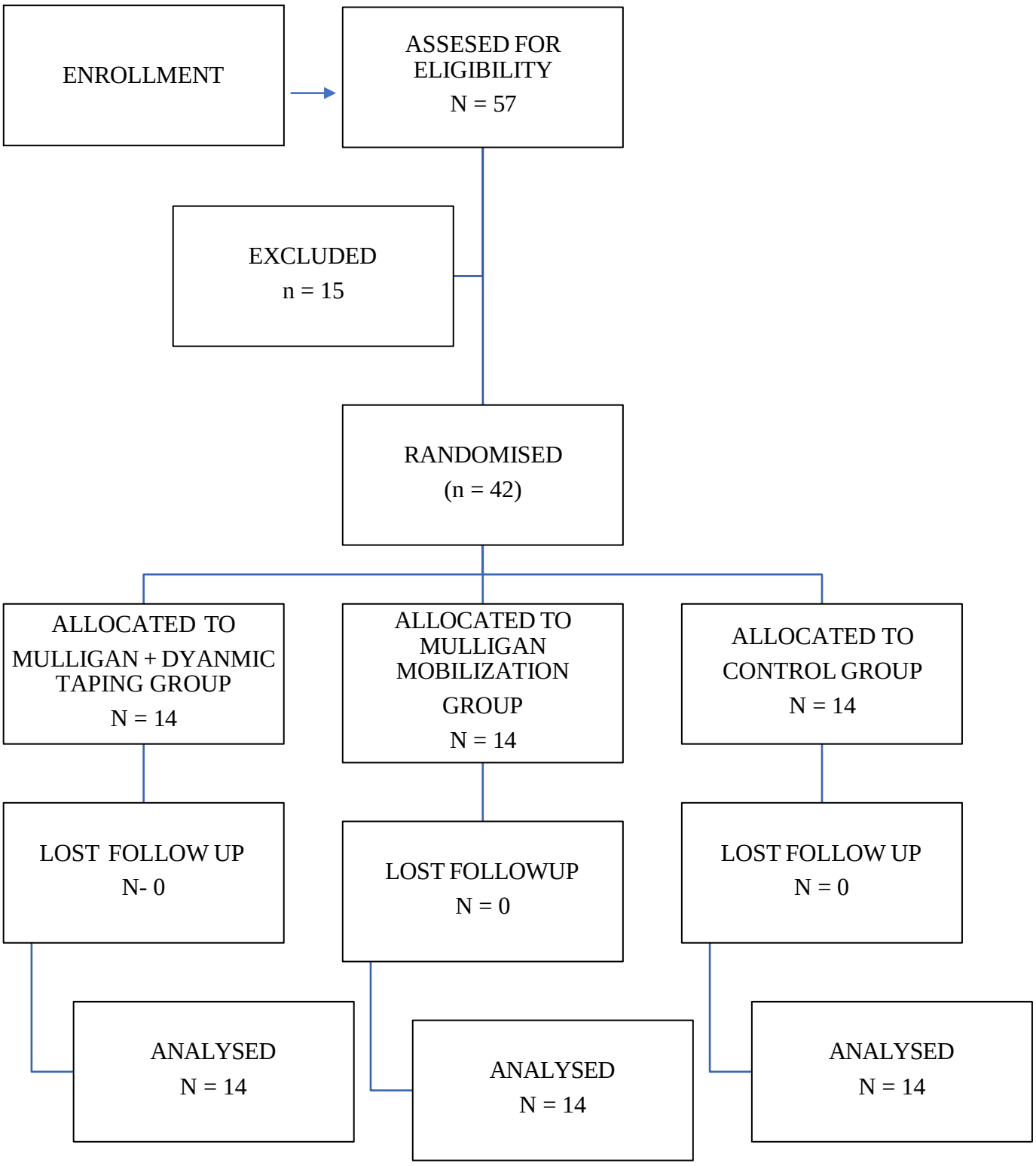



**FIGURE 1:** CONSORT FLOW DIAGRAM

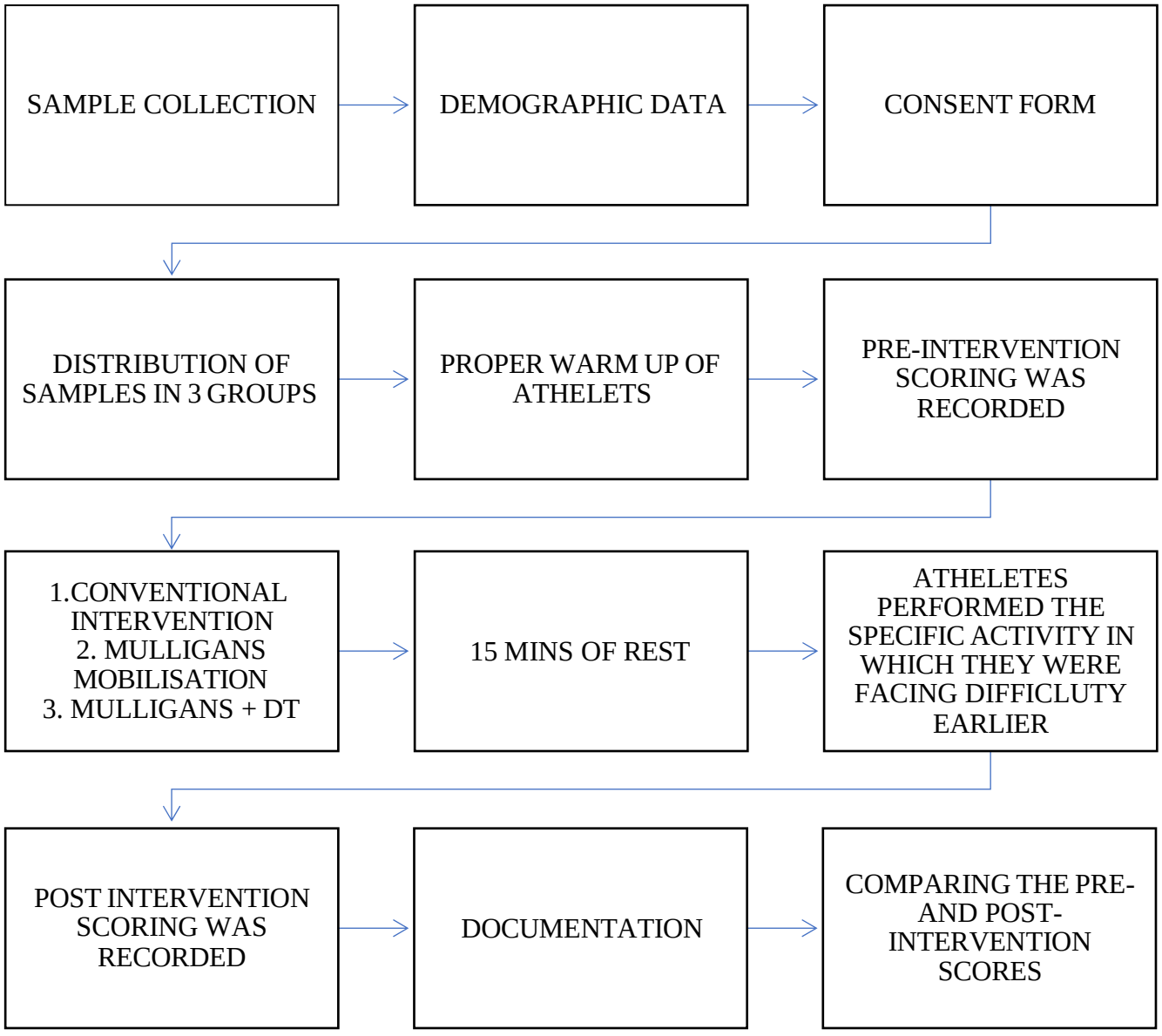



**FIGURE 2:** FLOW CHART representing the procedure of the study

| **TABLE 1:** REPRESENTS GROUP-SPECIFIC ALLOCATION WITH INTERVENTION | | |
|---|---|---|
| Experimental group 1 | Experimental group 2 | Control group |
| Dynamic taping + mulligan's mobilization (n=14) | Mulligan's mobilization alone (n=14) | Self-stretches and strengthening exercise + sham mulligan's mobilization (n=14) |
| This group underwent Mulligan's mobilization along with dynamic tapping. | This group underwent Mulligan's mobilization alone. | This group underwent self-administered stretches and strengthening exercises along with a sham mulligan mobilization. |
| 1. Warm-up – 10 minutes<br>2. Pre-intervention scoring<br>3. Sport-specific painful motion<br>4. Intervention – DT + Mulligan's<br>5. Rest – 15 minutes<br>6. Repetition of painful motion<br>7. Post-intervention scoring | 1. Warm-up – 10 minutes<br>2. Pre-intervention scoring<br>3. Sport-specific painful motion<br>4. Intervention – Mulligan's alone<br>5. Rest – 15 minutes<br>6. Repetition of painful motion<br>7. Post-intervention scoring | 1. Warm-up – 10 minutes<br>2. Pre-intervention scoring<br>3. Sport-specific painful motion<br>4. Intervention<br>5. Rest – 15 minutes<br>6. Repetition of painful motion<br>7. Post-intervention scoring |
| Pre & post-intervention scoring was done –<br>1. NPRS<br>2. ODI<br>3. ADI | Pre & post-intervention scoring was done –<br>1. NPRS<br>2. ODI<br>3. ADI | Pre & post-intervention scoring was done –<br>1. NPRS<br>2. ODI<br>3. ADI |

# STATISTICAL ANALYSIS

## STATISTICAL ANALYSIS

Mathematical evaluation for the present study was performed manually and also by using Statistical Product and Service Solution 27 Version, so as to authenticate the results found. The data was filled into an Excel sheet and then tabulated, which was then subjected to evaluation for the same. Numerous mathematical calculations, such as mean, standard deviation, were employed. The test for normality for the data set was done using the Kolmogorov-Smirnov test.

