EFFECTIVENESS OF THORACIC MOBILITY EXERCISE VERSUS MANUAL RELEASE TECHNIQUE IN MINIMIZING MECHANICAL UPPER BACK PAIN (UBP) AMONG UNDERGRADUATES IN SRI LANKA

By

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Student's Declaration

- This work has not previously been accepted in substance for any degree and is not concurrently submitted in candidature for any degree.

- This dissertation is being submitted in partial fulfillment of the requirements for the degree of MSc in Rehabilitation Science.

- This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A Bibliography is appended.

- I confirm that if anything identified in my work that I have done plagiarism or any form of cheating that will directly awarded me fail and I am subject to disciplinary actions of authority.

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Thesis Supervisor's Statement

As supervisor of Ms. Vithursha Sivakumar's Masters in Rehabilitation Science thesis work, I have certify that her thesis "**Effectiveness of thoracic mobility exercises versus manual release technique in minimizing mechanical Upper Back Pain (UBP) among Undergraduates in Sri Lanka**" is suitable for examination.

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LIST OF ABBREVIATIONS

Upper Back Pain (UBP)

Thoracic Spine Pain (TSP)

Transcutaneous electrical nerve stimulation (TENS)

Forced Vital Capacity (FVC)

Forced Expiratory Volume (FEV)

Pain Self Efficacy Questionnaire (PSEQ)

Activities of Daily Living (ADL)

Visual Analogue Scale (VAS)

Body Mass Index (BMI)

Manual Muscle Testing (MMT)

Randomized Control Trail (RCT)

Thoracic Vertebrae 1 (T1)

Thoracic Vertebrae 12 (T12)

Cervical Vertebrae 7 (C7)

Sacral Vertebrae (S1)

Medical Research Council (MRC)

Intra-class Correlation Coefficient (ICC)

Institutional Review Board (IRB)

ABSTRACT

Introduction: Upper Back Pain refers to pain anywhere in between T1 to T12 area which referred as “Cinderella” region because of less research focus. Currently, Upper Back Pain common among young population significantly undergraduates due to poor ergonomics, academic work load and stress which is higher among Sri Lankan undergraduates. There are few studies focus on therapeutic techniques and effectiveness regarding Upper back Pain.

Objective: Compare the effectiveness of thoracic mobility exercise in combination with breathing with manual release technique which includes thoracic mobilization technique and myofascial release technique in improving pain intensity, muscle strength, thoracic spine mobility and self-efficacy.

Method: This Study was Double-Blinded randomized Control Trail, 60 participants were selected and randomly allocated in experimental and control group by lottery method. 57 were completed the study. Allocation was concealed and participants and accessors were blinded. Experiment group receives thoracic mobility exercise training and control group provided with manual therapy for 3 times a week for 2 weeks. Individuals were assessed for pain intensity, thoracic mobility, muscle strength of thoracic extensors and self-efficacy at baseline and after the intervention.

Results: In demographic characteristics, BMI of participants associated with present intensity ($p=0.006$). Participants’ pain intensity who are under overweight (22.5-26.9kg/m^2) and obese (>27kg/m^2) shows increased tendency in VAS scale. Both groups are similar at baseline. After intervention, significant difference in present pain intensity, and pain intensity during sitting, forward bending, walking, and standing and in activities of daily living in experiment group than controls. Experiment groups indicated a significant improvement in thoraco-lumbar extension ($p=0.036$), muscle strength of thoracic spine extensors in Oxford grading Scale ($p=0.000$). Further, significant improvement in pain intensity except walking and standing, thoracic mobility except thoraco-lumbar extension in control group. Moreover, both group showed improvement in self-efficacy.

Conclusion: Thoracic mobility exercises in combination of breathing are more effective exercises in managing upper back pain than manual release technique which can effectively improve upper back pain and spine health among undergraduates or young population without any therapeutic assistance.

Key word: Upper Back Pain, Undergraduates, Thoracic mobility exercises, Manual Release technique and Muscle strength

CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION

Upper back refers to the region anywhere between cervical regions to thoracic region which depicts from T1 to T12 region of the spine (Exelby, 2011). Pain in this region referred as Upper Back Pain (UBP). According to the available literature, there is no any clear definition for UBP. In some literature it often referred as thoracic back pain or Thoracic Spine Pain (TSP) (Fouquet et al., 2015). Further, Incidence of Thoracic Spine Pain (TSP) or UBP referred as less common in literature because of the anatomy of ribcage and thoracic spine which are closely packed each other. TSP has to be considered as a serious issue than neck and low back pain because vital organs such as heart and lungs belong to its anatomical land mark. According to available evidence, there is a lack of attention regarding TSP when compared to pain in other regions such as neck and low back (Briggs et al., 2009).

Overall, Spinal pain signifies a considerable influence on productivity as well as in reduction of an individual's quality of life in general population (Collins et al., 2005; Dagenais et al., 2008). Evidence stated that, poor thoracic posture affects the quality of life and hampers productivity of an individual (Linaker & Walker-Bone, 2015). Evidence depicts that thoracic spine pain did not significantly impact on health care resources as like neck and Low Back Pain (LBP) however, the thoracic spine may be a 'silent' contributor to economic burden of an individual (Sueki et al., 2013). A significant drawback of prior research on thoracic spine pain, as noted by Briggs et al. (2009), is the reliance on a combined outcome measure for spinal pain. This approach limits the interpretation of the data, as risk factors for the onset of pain and dysfunction likely differ by spinal level due to the varied functional demands at each level (Briggs et al., 2009). Thoracic spine pain can be just as debilitating as pain in other regions, potentially placing comparable burdens on individuals, communities, and the workforce.

Generally, Prevalence of acute or subacute TSP and chronic pain is ranging from 3.4%-34.8% and 15.6%- 19.5% respectively among general population (Fouquet et al., 2015). However, Prevalence of UBP among young population remains under focus in the Asian and south Asian region. In Sri Lankan context, prevalence of UBP among undergraduates shows high prevalence of UBP in clinical settings however, exact statistical data is not available.

UBP in young population can occur from variety of causes. Upper back part of human body is crucial because its composition of vital organs which is covered with thoracic cage. Muscles, ligaments, and tendons surround and support this region, facilitating a thoracic cage movements while maintaining stability(Middleditch & Oliver, 2005). The upper back serves as a crucial junction for the neck and lower back, playing a pivotal role in maintaining posture, supporting the upper body, and protecting the spinal cord (Middleditch & Oliver, 2005). Understanding the complex interplay of these components is essential for pathophysiology of UBP. Thoracic spine mobility affects the mobility of rib cage, stiffness in the thoracic spine reduce the effectiveness of respiratory mechanism (French et al., 1997). According to evidence, wide range of causes for non-specific UBP which includes musculoskeletal causes as well as systemic origin (Maselli et al., 2022). It requires a thorough differential diagnosis (Maselli et al., 2022). Thoracic pain mainly occurs due to poor posture and overuse injuries(Lin et al., 2020). Long term sitting with bad posture leads to the tightness chest muscles mainly pectoralis major, minor, subclavius and intercostal, lead to hunched position, although the muscles of the upper back and neck mainly trapezius, rhomboids, levator scapulae, splenius and erector spinae become weak (Lin et al., 2020). These imbalances can lead to tension and pain. Effective physiotherapy management plays a crucial role in addressing and alleviating UBP, a common musculoskeletal issue that can significantly impact daily life. Through tailored therapeutic interventions and targeted exercises, physiotherapists aim to restore function, reduce pain, and enhance the overall well-being of individuals experiencing discomfort in their upper back.

In this context, a comprehensive physiotherapy approach becomes instrumental in not only managing symptoms but also identifying and addressing the underlying causes of UBP for long-term relief and improved quality of life (Vasudevan, 2015). Physiotherapy play a crucial role in managing TSP through a comprehensive approach encompassing various techniques. The treatment protocol involves a diverse range of methods, including soft tissue massage, trigger point releases, and both light and firm thoracic spinal mobilizations tailored to alleviate pain and stiffness (Risetti et al., 2023). Manipulations, modalities like heat, ice, and TENs, as well as protective measures such as compression, padding, and strapping contribute to a holistic treatment plan(Risetti et al., 2023). Supportive braces, tape-assisted posture retraining, muscle stretch and exercise for muscle strength, endurance and breathing aid in restoring range of motion and reducing discomfort. Patient education and ergonomic advice are integral components, emphasizing lifestyle changes(Moffett & McLean, 2006). Furthermore, fostering hobbies or sports activities is encouraged, promoting overall well-being and reinforcing the importance of a balanced and active lifestyle in spinal health (Henderson, 2012). Despite the prevalence of UBP, there is a noticeable scarcity of research focusing specifically on physiotherapy interventions for significant improvement of pain. This research gap emphasizes the necessity for more targeted studies to explore and validate the efficacy of various physiotherapeutic approaches in managing UBP. The limited available evidence highlights the potential for advancing the field and enhancing clinical practices through rigorous investigation into the effectiveness of specific physiotherapy techniques, exercises, and modalities tailored to address the complexities of UBP. Bridging this research gap is imperative to refine treatment protocols, optimize patient outcomes, and contribute to the evidence-based evolution of physiotherapy strategies for UBP management. Thoracic mobility exercises, Thoracic mobilization techniques was found to be an effective treatment methods for UBP. Even though effectiveness of those techniques remain under researched.

The thoracic spinal mobilization technique developed by Geoffrey Maitland, a renowned physiotherapist, is rooted in the principles of manual therapy and the Maitland Concept (Maitland, 1986). The mechanism of Maitland-based thoracic spinal mobilization involves a series of graded, passive oscillatory movements applied by the physiotherapist to the patient's thoracic spine(Maitland, 1986). These movements are specifically directed to targeted vertebral levels based on the individual's presenting symptoms and assessment findings. Thoracic Spinal mobilization technique forwarded by Maitland suggests that Grade I and II oscillatory technique mainly contributes in reduction of pain can potentially help reduce pain in the spine through several mechanisms including gate control theory, by release of endorphins, and improve blood flow to the muscle and Grade III and Grade IV techniques mainly contributes in improving mobility(K.-S. Lee & Lee, 2017; Maitland, 1986). Application of Maitland’s mobilization technique grades will be differ according to the patient’s individual factors and pain intensity (K.-S. Lee & Lee, 2017). Widely use technique to reduce the symptoms in thoracic spine is application of Postero-anterior central vertebral pressure. This application of central pressure is successful in reducing symptoms arising from the midline of thoracic region or evenly distributed to each side of the body. In addition it can be applicable for unilateral symptoms (Maitland, 1986).

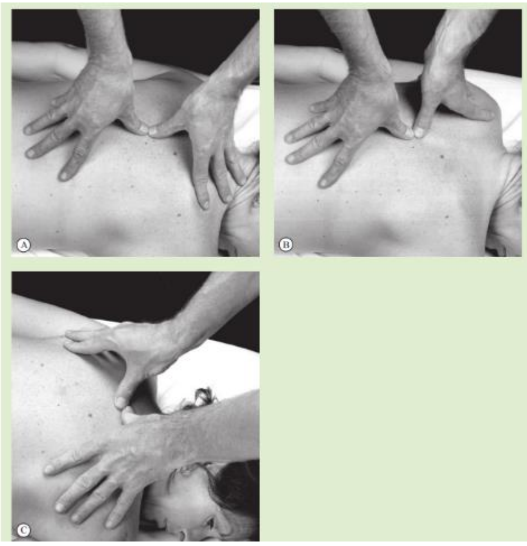


Figure 1.1 Postero-anterior central vertebral pressure

Mobilization is performed by applying oscillating pressure to the spinous processes. This pressure is generated by the body's movement and transferred through the arms to the thumbs. It is crucial that the pressure comes from the body weight over the hands, not from the thumbs squeezing (Maitland, 1986). The fingers, which should be spread across the patient's back, should not apply any pressure but instead serve to stabilize the thumbs. Improper use of the fingers can dissipate the pressure and reduce the effectiveness of the thumbs (Maitland, 1986). The therapist apply controlled and graded pressure or oscillations in different directions, considering factors such as pain response, range of motion, and tissue tension (Maitland, 1986). The goals of this technique include the lessening of pain, enhancement of joint mobility, and restoration of normal movement patterns within the thoracic spine (K.-S. Lee & Lee, 2017). The mobilization technique is typically characterized by its graded nature, with the therapist gradually progressing from gentle oscillations to more significant movements as tolerated by the patient. This adaptability allows for a patient-specific approach, promoting optimal results in terms of pain relief and functional development(K.-S. Lee & Lee, 2017).

Myofascial release technique is a gentle, sustained form of massage designed to alleviate tightness and pain in the myofascial tissues. This technique aims to reduce musculoskeletal pain and is supported by various theories explaining its effectiveness (Werenski, 2011). According to the Gate Control Theory, rapid sensory stimuli such as pressure can block the transmission of pain signals to the brain, effectively "closing the gate" to pain perception (Melzack, 1996). Additionally, the personalized, hands-on nature of the massage provides interpersonal attention that has a soothing effect, reducing pain perception through the parasympathetic response of the autonomic nervous system (Werenski, 2011). This response lowers the release of stress hormones, anxiety, depression, and pain. Furthermore, the release of serotonin during the process helps to inhibit the transmission of harmful stimuli to the brain (Desai et al., 2013). The pressure applied during myofascial release may also trigger the release of inhibitory neurotransmitters like endorphins, potentially alleviating pain and muscle spasm (Desai et al., 2013). Myofascial release is a widely used form of direct manual therapy that applies precisely controlled mechanical forces to relieve myofascial restrictions linked to various somatic dysfunctions. When combined with traditional treatments, myofascial release proves effective in promptly alleviating pain and reducing tissue tenderness (Werenski, 2011). Few literature forwarded that pressure or tension should be applied for nearly 40 to 120 seconds in an angle of 30- 60 degree for the effective release of trigger points (Kim, Sung and Lee, 2017). There are two type of myofascial release technique which are direct and indirect method of application. The direct technique is based on the premise of directly addressing restricted fascia (Ajimsha, 2011). Practitioners use techniques like applying pressure with knuckles, elbows, or specialized tools to slowly work through the fascial layers. The applied pressure typically amounts to a few kilograms of force, with the intention of making direct contact with the restricted fascia (Ajimsha, 2011). During this process, the practitioner may apply tension or gently stretch the fascia to promote its release and alleviate any associated restrictions or discomfort (Ajimsha, 2011). The indirect method in myofascial release technique entails applying a subtle stretch to the fascia (Ajimsha, 2011). This technique involves applying minimal force, usually just a few grams of pressure, as the hands move in the direction of the fascial restriction. The practitioner maintains the stretch, allowing the fascia to gradually "unwind" and release tension naturally. This gentle approach aims to facilitate a gradual and therapeutic process, promoting the restoration of flexibility and reducing restrictions within the fascial tissues (Ajimsha, 2011). According to the evidence both methods seems to be effective in improving pain related to tight fascia and muscle (Ajimsha, 2011). In this study, therapist has used direct method of Myo-Fascial Release technique to improve pain in control group.

It’s known that thoracic region is important as thoracic cage covers the vital organs. The thoracic spine is designed for flexibility, allowing movements like flexion, extension, and rotation. However, prolonged periods of inactivity, often associated with sedentary office jobs and poor posture, can lead to a reduction in thoracic spine mobility (Heneghan et al., 2018). Conversely, the lumbar spine, situated in the lower back, is structured for stability. It bears the body's weight and resists excessive rotation, preferring stability to support powerful hip movements (Graham, 2015). While the lumbar spine can exhibit some mobility, its primary function is to provide a stable foundation. Striking a balance between maintaining mobility in the thoracic spine and stability in the lumbar spine is essential for overall spinal health (Borghuis et al., 2008). Regular movement, correct posture, and targeted exercises are key in preserving the natural functions of both spine sections, contributing to a healthier and more resilient back.