**TABLE 2:** THIS TABLE SHOWS THE NORMALITY OF THE DATA

| | KOLMOGOROV-SMIRNOV | | | SHAPIRO-WILK | | |
|---|---|---|---|---|---|---|
| | Statistic | Df | Sig. | Statistic | Df | sign |
| AGE | 0.188 | 42 | > 0.05 | 0.907 | 42 | >0.05 |
| GENDER | 0.400 | 42 | >0.05 | 0.616 | 42 | >0.05 |

One-way ANOVA was administered for all the pre- and post-outcome measures in terms of NPRS, ODI, and ADIQ. P-value <0.05 was considered powerful, and p-values <0.001 were highly powerful.

## SAMPLING

57 participants were screened for this study; out of these, 42 participants were selected on the basis of inclusion and exclusion criteria, having an age between 18-30 years,

must have at least 2 years of professional swimming experience and be free from any congenital abnormalities.

Total 42 participants were counted in the study via simple random sampling and allocated into specific groups via chit method. Respected groups received specific interventions, and post-scoring was done immediately after re-performing the painful activity after getting the intervention. Out of 42 participants, all 42 were able to complete the study procedure.

# RESULTS

## RESULTS

The present study, titled "Immediate effect of Mulligan's Mobilization along with dynamic taping vs Mulligan's mobilization in acute low backache in professional Swimmers included 42 subjects in 3 specific groups who received group-specific intervention and scored immediately after the intervention. The pre- and post-test results were based on outcome measures NPRS, ODI & ADIQ.

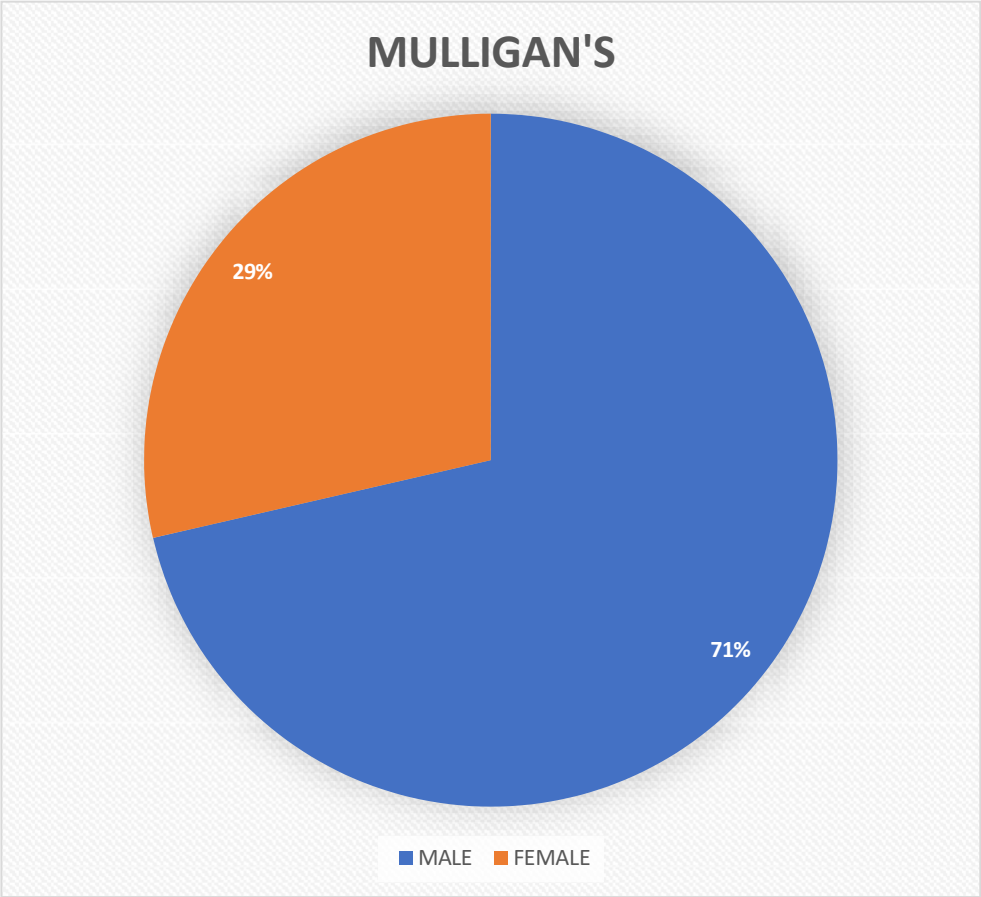
### PARTICIPANT DEMOGRAPHICS

### GENDER DISTRIBUTION:

The total number of participants was 42 in number; via the chit method 14 participants were distributed to each of the 3 specific groups, i.e. 26 males & 16 females.

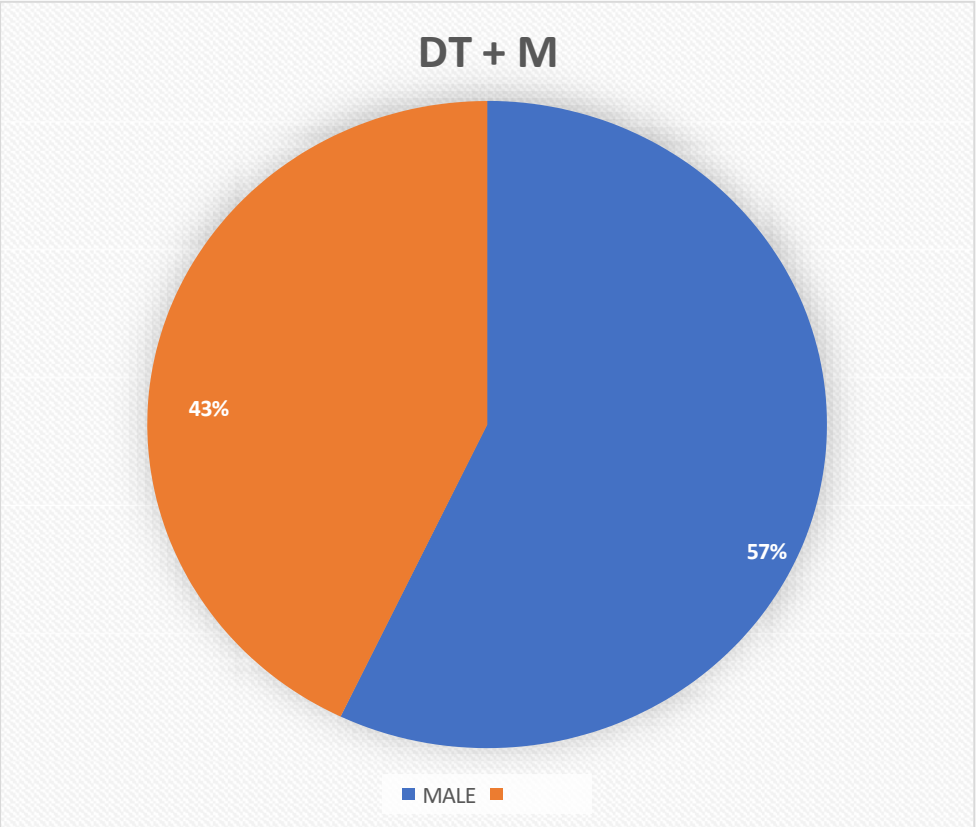
**TABLE 3:** GENDER DISTRIBUTION AMONG GROUPS

| GENDER | MULLIGAN'S MOBILIZATION | DT + Mulligan's | Control Group |
|---|---|---|---|
| Male | 71.4% | 57.1% | 57.1% |
| Female | 28.6% | 42.9% | 42.9% |



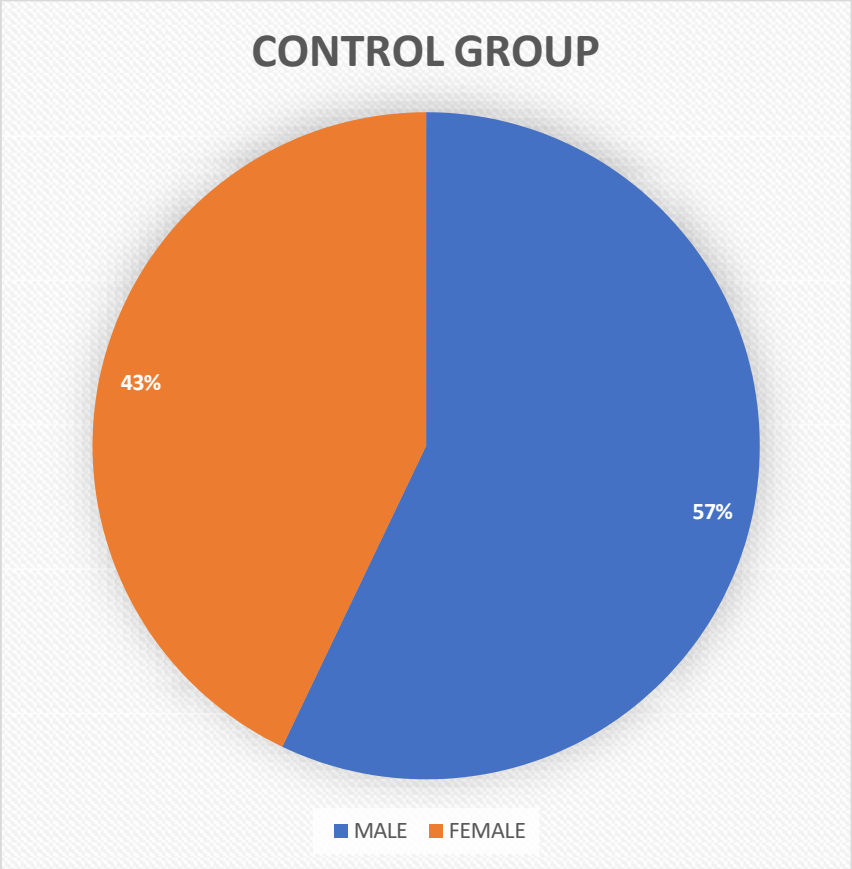

**GRAPH 1**: THIS GRAPH REPRESENTS GENDER DISTRIBUTION AMONG GROUP-A CONSISTING OF 10 MALES AND 4 FEMALES

This graph represents the gender distribution in Mulligan's Mobilization group. The demographic breakdown of participants in this experimental group reveals a distribution of 71% Male and 29% female participants.