If the thoracic spine lacks mobility, the lumbar spine may compensate, potentially resulting in low back pain and fatigue. On the other end, immobility in the thoracic spine can impact the shoulders and neck. Numerous studies, such as one by Heneghan et al. (2020), provide strong evidence linking dysfunction in thoracic spine movement to pathologies and pain in the neck, shoulder, and elbow (Heneghan et al., 2020). Additionally, the thoracic spine is crucial for neck movement, contributing to 33% of neck flexion and 21% of neck rotation. Consequently, reduced mobility in the thoracic spine can lead to neck pain (O’Leary et al., 2009). This highlights the interconnectedness of spinal segments and the importance of maintaining proper mobility throughout the spine to prevent discomfort and dysfunction in adjacent areas. Regular exercises and movements that enhance thoracic spine mobility can help prevent these issues and promote overall spinal health (O’Leary et al., 2009).

Sedentary lifestyle and prolonged sitting causes hunched posture, includes forward head posture which reduce the mobility of the thoracic spine. Researchers have discovered that people who engage in prolonged periods of sitting, exceeding 7 hours per day, exhibit reduced thoracic mobility compared to those with lower levels of sedentary behaviour (4-7 hours of sitting daily). Interestingly, even those who are moderately active and participate in physical activity show greater thoracic mobility compared to individuals with a sedentary lifestyle. This underscores the detrimental effect of prolonged sitting on thoracic mobility and highlights the importance of regular physical activity in maintaining optimal spinal flexibility (Elpeze & Usgu, 2022).

Dosage for thoracic mobility exercises differs according to evidence. A study conducted in 2005 reported that 8 weeks of thoracic mobility exercise for 3 session per week for 8 weeks reduces thoracic pain and kyphosis(Choi et al., 2005). A review, conducted by expert reviewers at various stages, encompassed searches across key databases and social media sources up to August 16, 2019 which analysed about 38 thoracic spine exercise and how it contributes in the improvement in work capacity, motor control, strength and mobility (Heneghan et al., 2020). However according to the same study, reviewers reported the necessity to check the effectiveness and validity of each exercises based on the outcome(Heneghan et al., 2020).

Variety of studies showed different dosage of thoracic mobility exercise which contributes in improving respiratory function, mobility and pain reduction. Few studies suggest that 4 weeks session 5 times in a week with 10 repetition two times a day for moderate intensity improve muscle endurance (Arbane et al., 2011). Further, 6 weeks session and two week session with 10 repetition two times a day shows a significant improvement in pain (K.-W. Lee & Kim, 2016). There is a lack of evidence in for specific exercises and its dosage. In a clinical setting, exercises such as the cat and camel, horizontal chest expansion, and cross-arm chest expansion demonstrated significant improvements in pain reduction and thoracic mobility when performed five times a week, twice a day, for two weeks. Despite these positive outcomes, further evidence is necessary to validate their effectiveness.

Cat and camel exercise is a core stabilization exercise rather than mobilize low back spine, its mobilizing the whole spine, helps in improving stiffness and improve the muscle strength of shoulder, arm and chest muscles while incorporates breathing in exercise. The routine should commence with the cat-camel motion exercise, which involves performing cycles of spine flexion and extension. This motion is aimed at reducing the viscosity of the spine, addressing internal resistance and friction within the spinal column. Additionally, the exercise is designed to "floss" the nerve roots as they exit at each lumbar level. It's important to note that the cat-camel exercise is intended as a dynamic motion rather than a static stretch. The emphasis should be on smoothly moving through the range of motion, highlighting the dynamic nature of the exercise instead of pushing to the extreme points of flexion and extension. To achieve the desired benefits, it's recommended to perform five to eight cycles of the cat-camel motion. This range of repetitions has been shown to be effective in reducing most viscous-frictional stresses within the spine, promoting flexibility, and potentially alleviating discomfort associated with internal resistance and friction in the spinal column. According to a study conducted in 2022 among adolescence, reported that thoracic exercise program includes cat and camel exercise significantly reduces the kyphosis angle (Elpeze & Usgu, 2022). Additionally, numerous evidences suggests that core stabilization exercises including cat and camel exercise depicts a significant improvement in low back pain(Alagesan et al., 2024; Kostadinović et al., 2020; Salik Sengul et al., 2021). A study conducted by Pathak et al reported that structured exercise program includes cat and camel exercise showed a significant improvement in rounded shoulder within 4 weeks(Salik Sengul et al., 2021). There is a lack of literature regarding effectiveness of cat and camel exercise to improve the thoracic spine. In addition, accurate dosage for the efficacy of the exercise did not report clearly.

The thoracic spine and thoracic cage are essential for preserving general spinal well-being, shoulder mobility, and respiratory effectiveness. Limited mobility in this region can lead to various issues, including poor posture and restricted breathing. The horizontal chest expansion exercise, combined with mindful breathing, offers a targeted approach to enhance thoracic mobility, promoting flexibility and strength in the upper body. According to a study in Korea, chest expansion exercise improve respiratory functions such as Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV) in post stroke patients, in addition there is a significant improvement in the chest expansion(S.-J. Park et al., 2017). The horizontal chest expansion exercise is specifically designed to target the thoracic spine and surrounding musculature. Its primary mechanisms of action include expansion of chest, the movement involves controlled stretching and opening of the chest. This action encourages increased flexibility in the thoracic spine by reducing the stiffness. In addition, it helps to activate the surrounding musculature such as rhomboids, serratus anterior, and trapezius, which play crucial roles in stabilizing and supporting the thoracic spine. Strengthening these muscles contributes to better postural alignment and reduced strain on the spine. Horizontal chest expansion exercises are performed with combination of breathing which increase the oxygen intake which helps to relax the accessory muscles and reduce the tension in upper back. Deep inhalation and exhalation during the exercise facilitate relaxation and reduce tension in the muscles surrounding the thoracic spine. This mindful breathing approach promotes stress reduction, which is often linked to UBP. Effectiveness of horizontal chest expansion in the reduction of thoracic spine pain is not statistically tested or measured through experimental studies.

Cross arm chest expansion exercise in combination of breathing improves mobility and flexibility in the upper back area through rotational movement. By crossing the arms and rotating the upper body, the exercise encourages better posture which can be beneficial for individuals who spend extended periods in sedentary positions such as sitting for a prolonged time (Heneghan et al., 2018). When performing the cross arm chest expansion, it encourages the thoracic extension which involves active opening of chest and upper back region. When the thoracic spine (upper and middle back) is properly extended, it reduces strain on the surrounding muscles and ligaments, promoting a more neutral spine alignment (Norris, 2008). When combined breathing, it promotes relaxation and help release tension in muscles and improve thoracic mobility by engaging intercostal and diaphragm.

Orientation of superior facet joints in the thoracic region limits the rotation and movements when compared to the vertebras in cervical and lumbar region (Middleditch & Oliver, 2005). Superior facets in thoracic region oriented backward, upward and lateral and angled at 60 degree to the transverse plane and 20 degree to the frontal plane which limits the flexion, extension and rotation when compared to other regions (Middleditch & Oliver, 2005). When a person in prolonged sitting position or bad posture, further limits the movement in thoracic spine and leads to stiffness of thoracic spine and limits the mobility in thoracic cage which reduce the respiratory function (Takatalo et al., 2020). Cross arm chest expansion exercise facilitates the rotation of spine and reduce the stiffness. Effectiveness of cross arm chest expansion exercise in reducing UBP, mobility and improving strength of extensor musculature is not statistically tested. Experimental studies related to proper thoracic mobility exercises and its effectiveness in thoracic mobility has to be tested statistically.

1.2 JUSTIFICATION OF THE STUDY

According to available literature, mechanical UBP is highly prevalent among adults who spent long hours in working or studying with prolonged poor sitting posture. The thoracic spine region plays a crucial role in overall spinal function and limitations in its mobility can contribute to UBP. There is a necessity of exploring the actual cause and therapeutic techniques in reducing UBP because the there is a scarcity of available literature which addressing the effectiveness of available therapeutic techniques. Mechanical UBP can adversely affect the quality of life, daily activities, and academic performance of students. Chronic pain may lead to decreased concentration, impaired study habits, and reduced overall well-being. Evidence reported that high incidence of UBP among high school students (Akulwar-Tajane et al., 2021). However, in the Sri Lankan context prevalence of UBP isn't reported even though it was highly reported in the clinical settings among young adults.

Prevalence of musculoskeletal pain among undergraduates in Sri Lanka depicts a significant increase after the COVID-19 due to increase screen time, sitting in long time lecture hours for nearly seven hours and increase of academic work load (Patterson and Warnakulasuriya, 2022). In Sri Lankan context, undergraduates and their academic performance is a significant factor in economic and social development of the country. Smart phone addition, academic workload and stress are the main contributing factors for musculoskeletal problems among undergraduates in Sri Lanka which leads to poor academic performance (Lasanthika & Hettiaratchi, 2022). It act as a vicious cycle in increase UBP among undergraduates.

Addressing the issue of mechanical UBP among undergraduates in Sri Lanka requires a holistic approach that combines proper ergonomic guidance and targeted exercises. This not only aims to alleviate immediate discomfort but also holds the potential to enhance academic performance and contribute to the long-term well-being and success of students in their future endeavors. Proper ergonomic guidance is a fundamental aspect of preventing and managing UBP. Many undergraduates spend extended hours sitting at desks, often adopting poor postures that can strain the thoracic spine and contribute to discomfort. Ergonomic recommendations focus on optimizing the workspace, chair, and computer setup to promote neutral spine alignment, reducing the risk of musculoskeletal issues. Incorporating ergonomic practices can significantly alleviate mechanical UBP by addressing its root causes. In conjunction with ergonomic adjustments, targeted exercises are critically important in improving thoracic mobility and reducing UBP. The thoracic spine is particularly susceptible to stiffness and limited mobility, especially in sedentary individuals. Introducing specific exercises that promote thoracic extension, rotation, and flexibility can contribute to the restoration of optimal spinal function. Moreover, incorporating breathing exercises alongside thoracic mobility exercises can enhance the overall effectiveness of the intervention. Deep breaths engage the diaphragm and intercostal muscles, promoting relaxation and improved rib cage movement, which is integral to thoracic mobility.

Despite the prevalence of UBP among undergraduates, there is a noticeable scarcity of research on this topic in the Sri Lankan context. Understanding the prevalence and effective physiotherapy treatments is crucial for developing evidence-based interventions tailored to the local population. The rise in screening and stress levels among students emphasizes the need for accessible and effective solutions. Scientifically evaluating the effectiveness of different therapeutic approaches, such as ergonomic guidance, thoracic mobility exercises, and manual therapy, is essential for providing informed recommendations to healthcare practitioners and policymakers. In clinical settings, there is emerging evidence that thoracic mobility exercises combined with breathing techniques yield significant improvements in UBP compared to manual therapy alone. This highlights the importance of scientific scrutiny in determining the most effective interventions. As a researcher, conducting a rigorous investigation into the comparative effectiveness of these therapies will contribute valuable insights to the field, guiding healthcare professionals in offering evidence-based treatments for mechanical UBP. Addressing mechanical UBP among undergraduates in Sri Lanka requires a multifaceted approach that includes ergonomic adjustments and targeted exercises. The lack of research in this domain highlights the significance of conducting scientific investigations to establish interventions based on evidence. The potential advantages go beyond alleviating pain, influencing academic performance and the holistic wellness of students, thereby shaping their future achievements.

1.3 HYPOTHESIS

Hypothesis about difference in baseline characteristics of participants between control and experimental groups

Null Hypothesis:,

H_0: μ_1 - μ_2 = 0, where there is no difference in between thoracic mobility exercise group and manual release technique group.

Alternate Hypothesis:

H_a: μ_1 - $\mu_2 \neq 0$, where is a difference in between thoracic mobility exercise group and manual release technique group

H0 : Null Hypothesis

Ha: Alternate Hypothesis

µ1: Mean of outcome measures of thoracic mobility exercise group (Experimental Group)

µ2: Mean of outcome measures of Manual release technique group (Control Group)

1.4 LITERATURE REVIEW

Upper Back Pain is a under research concept in literature. N.R. Heneghan et al in 2015, refers thoracic spine region as "Cinderella" region in his study, due to its lesser research focus on aetiology and epidemiology which has a strong connection to other clinical presentation of musculoskeletal disorders (Peek et al., 2015). Few evidences refer that pain between two shoulder blades can be considered as UBP (Brox, 2003; Sergienko & Kalichman, 2015). According to a systematic review conducted in 2009, summarized that life time prevalence of UBP among all type of occupational groups ranged from 3.7 to 77%. Further, a study conducted by N fouquet at el in 2015 among 1370 workers, reported that 1 in 10 men and 1 in 5 women suffered with thoracic spine pain which is commonly prevailed among white collar workers (Fouquet et al., 2015). Moreover, Health professionals reported the highest lifetime prevalence which was 77%. Prevalence of UBP among high school students is high, a study conducted among Finnish high school students depicts 17% reported disturbing symptoms in the neck, upper back and shoulder (Niemi et al., 1997). Further a study conducted in Saudi Arabia among undergraduates who are following dentistry complained about neck pain (69.2%) followed by shoulder (67.1%) and UBP (46.9%) (Felemban et al., 2021). Studies conducted among undergraduates who were studying in health discipline depicts a high prevalence of TSP, ranging from 13–39% (Inder, 2020). A cohort study conducted in Sweden, reported that 15% university students complained one year prevalence of neck and thoracic pain (Boström et al., 2008). Further, a study conducted among 684 undergraduates at Thammasat University in Thailand showed a incidence rate of 27% of thoracic spine pain and 23% of undergraduates showed a persistent of symptoms (Kanchanomai et al., 2013).

Worldwide literature suggest that, there are variety of causes for UBP. Long term screening which includes smartphone and laptop usage exaggerating this condition among young population (Shete and Shah, 2019; Puntumetakul et al., 2022). In addition to that, mental health factors like academic and personal stressors and physical inactivity significantly influence this condition among high school or undergraduate students (Shan et al., 2013). Further, it was increased after the COVID-19 pandemic due to online learning (Amro et al., 2020; Leirós-Rodríguez et al., 2020; Akulwar-Tajane et al., 2021; Elghomati et al., 2022). According to a study conducted in Malaysia, Undergraduates experiencing musculoskeletal pain due to academic stressors, environmental factors as well as personal factors associated with UBP (Harithasan et al., 2022). Worldwide, Little evidences assessed about the risk factors related to UBP in general population as well as youngsters and undergraduates.

Lack of investigations about proper treatment for UBP in literature. A systematic review on “The effectiveness of non-invasive interventions for musculoskeletal thoracic spine and chest wall pain” depicts about lack of quality studies regarding number of physical therapy management regarding musculoskeletal thoracic pain. Further, this study shows that, multimodal program includes manual therapy, heat or advice and exercise clinically not important pain reduction like spinal manipulation (Southerst et al., 2015). According to a comparative study conducted by Mary.S Pesco et al in 2006, among 24 subjects including 12 students reported that hand on exercise therapy showed a significant improvement in UBP in addition, physiological understanding of this pain and awareness to correct poor posture is crucial in reduction of incidence of pain (Pesco et al., 2006). A case study reported in 2006 depicts a patient suffered with TSP for 4 months showed a significant improvement in pain and restoration of function through interventions including costovertebral and costotransverse joint mobilization and tigger point release techniques(Fruth, 2006).

According to literature Joint mobilization is significantly improve pain, discomfort and function when compared to manipulation (Gross et al., 2010). However few literature shows equivalent efficiency in those two techniques (Bronfort et al., 2004). A study conducted by Junchul Cho et al in 2017 among participants with forward head posture reported that thoracic joint mobilization combination with mobility exercise showed a significant improvement in pain, Cranio-Vertebral angle and Neck Disability Index than upper cervical mobilization (Cho et al., 2017). Further, numerous studies reported there is a significant improvement in chronic neck pain through thoracic joint mobilization techniques (Hwangbo et al., 2014; Jun et al., 2015; K.-S. Lee & Lee, 2017; J. Yang et al., 2015).