**GRAPH 2**: THIS GRAPH REPRESENTS GENDER DISTRIBUTION AMONG GROUP-B CONSISTING OF 8 MALES AND 6 FEMALES

This graph represents Gender distribution in second experimental group i.e. DT+M group. The demographic breakdown of participants in the DT+M group revels a distribution of 57% male and 43% female participants.

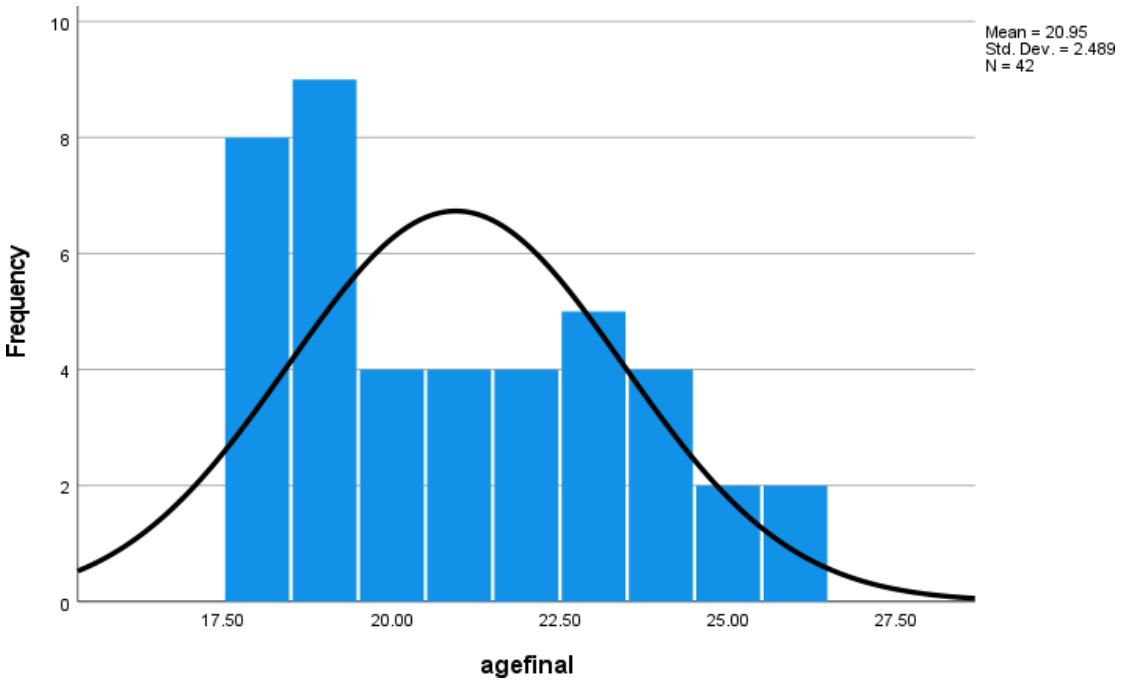



**GRAPH 3**: THIS GRAPH REPRESENTS GENDER DISTRIBUTION AMONG GROUP-C CONSISTING OF 8 MALES AND 6 FEMALES

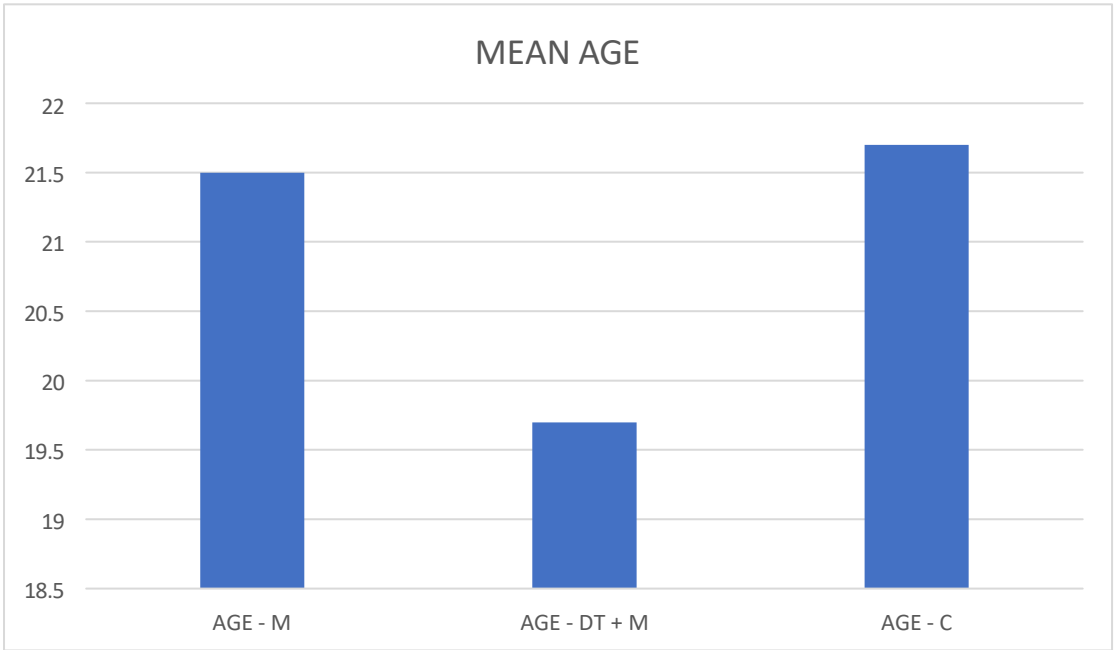
This graph represents Gender distribution in conventional training group i.e. Control group. The demographic breakdown of participants in control group revels a distribution of 57% male and 43% female participants.

**AGE DISTRIBUTION:**

The participants included in the study were between 18-30 years with a mean age of 20.9±0.38 years.




**GRAPH 4**: THIS GRAPH REPRESENTS AGE DISTRIBUTION WITH FREQUENCIES




**GRAPH 5**: THIS GRAPH REPRESENTS AGE MEAN AMONG VARIOUS GROUPS

**OUTCOME MEASURES**

**NPRS – NUMERIC PAIN RATING SCALE**

For between-group analyses One-way ANOVA test was used; the results of the study concluded mean sq. Value - 8.738, f-value- 6.474, p-value – 0.004.

*p-value - <0.05, i.e. Significant difference.

| **TABLE 4:** ANALYSIS FOR SIGNIFICANT DIFFERENCE BETWEEN THE GROUPS FOR REDUCTION OF PAIN INTENSITY BY NPRS | | | |
|---|---|---|---|
| GROUP | NO. OF SAMPLES | MEAN | STANDARD DEVIATION |
| MULLIGAN'S | 14 | 2.00 | 1.300 |
| DT + M | 14 | 1.35 | 1.39 |
| CONTROL | 14 | 0.42 | 0.64 |
| SUM OF SQ. | 17.47 | | |
| Df | 2 | | |
| SIG. VALUE | 0.004 | | |

For between between-group analyses between Group B & Group C one-way ANOVA test was used to conclude which showed:

| **TABLE 5:** THIS TABLE SHOWS GROUP-A COMPARISON WITH GROUP B & C | | | |
|---|---|---|---|
| GROUPS | MEAN DIFFERENCE | ST. ERROR | SIG. VALUE |
| GROUP B | 0.642 | 0.439 | 0.454 |
| GROUP C | 1.571 | 0.439 | 0.003 |

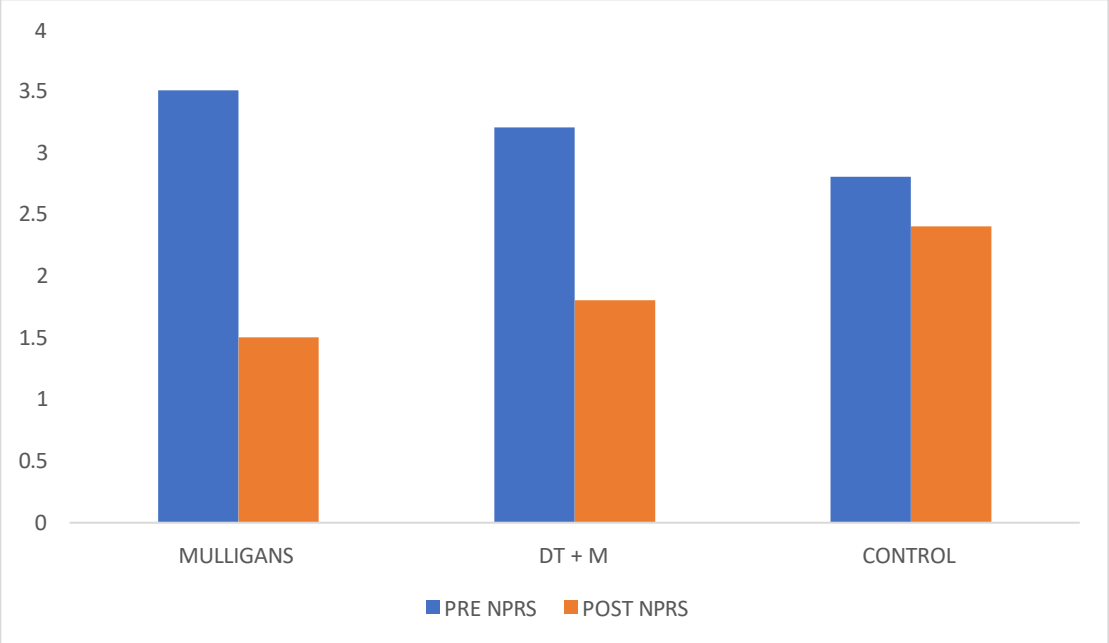
Between-group analysis – DT+M with the CONTROL Group

| **TABLE 6:** BETWEEN-GROUP ANALYSIS OF GROUP-B WITH GROUP-C FOR NPRS | | | |
|---|---|---|---|
| GROUPS | MEAN DIFFERENCE | ST. ERROR | SIG. VALUE |
| GROUP C | 0.928 | 0.439 | 0.123 |

Results concluded that between-group analysis showed there is a significant difference between groups with specific interventions, with a p-value of 0.004.