Another, effective exercises mentioned in literature was thoracic mobility exercise. According to the available literature, thoracic mobility exercises showed a significant improvement in neck pain (Ko et al., 2010). In addition, thoracic mobility exercises reported significant improvement in respiratory function (Ekstrum et al., 2009). It aims to enhance the flexibility, strength, and alignment of the spine, while the incorporation of controlled breathing can further aid in relaxation, stress reduction, and improved movement patterns (Csepregi et al., 2022). Thoracic mobility exercises reported wide range of benefits such as reducing pain level in chronic low back pain by improving lumbar spine stability(Divya et al., 2021).

Additionally trigger point release technique was found effecting reducing pain in back. Few studies reported that myofascial release technique is an adjunct therapy in improving chronic low back pain (Chen et al., 2021). However, there is a growing body of research on various manual therapy interventions, including thoracic mobilization, it's important to note that the evidence on the effectiveness of these techniques for UBP is little known when compared to other part of the spine.

1.5 OPERATIONAL DEFINITIONS

Upper Back Pain (UBP): Discomfort or pain experienced in the region of the spine between the first thoracic vertebra (T1) and the twelfth thoracic vertebra (T12).

Thoracic Mobility Exercises: A set of exercises designed to increase the flexibility and range of motion in the thoracic spine. Exercises include thoracic extensions, rotations, and other movements aimed at enhancing thoracic mobility, performed in combination with specific breathing techniques.

Manual Release Technique: Hands-on therapeutic techniques used by physiotherapists to relieve muscle tension and improve thoracic spine mobility it includes thoracic mobilization techniques and myofascial release techniques.

Pain Intensity: The level of discomfort or pain experienced by participants in any region.

Self-Efficacy: The belief in one's ability to manage and perform activities related to pain management.

CHAPTER II

RESEARCH METHODOLOGY

2.1 Conceptual Framework:

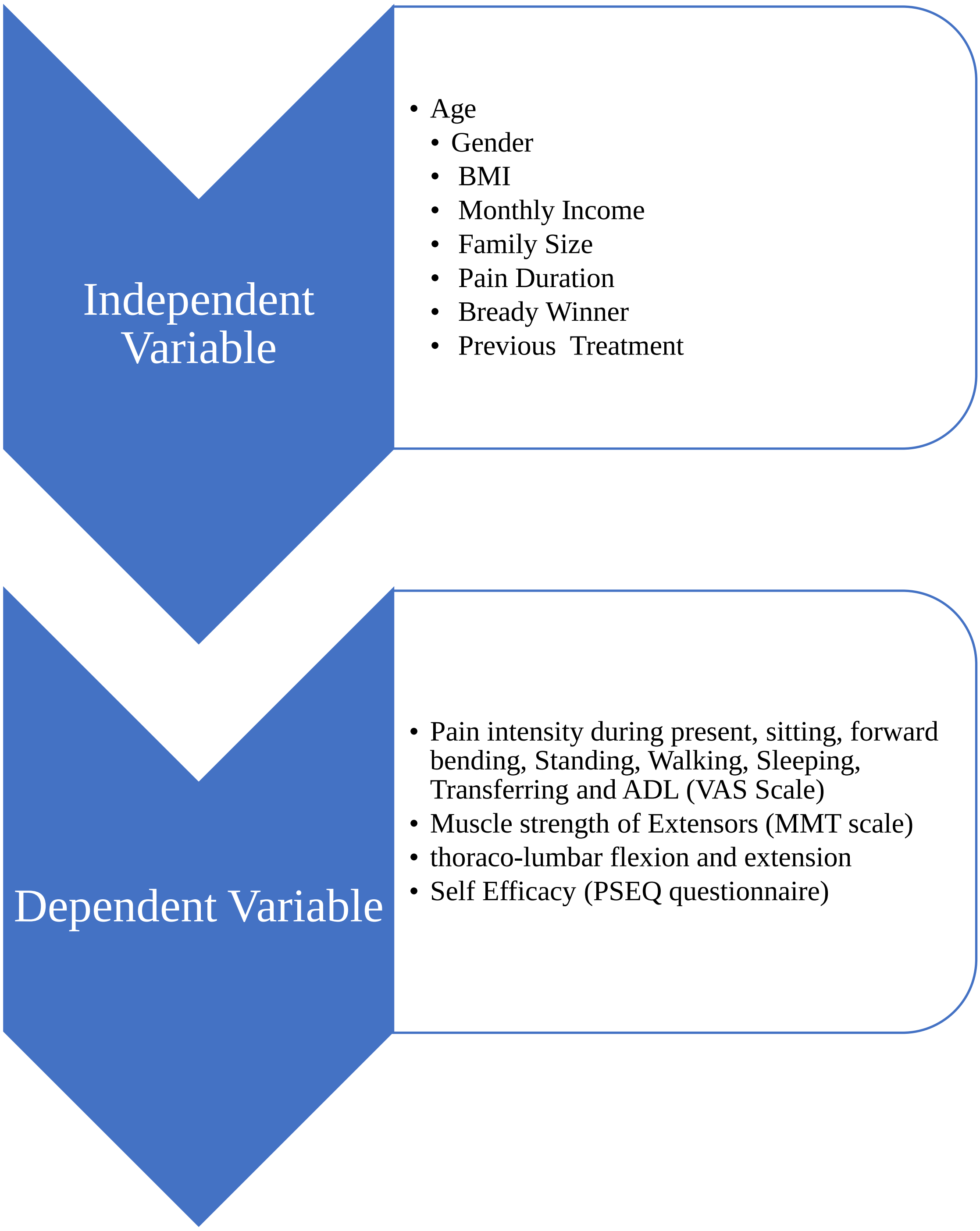


Figure 2.1: Conceptual Framework

2.2 Objectives:

2.2.1 General Objective:

To find out the effectiveness thoracic mobility exercise compared with manual release technique in minimizing UBP

2.2.2 Specific Objective: -

- To evaluate correlation between the sociodemographic factors and pain intensity of participants in experimental and control group.
- To evaluate the effectiveness of thoracic mobility exercise and manual release technique in improving UBP intensity
- To evaluate the effectiveness of thoracic mobility exercise and manual release technique in improving upper thoracic mobility
- To evaluate the effectiveness of thoracic mobility exercise and manual release technique in improving trunk upper back muscle strength
- To evaluate the effectiveness of thoracic mobility exercise and manual release technique in improving disability

2.3 Study Design:

The study in question adopts a robust Randomized Controlled Trial (RCT) design, which is considered the gold standard in clinical research, with the additional feature of double-blinding. Double-blinding ensures that both the assessors evaluating outcomes and the participants receiving treatment remain unaware of who belongs to which treatment group, safeguarding against potential biases. Notably, the accessors were kept unaware of participants' treatment group assignments, ensuring impartiality in outcome assessment. Simultaneously, participants remained oblivious to their group allocation, preventing any behavioral changes or placebo effects that could confound the results. The study's registration on the National Library of Medicine's ClinicalTrials.gov platform (Protocol ID: NCT06340542, Link address: https://classic.clinicaltrials.gov/ct2/show/NCT06340542) adds a layer of transparency and credibility, providing a detailed record of the study's objectives and methodology for public scrutiny.

The allocation of participants via a lottery method further enhances the study's robustness to minimize the selection bias. Baseline data was collected from the participants at the beginning of the treatment and before the allocation in to groups. Each participants were provided with treatment for two weeks. Accessors were unware about the treatment procedure. Overall, the meticulous design of this study underscores its commitment to rigorous methodology, transparency, and the generation of reliable evidence in the field of clinical research.

2.4 Study Problem:

Upper back pain (UBP) in the thoracic spine (T1-T12) is a common issue among young people, especially undergraduates, due to poor ergonomics, academic workloads, and stress. Despite its prevalence, UBP is under-researched, leaving a gap in effective therapeutic techniques. This study addresses this gap by comparing thoracic mobility exercises with breathing techniques to manual release techniques in improving pain intensity, muscle strength, thoracic spine mobility, and self-efficacy among undergraduates.

2.5 Study Population:

Undergraduates who are currently studying in state universities in Sri Lanka and those who were currently having upper back pain for more than seven days was selected as sample. Participants who have sub-acute and chronic pain in the area of upper back which means who have pain more than a week or seven days will be selected as sample and who have subjected to any recent surgeries, recent fractures, accidents or injuries in upper back will be excluded from the study. Undergraduates who are currently studying in state universities of Sri Lanka was selected as sample. Age of the participants between 20 to 26 years.

2.6 Study Site:

Study was conducted in Service Unit and Therapeutic Gymnasium of Department of Physiotherapy, University of Peradeniya. Service Unit and Therapeutic gymnasium was designed to provide physiotherapy treatment for university students and outsiders. Rooms are air conditioned with ambient temperature between 25 degree to 28 degree Celsius to increase the participant comfort. Service Unit was designed according to the clinical set up with necessary equipment for physiotherapy treatment delivery with adjustable bed for treatment delivery and manual therapy as well as exercise therapy. Manual therapy was delivered to patients in adjustable treatment bed in service unit. Therapeutic gymnasium was used to deliver exercise therapy for participants which floor is not slippery and modified according for therapy delivery. Participants can able to perform exercise in the floor by using Exercise mat.

2.7 Study Period:

Study was started with proposal development from october 2023 and continued for six months. Data collection was lasted for nearly 3 months. Total study period for nearly 2 years.

2.8 Sampling Method:

The Random sampling method employed in this study. After they screen for inclusion and exclusion criteria, they have undergone a randomization through lottery method by numbering participant IDs from 001 to 060 and concealing them in folded sheets, researchers ensure randomness in allocation while maintaining blinding, thereby preventing any potential bias in group assignment. This approach minimizes the risk of systematic errors and enhances the study's internal validity.

Furthermore, the allocation strategy of assigning two individuals to select sheet for two participants and they will allocate randomly either to control or experiment group. This balanced representation across groups helps to mitigate the influence of any confounding variables that may affect the outcomes differently in each group. It also aids in the comparability of results between the two intervention groups. Overall, this meticulous approach to participant allocation not only upholds the principles of randomization and blinding but also contributes to the study's methodological rigor. By minimizing selection bias and ensuring balanced representation, researchers can have greater confidence in the validity and generalizability of their findings.

2.9 Sample Size and calculations:

The sample size determination process was conducted using G*power 3.1.9.4 software, which is a widely used tool for statistical power analysis. Key parameters were set to ensure the study's robustness and reliability. These included an 80% power level, which indicates the probability of detecting an effect if it truly exists, an effect size of 0.5, representing the magnitude of the difference being investigated, and a type I error rate (α) of 0.05, which signifies the acceptable level of false positives. Additionally, a type II error rate (β) of 0.2 was specified, indicating the acceptable level of false negatives.

Based on these parameters, the software initially calculated a sample size of 42 participants. However, recognizing the potential for participant attrition or dropout, a dropout rate of 25% was factored into the calculation. Consequently, the final sample size was adjusted upward to 60 participants to mitigate the impact of potential dropout on the study's statistical power. This adjustment ensures that the study remains adequately powered to detect meaningful effects while accounting for the possibility of data loss due to participant attrition. By increasing the sample size to 60, the study aims to maintain sufficient statistical power, thereby enhancing the validity and reliability of its findings. During treatment session 3 participants were left the research. Therefore, total sample size was 57 which is higher than the actual sample size. Therefore, validity and reliability of the study is high. This meticulous approach to sample size determination strengthens the study's ability to draw meaningful conclusions and contributes to the overall rigor of the research endeavor.

2.10 Inclusion and exclusion criteria:

2.10.1 Inclusion criteria

- Partcipants who gave consent to participate in this study
- Partcipants who have pain more than 7 days (acute and subacute pain)
- Particpants who did not have any recent pain or trauma in back area or associated with back pain

2.10.2 Exclusion criteria

- Partcipants who underwent recent surgeries in back or chest areas
- Partcipants who experienced recent accidents which associated with back
- Participants who have any congenital abnormalities related to back/spine
- Participants who are currently in medications or anestheics for chronic conditions were excluded from the study

2.11 Data collection method:

Firstly, Participants were screened according to inclusion and exclusion criteria. After that, consent was obtained by participants to participate in the study. Later, Participants were undergone a randomization procedure through lottery method by assigning number from 001 to 060. Participants who were assigned to either experimental or control group. Data was collected from the participants at baseline and after two weeks of treatment session. Informed consent form was administered to the participants to obtain the consent for the participation in research. After the participant’s consent, baseline data was collected by administering a pre-test questionnaire. Demographic data and pain related questions were filled by participants with the help of accessors. In next two section, thoraco-lumbar flexion, extension and muscle strength of extensors were measured by accessor. Last section which includes Pain Self Efficacy Questionnaire (PSEQ) was filled by the participants. After the base line information, participants was allocated to the groups by lottery method. Treatments were provided by two therapist in each groups for 3 times a week for two weeks. After completion of treatment session, participants were measured for post- test data by administering 4 session of questionnaire with the same set of questions and thoraco lumbar flexion, extension and muscle strength were measured by accessor.