When group A was compared to group B (DT+M), concluded mean diff -0.642 with a p-value – 0.454, not significant. But when compared to Group C(Control), concluded mean diff- 1.571 with a p-value of -0.003 (<0.05), significant.

When Group B (DT+M) was compared to Group C(Control), concluded mean diff-0.92 with a p-value of 0.123 (>0.05), not significant.




**GRAPH 6:** THIS GRAPH REPRESENTS PRE AND POST NPRS VALUES AMONG DIFFERENT GROUPS

**ODI – OSWESTRY DISABILITY INDEX:**

For between-group analysis, the One-way ANOVA test was used; the results concluded, mean sq.-7.143, f-value = 2.267, with p- p-value = 0.117(>0.05), not a significant difference.

ODI mean scores in specific groups were:

| **TABLE 7:** ANALYSIS FOR SIGNIFICANT DIFFERENCE BETWEEN THE GROUPS FOR IMPROVEMENT IN DISABILITY BY ODI | | | |
|---|---|---|---|
| GROUP | NO. OF SAMPLES | MEAN | STANDARD DEVIATION |
| MULLIGAN'S | 14 | 1.571 | 2.502 |
| DT + M | 14 | 0.857 | 1.703 |
| CONTROL | 14 | 0.142 | 0.534 |
| SUM OF SQ. | 14.286 | | |
| Df | 2 | | |
| SIG. VALUE | 0.117 | | |

*p-value –( <0.05)

For between-groups analyses one-way ANOVA test was used, which showed:

When Group A was compared to Group B & Group C:

| **TABLE 8:** THIS TABLE SHOWS GROUP-A COMPARISON WITH GROUP-B & C | | | |
|---|---|---|---|
| GROUPS | MEAN DIFFERENCE | ST. ERROR | SIG. VALUE |
| GROUP-B | 0.714 | 0.670 | 0.881 |
| GROUP-C | 0.142 | 0.670 | 0.119 |

When Group B was compared to Group C:

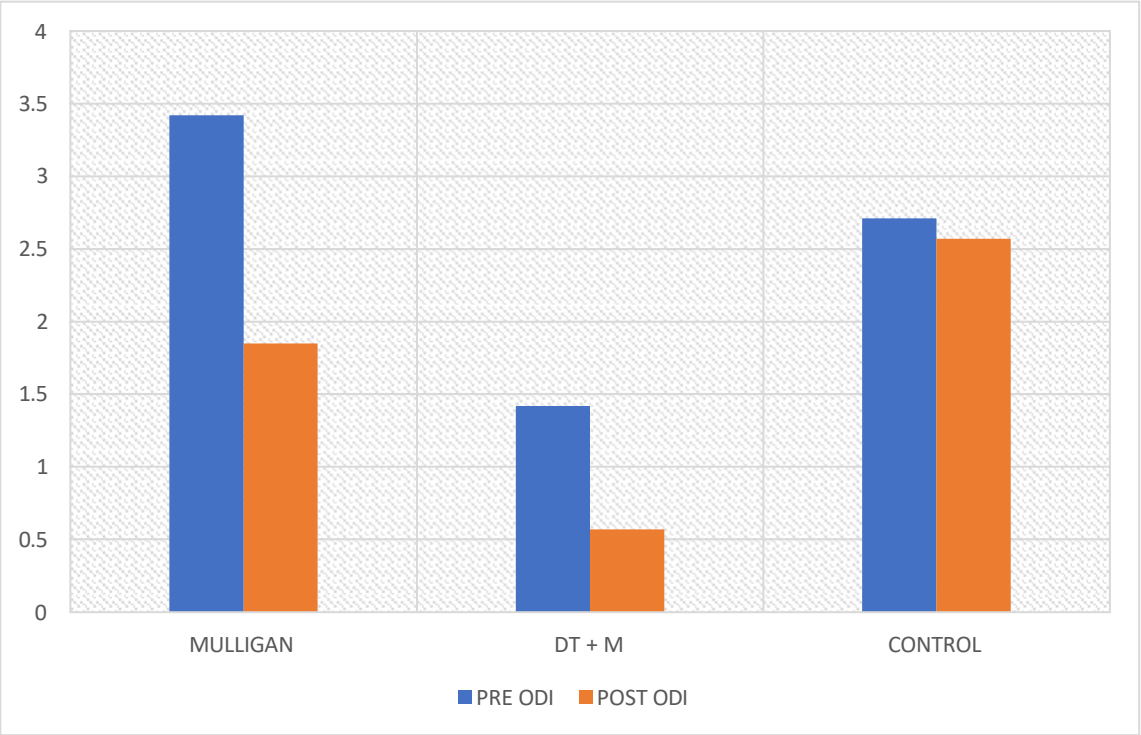
| **TABLE 9:** THIS TABLE SHOWS GROUP-B COMPARISON WITH GROUP-C | | | |
|---|---|---|---|
| GROUPS | MEAN DIFFERENCE | ST. ERROR | SIG. VALUE |
| GROUP C | 0.714 | 0.670 | 0.881 |

Results concluded that between-group analysis showed there was no significant difference, p-value = 0.117(>0.05).

When Group A was compared to B, it concluded that the mean diff was -0.714 with a p-value of 0.881 (>0.05), not significant and when compared to C, the mean diff was -0.142, p-value 0.119(>0.05), not significant.

When Group B was compared with C, it concluded a mean diff-0.714, p-value-0.881 (>0.05), not significant.

| **TABLE 10:** THIS TABLE SHOWS PRE AND POST ODI VALUES AMONG DIFFERENT GROUPS | | |
|---|---|---|
| INTERVENTION | PRE-ODI | POST-ODI |
| MULLIGAN'S | 3.42 | 1.85 |
| DT + M | 1.42 | 0.57 |
| CONTROL | 2.71 | 2.57 |




**GRAPH 7**: THIS GRAPH REPRESENTS PRE AND POST ODI VALUES AMONG DIFFERENT GROUPS

**ADIQ – ATHELETE DIABILITY INDEX QUESTIONNAIRE:**

For between-group analysis, the One-way ANOVA test was used results concluded, mean sq. Value-326.79, f-value-12.843, p-value - <0.01 (<0.05), heavily significant.

ADIQ mean scores in specific groups were:

**TABLE 11:** ANALYSIS FOR SIGNIFICANT DIFFERENCE BETWEEN THE GROUPS FOR IMPROVEMENT IN DISABILITY FOR ADIQ

| GROUP | NO. OF SAMPLES | MEAN | STANDARD DEVIATION |
|---|---|---|---|
| MULLIGAN'S | 14 | 9.727 | 6.962 |
| DT + M | 14 | 3.572 | 5.226 |
| CONTROL | 14 | 0.198 | 6.336 |
| SUM OF SQ. | 653.58 | | |
| Df | 2 | | |
| SIG. VALUE | <0.001 | | |

When Group A was compared to Group B & C:

| **TABLE 12:** THIS TABLE SHOWS GROUP-A COMPARISON WITH GROUP-B & C | | | |
|---|---|---|---|
| GROUPS | MEAN DIFFERENCE | ST. ERROR | SIG. VALUE |
| GROUP-B | 6.154 | 1.906 | 0.007 |
| GROUP-C | 9.528 | 1.906 | <0.001 |

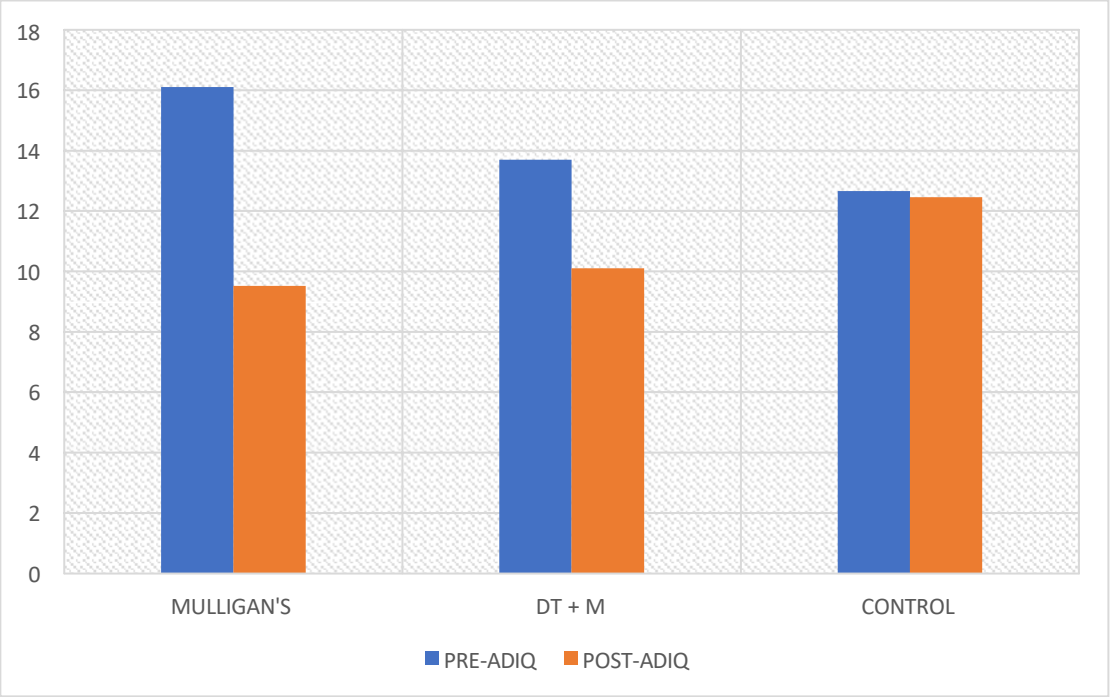
When Group B was compared to Group C:

| **TABLE 13:** THIS TABLE SHOWS GROUP B COMPARISON WITH GROUP C | | | |
|---|---|---|---|
| GROUPS | MEAN DIFFERENCE | ST. ERROR | SIG. VALUE |
| GROUP C | 3.374 | 1.906 | 0.193 |

Results concluded that between-group analysis showed there was a significant difference in mean sq. Value-326.794, f- value-12.843, p-value - <0.001(<0.05), heavily significant.