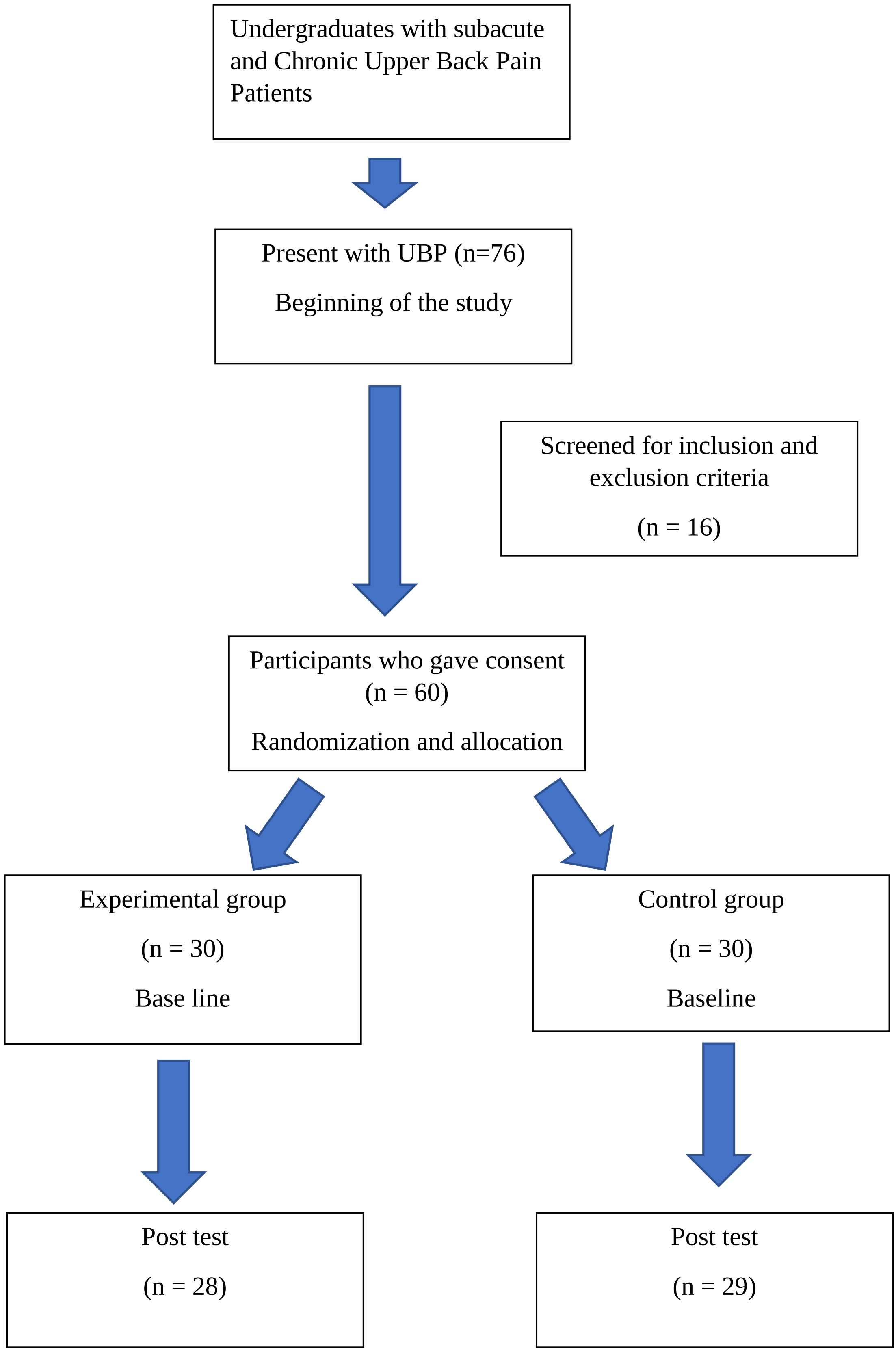


Figure 2.2 : Flow chart of patients allocated by randomization and follow up

2.12 Data collection tool:

Measurement tool contains two sections such as pre-test and post-test questionnaire. In Pre-test questionnaire, there are six sections which includes personal details of the participants, pain related questions, Measurement of range of motion at base line, muscle strength at base line and pain-self-efficacy Questionnaire (PSEQ) at base line. In Post-test questionnaire, there are 4 sections which include, pain related questions mainly pain intensity after two weeks, muscle strength after two weeks, Range of motion after two weeks and pain-self-efficacy Questionnaire (PSEQ).

Demographic Details:

In the first section of the questionnaire (pre-test), demographic details such as age, gender, Height, weight, BMI, Monthly income, family size, bread winner and financial support of the family and how long they are experiencing the pain duration. These are considered as responsible factors which could impact in the intensity of UBP.

Visual Anolog Scale (VAS):

VAS scale will be used to measure the intensity of pain in different situations which include present pain intensity, in sitting, in forward bending, in standing, in walking, in sleeping, in transferring and during day to day activities. According to the review conducted by MR begum et al in 2019, indicated that VAS scale has high validity and reliability in most of the studies for pain measurement (Begum & Hossain, 2019). Visual Analogue Scale was used to measure the pain intensity. Subjects will be asked to mark the number between 0 and 10 that fits best to their pain intensity. Zero indicates ‘no pain at all’ whereas 10 represents ‘the worst pain ever possible’. Measurement will be obtained in the baseline and at the end of two weeks (figure 2).

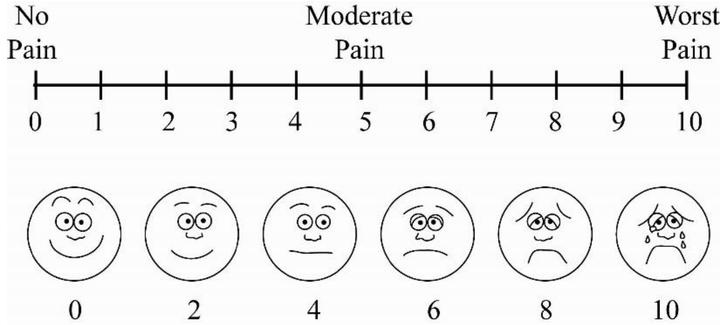


Figure 2.3: VAS Scale

Tape measurement of Thoraco-Lumbar flexion and Extension:

Thoraco lumbar flexion and extension was measured using tape performed by placing the tape ends on C7 and S1 during standing in normal position, forward and backward bending. Differences between those measurements was taken.

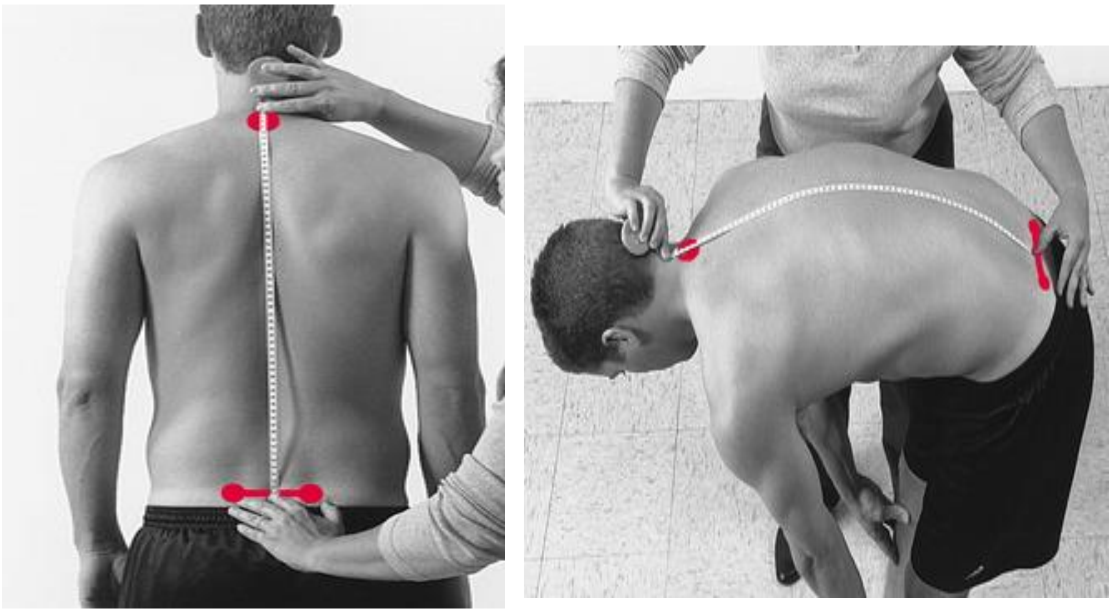


Figure 2.4 Measurement of Thoraco-lumbar flexion

Figure 2.5 Measurement of Thoraco-lumbar extension

Thoraco-Lumbar flexion and Extension of thoracic spine Range of Motion was taken in the fourth section. Measurement was taken by using measuring tape. Measurement was taken at the baseline and after two weeks. For this measurement, the reference book named as “Measurement of Joint Measurement – A guide to Goniometry” third edition which was written by Cynthia C. Norkin was used (Nokin et al., 2019). According to this book, 6-7.5cm and 4 – 5cm found as a average measurement of thoraco – lumbar flexion and thoraco-lumbar extension for the adults (Nokin et al., 2019).

Manual Muscle Test – Oxford grading Scale

Muscle strength of thoracic spine extensors was measured using Oxford-Grading Scale. Oxford Muscle Scale is a numerical rating scale used to quantify the power or strength produced by the contraction of a muscle. The scale was originally developed by a UK government research group called the Medical Research Council (MRC). Reliability of the scale explained by Intraclass Correlation Coefficient (ICC) and Interrator Reliability. It shows high ICC coefficient of 0.95 (ranging from 0.92 to 0.97) (Hermans et al., 2012).

Pain Self-Efficacy Questionnaire (PSEQ)

IThe Pain Self-Efficacy Questionnaire (PSEQ) is a 10-item questionnaire developed to assess the confidence people with ongoing pain have in performing activities in daily life while in pain. The PSEQ has high internal consistency (0.92 Cronbach's alpha) and test-retest reliability is high of a 3-month period. Total score of PSEQ is 60, average score more than 30 high level of self-efficacy and less than 30 depicts low level of self – efficacy.

2.13 Interventions:

Two types of interventions administered to the participants which are Thoracic mobility exercises and manual release technique. Experimental group receives thoracic mobility exercises which include cat and camel exercise, cross arm chest expansion and horizontal arm chest expansion with for 3 time a week for 2 weeks (detailed method of application in Annex II). Control group receives manual release technique for 3 times a week for 2 weeks which include thoracic mobilization technique and myofascial release technique. (detailed method of application in Annex II)

2.14 Quality assurance and quality control

Quality control and quality assurance was maintained by selecting participants as strictly adherence to the proposed criteria. In addition to that, all the data collection tool used in this study was selected according to the high reliability and validity that was tested in previous literatures.

Information of all the participants were numbered according to the order of participation and entered, and stored in a computer according to the numbering. All these entered data are kept in a locked folder as no one can access except the principal investigator.