When Group-A was compared to Group-B, mean diff-6.154, p- value-0.007(<0.05), significant difference & when compared to Group-C, mean diff-9.528, p-value-<0.001(<0.05), highly significant. When Group B was compared to Group C, the mean diff-3.374, p-value-0.193(>0.05), not significant.

| **TABLE 14:** THIS TABLE REPRESENTS PRE AND POST ADIQ VALUES AMONG DIFFERENT GROUPS | | |
|---|---|---|
| INTERVENTION | PRE-ADIQ | POST-ADIQ |
| MULLIGAN'S | 16.1 | 9.52 |
| DT + M | 13.7 | 10.11 |
| CONTROL | 12.66 | 12.46 |




**GRAPH 8**: THIS GRAPH REPRESENTS PRE AND POST ADIQ VALUES AMONG DIFFERENT GROUPS

OVERVIEW OF FINDINGS FROM THE RESULTS OF THIS STUDY

| **TABLE 15:** Between-group comparison for all outcome measures using One-way ANOVA | |
|---|---|
| GROUPS | SIGNIFICANT VALUE |
| NPRS | 0.004 |
| ODI | 0.117 |
| ADIQ | <0.001 |
| *Significant value($p<0.05$) | |

| **TABLE 16:** Within-group comparison for Pre vs Post intervention for all the set outcome measures using Paired T-Test | | | |
|---|---|---|---|
| GROUPS | NPRS | ODI | ADI |
| MULLIGAN'S | <0.001 | 0.035 | <0.001 |
| DT+M | 0.003 | 0.082 | 0.024 |
| CONTROL | 0.028 | 0.336 | 0.336 |
| *Significant value($p<0.05$) | | | |

The between-group analysis revealed significant differences in pain reduction and disability improvement.

Specifically, Mulligan's mobilization demonstrated the most pronounced effects, with statistically significant differences in pain reduction (NPRS) and disability improvement (ADIQ) compared to the other groups.

The DT+M group showed positive outcomes, although to a lesser extent than Mulligan's mobilization.

While the ODI scores showed better outcomes for both intervention groups, the differences did not reach statistical significance.

These findings suggest that Mulligan's mobilization is the most effective treatment approach among the three groups, with significant benefits in pain reduction and disability improvement.

# DISCUSSION

## DISCUSSION

The current study aimed to investigate the additive effect of dynamic taping over Mulligan's mobilization in acute low backache conditions in professional swimmers. Pain was measured using the Numeric Pain Rating Scale (NPRS), and functional limitations and disability were measured using the Oswestry Disability Index (ODI) and Athlete Disability Index Questionnaire (ADIQ).

The participants selected were within the age group of 18–30 years and had at least 2 years of professional swimming experience.

The results of this study revealed important applications of both Mulligan's mobilization and dynamic taping.

The results of this study demonstrated significant pain reduction, as measured by the Numeric Pain Rating Scale (NPRS), across all three groups. Between-group analysis revealed statistically significant differences in pain reduction ($p = 0.004$). Specifically, comparisons between Group A (Mulligan's mobilization) and the control group showed significant differences in pain reduction ($p = 0.003$), whereas comparisons between Group A and Group B (DT+M) did not yield statistically significant differences. Similarly, the comparison between Group B and the control group did not demonstrate statistically significant differences. The findings suggest that while both Mulligan's mobilization and DT+M interventions resulted in pain reduction, the addition of dynamic tape over Mulligan's mobilization did not confer additional benefits in terms of pain reduction, indicating no significant difference between the two interventions ($p > 0.05$).

An experimental study was done on the immediate effect of modified lumbar SNAGs in non-specific chronic low back pain patients. The study concluded that modified lumbar SNAG had an immediate statistically significant effect on reducing pain, which supports the current study showing the immediate favorable effect of Mulligan's mobilization on pain reduction [6].

A randomized controlled trial was conducted in 2015 on the short-term immediate effects of MWM. The results concluded that lumbar spine SNAG had short-term favorable effects on reducing pain, which supports the current study [8].

A study was conducted on Mulligan's technique: immediate effect on ROM and pain in subjects with LBP. The results showed no statistically significant reduction in pain, which contradicts the current study. However, the results still highlighted positive effects of Mulligan's mobilization in reducing pain when compared to the control group [10].

A systematic review was published in 2017 on the effectiveness of MWM on low back pain. The results concluded that current evidence is insufficient to support the benefits of Mulligan's mobilization. However, the current study shows positive benefits of Mulligan's, mainly in improving pain, and could be an essential piece of evidence to support the benefits of MWM [11].

A study done in 2017 on the Dynamic Tape Cervical Offload Approach showed positive effects of DT in offloading soft tissue, which proved to be beneficial in pain reduction. But the results of the current study do not show additional benefits of DT in improving pain, even though it theoretically helps in offloading the soft tissue and provides eccentric support to the tissue [15].

Mulligan's mobilization is thought to operate through two primary domains: biomechanical and neurophysiological. The neurophysiological domain involves modulation of the descending pain inhibitory system and alterations in central pain processing. Specifically, it is believed to inhibit descending pain facilitatory structures via the periaqueductal grey (PAG) and the rostral ventromedial medulla (RVM), thereby suppressing pain transmission at the spinal cord level.

The biomechanical domain involves correction of joint faults, which stimulates joint receptors and subsequently alters the pain-spasm cycle through presynaptic inhibition of nociceptive fibres. This results in pain modulation and reduction [7], [11].

Dynamic Tape exhibits unique biomechanical properties, characterized by multidirectional stretchability, strong resistance, and elastic recoil. Its elastic properties allow for smooth, continuous stretch without rigid endpoints. The tape's viscoelastic properties enable it to absorb sudden impact loads and subsequently release stored energy through rapid recoil, thereby providing a dynamic support mechanism.

By altering the length-tension properties of tissues, Dynamic Tape enhances force-generating capacity and shares loads, reducing the stress transmitted to tissues. This load-sharing mechanism contributes to pain reduction by mitigating excessive tissue loading.

The results of the study revealed that disability and functional limitations measured using the primary outcome measure, ODI, improved in all three groups but did not show a statistically significant difference between-group analysis ($p = 0.117$).

When Group A was compared to Groups B and C, the results did not show significant differences, with p-values of 0.881 and 0.119, respectively. When Group B was compared to Group C, the results also showed no significant difference. The results of the current study showed no significant improvement in any of the three groups.

However, the secondary outcome measure, ADIQ, used to measure disability and functional limitations in the athletic population, showed significant improvement in disability. Results showed improvement in all three groups with a highly statistically significant difference in between-group analysis ($p < 0.001$).

When Group A was compared to Groups B and C, results showed significant differences with p-values of 0.007 and <0.001, respectively. But when Group B was compared to Group C, results showed no significant difference between the two, indicating no additional benefit of DT in improving disability and functional limitations on both ODI and ADIQ. According to ADIQ, Mulligan's group showed a significant difference in comparison to both DT+M and the control group.

An experimental study done in 2015 on the immediate effect of modified lumbar SNAGs in non-specific chronic low back patients concluded that modified lumbar SNAG has an immediate effect on improving the back performance scale and lumbar ROM. This supports the current study, showing the positive outcome of Mulligan's mobilization in improving disability and functional limitations in the athletic population [6].

A randomized controlled trial on short-term effects of MWM showed that lumbar spine SNAG had favorable effects on disability and kinetic spinal movements, which supports the current study [8].

A study published on the effectiveness of SNAG and Maitland mobilization in facet joint syndrome (single-blinded RCPS) showed a significant decrease in disability and improved back muscle endurance, which plays an important role in the athletic population [9].

A study on the Flexion MWM technique: immediate effect on ROM and pain in subjects with LBP showed significant but small improvement in spinal mobility, which also supports the current study, citing decreased disability and improvement in functional restrictions[10],[11].

When Group A was compared to Groups B and C, results showed significant differences with p-values of 0.007 and <0.001, respectively. But when Group B was compared to Group C, results showed no significant difference between the two, showing no additional benefit of DT in improving disability and functional limitations in both ODI and ADIQ.

The biomechanical domain of Mulligan's mobilization involves the correction of joint positional faults and restoration of normal joint tracking, thereby improving joint mechanics and reducing disability and functional limitations in athletes.

In contrast, Dynamic Tape provides biomechanical support by redistributing loads across tissues and assisting weakened muscles through its viscoelastic properties. By altering the length-tension relationship, enhancing force-generating capacity, and providing eccentric support to tissues, Dynamic Tape improves joint stability and movement patterns. This synergistic effect contributes to enhanced functional ability and reduced disability in athletes by mitigating excessive stress on injured or vulnerable tissues.

# CONCLUSION

## CONCLUSION

The findings of the study come to the conclusion that Mulligan's mobilization group and the DT+M group demonstrate improvements in pain and disability. But only Mulligan’s Group showed significant favorable results as an intervention in respect to variables. However, the addition of dynamic tape to Mulligan's mobilization did not yield any additional benefits compared to Mulligan's mobilization alone, supporting the null hypothesis i.e. which stated that addition of dynamic tape to mulligan’s mobilization does not provide any significant amount of benefit in reducing pain or improving disability.

# LIMITATIONS
# &
# FUTURE RECOMMENDATIONS

## LIMITATIONS

1. **Short-term effects only**: The study only examined the immediate effects of the interventions, and long-term effects were not assessed.
2. **Small sample size**: With 14 participants per group, the sample size is relatively small, which may limit the generalizability of the findings.
3. **Limited population**: The study only included elite swimmers, which may not be representative of other populations or athletes.
4. **Lack of follow-up**: There was no follow-up assessment to determine if the benefits of the interventions were sustained over time.
5. **Sham mobilization**: The control group's sham mobilization may not have been an adequate control condition, potentially influencing the results.

## FUTURE RECOMMENDATIONS

1. **Combination with other interventions**: Exploring the effects of combining Mulligan's mobilization and dynamic tape with other interventions, such as exercise programs or manual therapy, could provide valuable insights.
2. **Mechanistic studies**: Future research could investigate the underlying mechanisms of Mulligan's mobilization and dynamic tape, providing a deeper understanding of their effects on pain and disability

# SUMMARY

## SUMMARY

Both the DT+M and Mulligan's mobilization groups demonstrated improvements in pain and disability. However, the between-group comparisons revealed no statistically significant differences between the DT+M and Mulligan's groups. Notably, a significant difference was observed when Mulligan's group was compared to the control group, whereas no significant difference was found between the DT+M group and the control group. These findings suggest that the addition of Dynamic Tape to Mulligan's mobilization did not confer additional benefits beyond those achieved with Mulligan's mobilization alone.

## STATEMENT OF FUNDING

No funding had been granted or used for the study.

## CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest reported during the course of this study.

## DATAAVAILABILITY STATEMENT

The datasets produced and/or analyzed in this study are not publicly accessible due to privacy and confidentiality concerns, but can be obtained from the corresponding author upon reasonable request. The detailed original data underlying the findings of this study, including raw measurements and analysis files, are securely stored and can be accessed upon request for research and verification purposes**.**

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# ANNEXURE

# ANNEXURE 1

**Informed Consent Form to Participate in a Clinical Trial**

**Study Title: Immediate effect of Mulligan's Mobilization with Dynamic Taping Vs Mulligan's Mobilization in Acute Low backache in Professional Swimmers – A Single Blinded Randomized Control Trial.**
**Study Number:**
**Subject's Name: _____**
**Date of Birth/Age: _____**
**Address of the Subject: _____**
**Qualification: _____**
**Occupation: Professional Swimmer**
**Signature of Participant: _____**

---

**(i) I confirm that I have read and understood the information sheet dated _____for the above study and have had the opportunity to ask questions.**
**(ii) I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason.**
**(iii) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purposes.**
**(iv) I agree to take part in the above study.**

**Signature of the Participant: _____**

**Date: _____/_____/_____**

**Signatory's Name: _____**

---

**Investigator Details**
**Date:_____**
**Signature of the Investigator:_____**
**Study Investigator's Name: Shivansh**

---

**Witness Details**
**Signature of the Witness:_____**
**Date:_____/_____/_____**
**Name of the Witness: _____**

---

***Copy of the Patient Information Sheet and duly filled Informed Consent Form shall be handed over to the subject or his/her attendant.***

# ANNEXURE 2

## PERMISSION LETTER FROM STUDY SETTING

**Pt. Chiranjilal Sharma Govt. College, Karnal (Haryana)**

(Affiliated to Kurukshetra University,Kurukshetra)

Ref. No. GCK/SoTu/2025 Date 07.05.2025

To

Shivansh
ABS-MPT-2023-44
Reg. No. 23mp435039
Abhinav Bindra Sports Medicine and Research Institute
Bhubaneswar, Odhisa

Subject: Granting of Samples for Research Purposes

Dear Shivansh,

We are pleased to provide you with the requested samples to support your research endeavors. Recognizing the significance of your work, we are happy to extend our institutional assistance.

The samples are being granted under the following conditions:
1. Usage Restriction: The samples shall be used solely for research purposes.
2. Acknowledgement: Our institution must be duly acknowledged in any publications or outcomes arising from this research.
Sample Details:
- Description: Professional swimmers
- Quantity: 42

Should you have any further questions or require additional assistance, please do not hesitate to contact us.

We wish you success in your research and look forward to your findings.

07.5.25

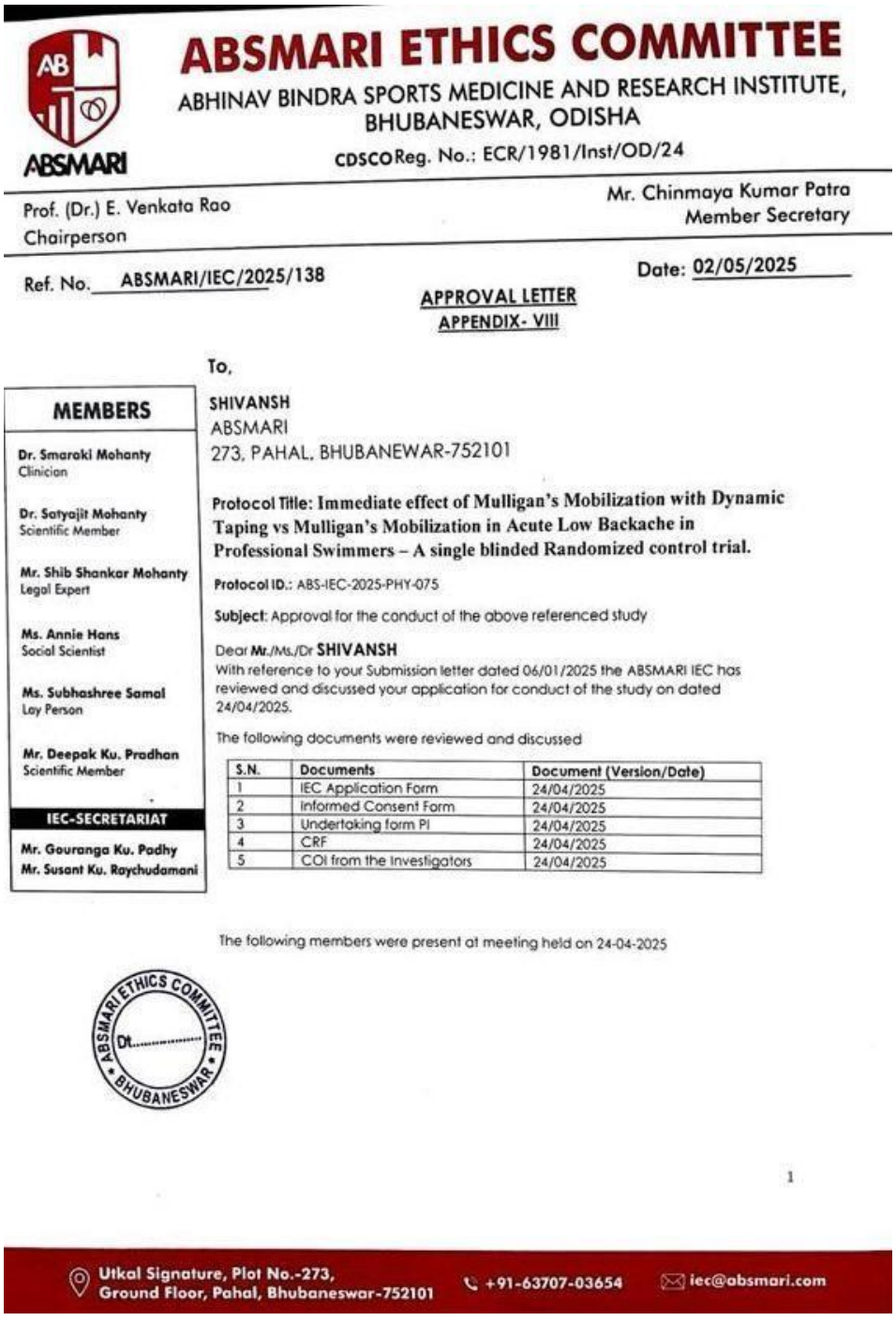
Principal
Pt. Chiranji Lal Sharma
Govt. College, KARNAL

Ph: 0184-2201555,2204456 E-mail: gckarnal@gmail.com

आज़ादी का अमृत महोत्सव

# ANNEXURE 3

## ETHICAL COMMITTEE CLEARANCE CERTIFICATE



**ABSMARI ETHICS COMMITTEE**

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE, BHUBANESWAR, ODISHA

CDSCO Reg. No.: ECR/1981/Inst/OD/24

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2025/138

Date: 02/05/2025

**APPROVAL LETTER**
**APPENDIX- VIII**

To,

**SHIVANSH**
ABSMARI
273, PAHAL, BHUBANEWAR-752101

**MEMBERS**

**Dr. Smaraki Mohanty**
Clinician

**Dr. Satyajit Mohanty**
Scientific Member

**Mr. Shib Shankar Mohanty**
Legal Expert

**Ms. Annie Hans**
Social Scientist

**Ms. Subhashree Samal**
Lay Person

**Mr. Deepak Ku. Pradhan**
Scientific Member

**IEC-SECRETARIAT**

**Mr. Gouranga Ku. Padhy**
**Mr. Susant Ku. Raychudamani**

**Protocol Title: Immediate effect of Mulligan's Mobilization with Dynamic Taping vs Mulligan's Mobilization in Acute Low Backache in Professional Swimmers – A single blinded Randomized control trial.**

**Protocol ID.:** ABS-IEC-2025-PHY-075

**Subject:** Approval for the conduct of the above referenced study

Dear **Mr.**/Ms./Dr **SHIVANSH**
With reference to your Submission letter dated 06/01/2025 the ABSMARI IEC has reviewed and discussed your application for conduct of the study on dated 24/04/2025.

The following documents were reviewed and discussed

| S.N. | Documents | Document (Version/Date) |
|---|---|---|
| 1 | IEC Application Form | 24/04/2025 |
| 2 | Informed Consent Form | 24/04/2025 |
| 3 | Undertaking form PI | 24/04/2025 |
| 4 | CRF | 24/04/2025 |
| 5 | COI from the Investigators | 24/04/2025 |

The following members were present at meeting held on 24-04-2025

ABSMARI ETHICS COMMITTEE Dt..... BHUBANESWAR

1

Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

# ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

CDSCO Reg. No.: ECR/1981/Inst/OD/24

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2025/138

Date: 02/05/2025

**MEMBERS**

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Scientific Member

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Legal Expert

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Social Scientist

**Ms. Subhashree Samal**
Lay Person

**Mr. Deepak Ku. Pradhan**
Scientific Member

**IEC-SECRETARIAT**

**Mr. Gouranga Ku. Padhy**
**Mr. Susant Ku. Raychudamani**

| S.N. | Name of the Member | Designation & Qualification | Representation as per NDCT 2019 | Gender (M/F) | Affiliation with the Institution (Y/N) |
|---|---|---|---|---|---|
| 1 | Prof. Dr. E. Venkata Rao | Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR | Chair Person | M | N |
| 2 | Dr. Smaraki Mohanty | Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med) | Clinician | F | N |
| 3 | Mr. Chinmaya Kumar Patra | Principal-ABSMARI, MPT | Member Secretary | M | Y |
| 4 | Ms. Annie Hans | Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Srilanka). /MA in Social Work | Social Scientist | F | N |
| 5 | Ms. Subhashree Samal | Ret. Reader-Pol Sc. | Lay Person | F | N |
| 6 | Mr. Deepak Kumar Pradhan | Asst. Prof-ABSMARI, MPT | Scientific Member | M | Y |

This is to confirm that only members who are independent of the Investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

**This Committee approves the documents and the conduct for the study in the presented form with necessary recommendation.**

The ABSMARI IEC must be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent/assent and request to provide a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

Yours sincerely,

Mr. Chinmaya Kumar Patra
Member Secretary
ABSMARI Ethics Committee

Member Secretary
ABSMARI ETHICS COMMITTEE
Pahal, Bhubaneswar

ABSMARI ETHICS COMMITTEE
Dt.
BHUBANESWAR

2

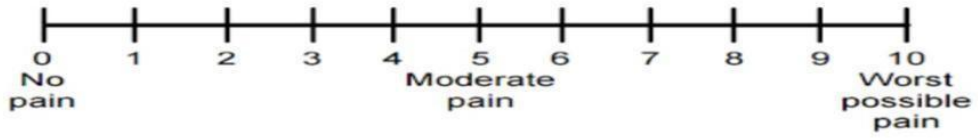
Utkal Signature, Plot No.-273, +91-63707-03654 iec@absmari.com

# ANNEXURE 4

**ASSESMENT FORMS**

## OUTCOME MEASURES

*NPRS – NUMERIC PAIN RATING SCALE*




PRE-TEST SCORE –

POST TEST SCORE -

## OSWESTRY LOW BACK DISABILITY QUESTIONNAIRE

Instructions: this questionnaire has been designed to give us information as to how your back pain has affected your ability to manage everyday life. Please answer every section and mark in each section only the ONE box which applies to you at this time. We realize you may consider 2 of the statements in any section may relate to you, but please mark the box which most closely describes your current condition.

**1. PAIN INTENSITY**
- ☐ I can tolerate the pain I have without having to use pain killers
- ☐ The pain is bad but I manage without taking pain killers
- ☐ Pain killers give complete relief from pain
- ☐ Pain killers give moderate relief from pain
- ☐ Pain killers give very little relief from pain
- ☐ Pain killers have no effect on the pain and I do not use them

**2. PERSONAL CARE (e.g. Washing, Dressing)**
- ☐ I can look after myself normally without causing extra pain
- ☐ I can look after myself normally but it causes extra pain
- ☐ It is painful to look after myself and I am slow and careful
- ☐ I need some help but manage most of my personal care
- ☐ I need help every day in most aspects of self care
- ☐ I don't get dressed, I was with difficulty and stay in bed

**3. LIFTING**
- ☐ I can lift heavy weights without extra pain
- ☐ I can lift heavy weights but it gives extra pain
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, i.e. on a table
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- ☐ I can lift very light weights
- ☐ I cannot lift or carry anything at all

**4. WALKING**
- ☐ Pain does not prevent me walking any distance
- ☐ Pain prevents me walking more than one mile
- ☐ Pain prevents me walking more than ½ mile
- ☐ Pain prevents me walking more than ¼ mile
- ☐ I can only walk using a stick or crutches
- ☐ I am in bed most of the time and have to crawl to the toilet

**5. SITTING**
- ☐ I can sit in any chair as long as I like
- ☐ I can only sit in my favorite chair as long as I like
- ☐ Pain prevents me from sitting more than one hour
- ☐ Pain prevents me from sitting more than ½ hour
- ☐ Pain prevents me from sitting more than 10 minutes
- ☐ Pain prevents me from sitting at all

**6. STANDING**
- ☐ I can stand as long as I want without extra pain
- ☐ I can stand as long as I want but it gives me extra pain
- ☐ Pain prevents me from standing for more than one hour
- ☐ Pain prevents me from standing for more than 30 minutes
- ☐ Pain prevents me from standing for more than 10 minutes
- ☐ Pain prevents me from standing at all

**7. SLEEPING**
- ☐ Pain does not prevent me from sleeping well
- ☐ I can sleep well only by using medication
- ☐ Even when I take medication, I have less than 6 hrs sleep
- ☐ Even when I take medication, I have less than 4 hrs sleep
- ☐ Even when I take medication, I have less than 2 hrs sleep
- ☐ Pain prevents me from sleeping at all

**8. SOCIAL LIFE**
- ☐ My social life is normal and gives me no extra pain
- ☐ My social life is normal but increases the degree of pain
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests, i.e. dancing, etc.
- ☐ Pain has restricted my social life and I do not go out as often
- ☐ Pain has restricted my social life to my home
- ☐ I have no social life because of pain

**9. TRAVELLING**
- ☐ I can travel anywhere without extra pain
- ☐ I can travel anywhere but it gives me extra pain
- ☐ Pain is bad, but I manage journeys over 2 hours
- ☐ Pain restricts me to journeys of less than 1 hour
- ☐ Pain restricts me to short necessary journeys under 30 minutes
- ☐ Pain prevents me from traveling except to the doctor or hospital

**10. EMPLOYMENT/ HOMEMAKING**
- ☐ My normal homemaking/ job activities do not cause pain.
- ☐ My normal homemaking/ job activities increase my pain, but I can still perform all that is required of me.
- ☐ I can perform most of my homemaking/ job duties, but pain prevents me from performing more physically stressful activities (e.g. lifting, vacuuming)
- ☐ Pain prevents me from doing anything but light duties.
- ☐ Pain prevents me from doing even light duties.
- ☐ Pain prevents me from performing any job or homemaking chores.

**PRE TEST SCORE:**

**POST TEST SCORE:**

## *Athletes Disability Index Questionnaire*

| |
|---|
| *This questionnaire is designed to assess how low back pain is affecting your sports and daily activities. Please read the following questions carefully and choose the option that best describes your current situation.* |
| *1.* ***Low Back Pain:***<br>☐ *I have no pain.*<br>☐ *I have mild pain.*<br>☐ *I have moderate pain.*<br>☐ *I have severe pain.* |
| *2.* ***Stretching exercises:***<br>☐ *I can perform all stretching exercises without any back pain.*<br>☐ *I can perform all stretching exercises but some of them are painful.*<br>☐ *I cannot perform some stretching exercises because of my back pain.*<br>☐ *I cannot perform any stretching exercises, because of my back pain.* |
| *3.* ***Strengthening /weight training exercises***<br>☐ *I perform all strength/resistance exercises without pain.*<br>☐ *I can perform all strength/resistance exercises but some with pain.*<br>☐ *There are some strength/resistance exercises I can't perform due to back pain.*<br>☐ *I have completely quit strength/resistance exercises because of pain.* |
| *4.* ***Your sport-specific moves or skills***<br>☐ *I perform all drills without any pain or restriction.*<br>☐ *I perform all drills, but I feel some pain.*<br>☐ *I cannot perform some of my drills because of pain.*<br>☐ *I cannot perform any sport specific drills.* |
| *5.* ***Movement involving back rotations or change of direction***<br>☐ *I have no problem rotating my back or changing direction.*<br>☐ *I can perform back rotation and direction changing activities but some with pain.*<br>☐ *I am restricted in rotating my back and/or changing direction due to pain.*<br>☐ *I cannot perform rotational back movements or change direction because of pain.* |
| *6.* ***Sitting***<br>☐ *I can sit on any chair (surface) for as long as required.*<br>☐ *I can sit as long as required but I experience some pain.*<br>☐ *I have to leave the chair earlier than required because of pain.*<br>☐ *I can only sit for a short while, because of pain.* |
| *7.* ***Walking***<br>☐ *I can walk on level and sloped surfaces, as well as stairs; without any pain*<br>☐ *I can only walk on level surfaces without experiencing pain.*<br>☐ *My walking duration or speed has been affected by pain.*<br>☐ *The pain has severely limited my ability to walk.* |

| |
|---|
| *8. **Sleep***<br>☐ *I have no pain or restrictions while sleeping.*<br>☐ *I can sleep without pain if I position myself in a certain way(s).*<br>☐ *I sleep less than before because of the pain.*<br>☐ *My sleep has been totally disrupted.* |

| |
|---|
| *9. **Personal care** (putting on socks and shoes, going to the bathroom)*<br>☐ *I can perform all personal-care activities without pain.*<br>☐ *I am capable of performing them, but they sometimes cause pain.*<br>☐ *I cannot perform some of my personal care due to pain.*<br>☐ *I need assistance for almost all personal care activities* |
| *10. **Fear of causing pain or damaging the back***<br>☐ *I have no fear of pain while performing sports activities/exercises.*<br>☐ *I perform my training despite the fear of pain.*<br>☐ *Fear of pain prevents me from performing some activities/movements.*<br>☐ *Fear of pain has made me stop performing sports activities/exercises* |
| *11. **Leisure activities***<br>☐ *I perform my leisure activities without any pain.*<br>☐ *Despite some pain, I do all of my leisure activities.*<br>☐ *I avoid some recreational activities due to pain.*<br>☐ *I avoid almost all recreational activities due to pain.* |
| *12. **Sexual Activity***<br>☐ *I do not experience any back pain or limitations during sexual activity.*<br>☐ *I have maintained my sexual activity but I do experience some back pain.*<br>☐ *I have had to reduce sexual activity due to pain.*<br>☐ *I completely refrain from sexual activity because of the back pain.* |

PRE-TEST SSCORING –

POST-TEST SCORING -

# ANNEXURE 5

## MASTER CHART

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NAME | AGE | GENDER | INTERVENTION | PRENPRS | POSTNPRS | PREODI | POSTODI | PREADIQ | POSTADIQ |
| 2 | HARSHLEIR SINGH | 19 | M | M | 6 | 3 | 4 | 2 | 33.30% | 13.80% |
| 3 | SUMIT | 20 | M | M | 2 | 0 | 0 | 0 | 11.11 | 0 |
| 4 | RAJESH | 25 | M | M | 4 | 1 | 2 | 0 | 16.66 | 2.77 |
| 5 | RISHAB | 20 | M | M | 2 | 1 | 0 | 0 | 11.11 | 8.33 |
| 6 | DIGVIJAY | 19 | M | M | 4 | 3 | 2 | 2 | 27.77 | 16.66 |
| 7 | ADDAB | 24 | F | M | 2 | 0 | 2 | 0 | 11.11 | 0 |
| 8 | VARUN SHARMA | 19 | M | M | 2 | 1 | 2 | 2 | 13.88 | 13.88 |
| 9 | ARSH BAINS | 19 | F | M | 6 | 1 | 12 | 4 | 36.11 | 13.88 |
| 10 | ROBIN NAIN | 20 | M | M | 3 | 0 | 2 | 0 | 16.66 | 2.77 |
| 11 | VANISHA | 26 | F | M | 3 | 3 | 2 | 2 | 16.66 | 16.66 |
| 12 | SHAURYA THAKUR | 21 | M | M | 4 | 1 | 10 | 4 | 25% | 13.88 |
| 13 | ANAND | 22 | M | M | 3 | 2 | 2 | 2 | 13.88 | 13.88 |
| 14 | SARTAJ SINGH | 24 | M | M | 3 | 1 | 2 | 2 | 13.88 | 5.55 |
| 15 | SHAURYA | 23 | F | M | 5 | 4 | 6 | 6 | 36.11 | 25 |

**CHART 1: MULLIGANS MOBILISATION**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NAME | AGE | GENDER | INTERVENTION | PRENPRS | POSTNPRS | PREODI | POSTODI | PREADIQ | POSTADIQ |
| 2 | ANVITA VERMA | 22 | F | DT+M | 2 | 2 | 0 | 0 | 5.77 | 2.77 |
| 3 | SHUBHNOOR KAUR | 19 | F | DT+M | 4 | 3 | 0 | 0 | 13.88 | 13.88 |
| 4 | AARAV SHARMA | 18 | M | DT+M | 5 | 2 | 2 | 0 | 27.77 | 22.22 |
| 5 | BHAVYA KATHURIA | 19 | M | DT+M | 6 | 1 | 6 | 0 | 33.33 | 13.88 |
| 6 | JASNOOR KAUR | 21 | F | DT+M | 3 | 2 | 2 | 0 | 16.66 | 16.66 |
| 7 | LAKSHAY JINDAL | 18 | M | DT+M | 1 | 1 | 0 | 0 | 2.77 | 2.77 |
| 8 | KANISHK MANN | 23 | M | DT+M | 3 | 2 | 2 | 2 | 11.11 | 8.33 |
| 9 | RAVINDER ATTHRI | 18 | M | DT+M | 4 | 4 | 6 | 6 | 27.77 | 27.77 |
| 10 | ASMITA VERMA | 19 | F | DT+M | 2 | 0 | 0 | 0 | 2.77 | 0 |
| 11 | GURKEERAT KAUR | 19 | M | DT+M | 3 | 3 | 0 | 0 | 8.33 | 5.55 |
| 12 | HIMANG | 18 | M | DT+M | 5 | 3 | 2 | 0 | 16.66 | 8.33 |
| 13 | JHUJHAR S. GILL | 18 | M | DT+M | 3 | 1 | 0 | 0 | 11.11 | 5.55 |
| 14 | JASLEEN KAUR | 21 | F | DT+M | 1 | 0 | 0 | 0 | 2.77 | 2.77 |
| 15 | AANYA | 23 | F | DT+M | 3 | 2 | 0 | 0 | 11.11 | 11.11 |

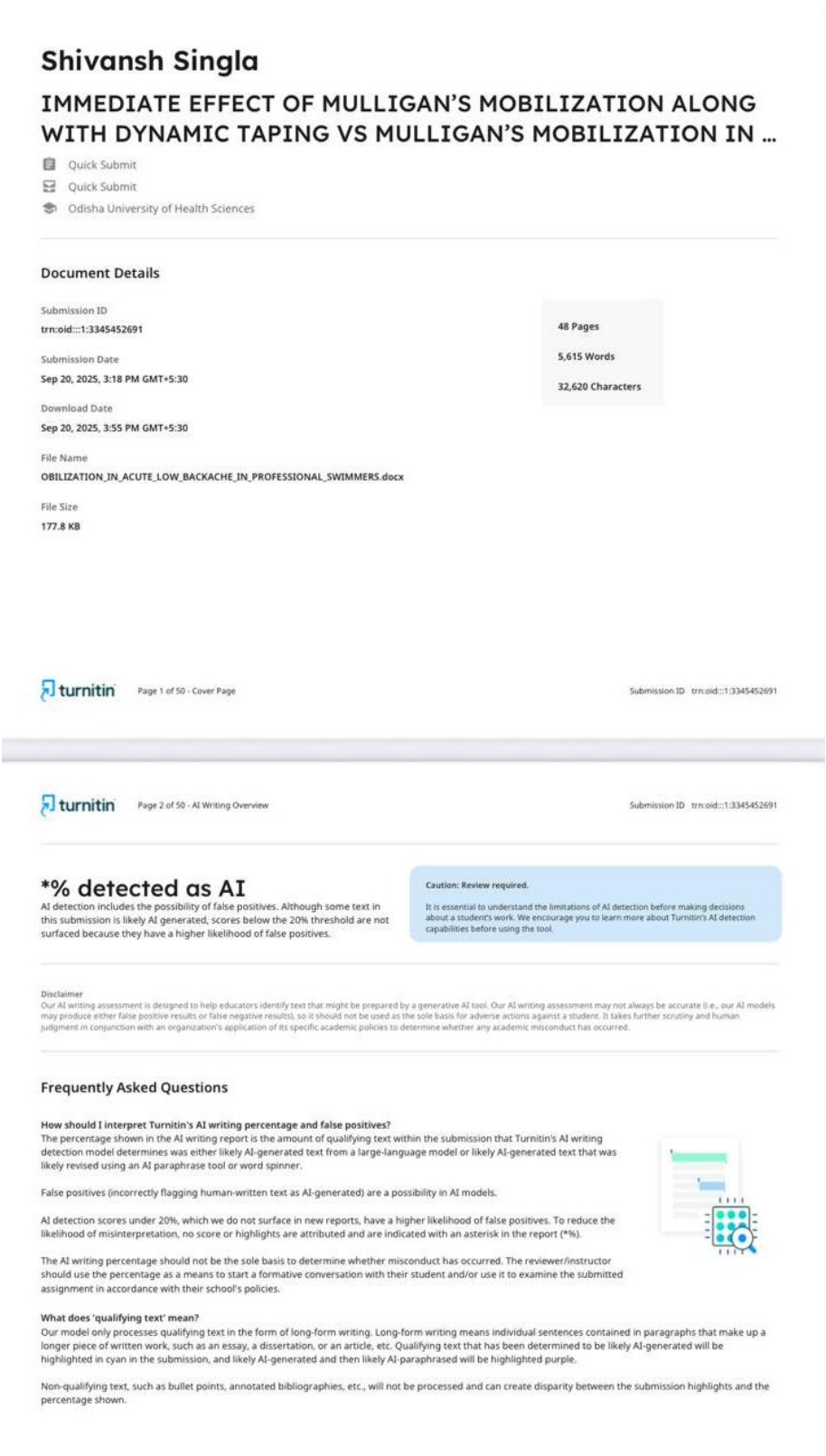
**CHART 2: MULLIGANS MOBILISATION + DYNAMIC TAPING**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NAME | AGE | GENDER | INTERVENTION | PRENPRS | POSTNPRS | PREODI | POSTODI | PREADIQ | POSTADIQ |
| 2 | SHIVAM SHARDA | 25 | M | C | 3 | 3 | 2 | 2 | 5.55 | 5.55 |
| 3 | GARIMAN SINGH | 23 | M | C | 2 | 2 | 0 | 0 | 8.33 | 8.33 |
| 4 | EAMANDEEP SINGH | 26 | M | C | 2 | 2 | 2 | 2 | 8 | 8 |
| 5 | KUDREET KAUR GHUMAR | 19 | F | C | 2 | 2 | 2 | 2 | 8.33 | 8.33 |
| 6 | DAVINDER KAUR | 22 | F | C | 2 | 2 | 2 | 2 | 8.33 | 8.33 |
| 7 | DIVYA THAKUR | 23 | F | C | 3 | 3 | 2 | 2 | 13.88 | 13.88 |
| 8 | JASHAN DHINGRA | 24 | M | C | 4 | 2 | 2 | 0 | 11.11 | 11.11 |
| 9 | UTTKARSH KAUSHIK | 18 | M | C | 3 | 3 | 4 | 4 | 16.6 | 16.6 |
| 10 | JEEHA SHARMA | 21 | F | C | 3 | 2 | 2 | 2 | 11.11 | 11.11 |
| 11 | TANMAY KAUSHIK | 24 | M | C | 4 | 3 | 2 | 2 | 22.22 | 19.44 |
| 12 | BALPREET SINGH | 20 | M | C | 1 | 1 | 0 | 0 | 5.55 | 5.55 |
| 13 | KARAN L. SINGH | 18 | M | C | 4 | 3 | 8 | 8 | 22.22 | 22.22 |
| 14 | PEISHI | 22 | F | C | 4 | 4 | 8 | 8 | 27.77 | 27.77 |
| 15 | MANYATA JAIN | 18 | F | C | 2 | 1 | 2 | 2 | 8.33 | 8.33 |

**CHART 3: CONTROL GROUP**

**ANNEXURE 6**

**PLAGIRISM CHART**



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