2.15 Ethical consideration:

Ethical approval was obtained from the Institutional Review Board of Bangladesh Health Professional Institute (Ref: CRP-BHPI/IRB/10/2023/734). Written informed consent was obtained from all the subjects who are willing to participate in the study. Participants were assessed in for baseline and after treatment session after obtained consent. Assessment and treatment section were done in a closed cabin with curtains and treatment was given to each participants in gender based which means female therapist provide treatment for female participants to avoid unnecessary discomfort. Therapists who administered the treatment session was registered in Sri Lankan Medical Council to avoid legal issues and enhance the efficiency of the treatment. Participation in this research is entirely voluntary basis and the participants have the right to withdraw from the study at any time.

2.16 Informed consent:

Participants were consented after being assessed for eligibility criteria. Written consent was obtained after providing the declaration whether there is no harm in the treatment and assessment. Declaration about confidentiality for personal data and patient's health details was ensured in consent form. Further, withdrawal and privacy policy during treatment session was clearly stated in the form. Consent form is annexed at the end of thesis (ANNEX - I)

CHAPTER III

RESULTS

3.1 Sociodemographic factors

Participants' selection: Undergraduates who are having acute and chronic UBP was selected as samples 60 samples selected. Three participants have left the study during the treatment period. Therefore total sample size was 57. Participants are randomly allocated to the treatment (n=28) and control (n=29) group. Overall demographic details of participants who are allocated to each experimental and control group are provided in the table 3 below.

Table 3.1 Demographic details of participants (overall)

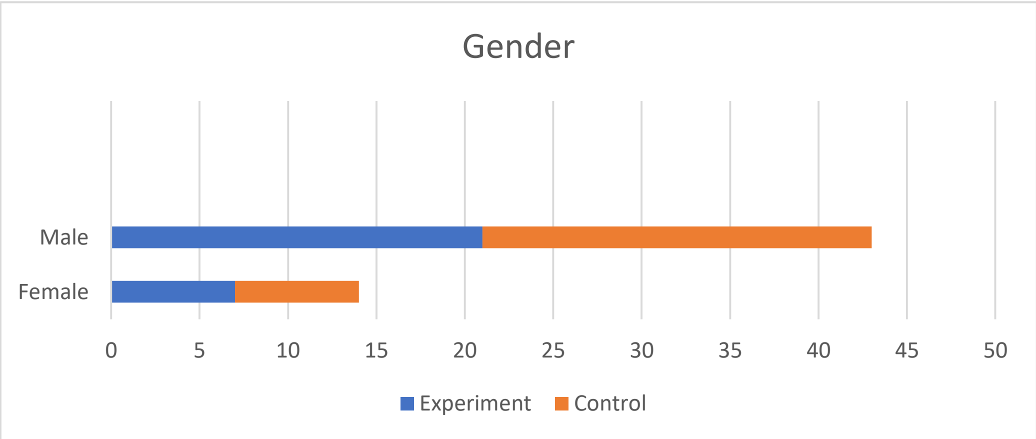
	Mean		**Percentage (%)**	
	Experiment	Control	Experiment	Control
Age	22.61 ± 1.892	22.14 ± 1.597		
BMI	21.289 ± 3.144	20.695 ± 3.611		
Monthly Income	47 928.57 ± 22835.53	64 896 ± 70 111.821		
Pain Duration	10.18 ± 12.681	8.97 ± 10.016		
Family size				
2			1.8	0
3			5.3	7
4			26.3	22.8
5			10.5	14
6			3.5	1.8
7			0	5.3
8			1.8	0
Bread Winner				

Father	42.1	31.6
Mother	3.6	3.6
Siblings	1.8	3.6
Parents (Both)	1.8	10.5
Relations	0	1.8
Financial support		
Father	33.3	29.8
Mother	1.8	3.6
Parents (Both)	7.2	7.2
Family	1.8	3.6
Sibilings	5.4	7.2
Previous treatment		
Oilment/ local anesthesia/ medication	10.8	9
Consult a doctor	3.6	0
Exercise	0	1.8
No	35.1	40.4

According to the demographic characteristics of participants, mean of particpants is nearly equal to 22 with the acceptable BMI range according to the south Asian BMI range which is between 18.5 – 24.9 kg/m^2 (Ansari et al., 2021). Monthly income of the participants' family in each group was nearly between 48 000 to 64 000 rupees which is quite lower than average monthly income of a Sri Lankan Family that was nearly Rs 76, 000/- according to 2019 statistics. Father is the breadwinner (73.7%%) and main financial support of the family of the participants. Most of the participants' family have family members of four to five numbers which is 49.1% and least of them have 2 members which is 1.8%. Further, in most of the participants' family father is the breadwinner and financial contribution of father is high which is nearly equal to 63.2%

and in some families all members contributing financially which is nearly 5.3%. Subacute and chronic pain participants were selected in this study. However, average pain duration of the participants in experimental and control group nearly equal to 10 and 9 months respectively. It symbolizes that most of the participants have chronic UBP. Even though, 75% of participants did not undergo any medical treatment. Only 3% of participants consult physician or doctor for the treatment and 19.2% of participants apply local anaesthesia as ailment or tablet to get rid of pain. Only 1 participant aware about the exercise.

According to the collected data, there are 43 (75.4%) males and 14 (24.6%) females among the total participants. Number of females and males among each group are shown in the graph given below (graph 3.1). Each group contains female and male in 1:1 ratio to maintain the equality between groups.



Graph 3.1 Gender in each groups

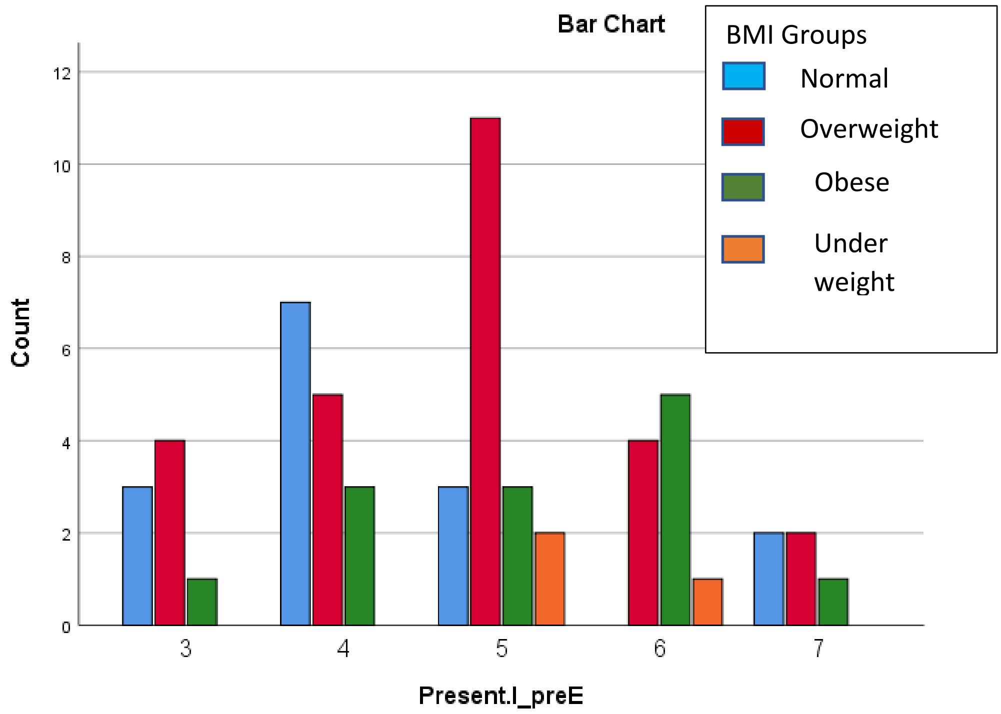
3.2 Association between pain intensity and sociodemographic factors

Table 3.2 correlation between demographic characteristics and pain intensity

Demographic factors	P value
Age	0.598
Gender	0.352
BMI	0.006*
Family size	0.462
Monthly income	0.791
Breadwinner	0.490
Pain Duration	0.247
***significant correlation**	

Statistical analysis was performed by using IBM SPSS version 26.0. Pain intensity level was measured by using VAS scale for each participants. Spearman rank correlation was used to find the contributing factors for UBP by taking significant value as 0.05 ($\alpha = 0.05$). It is a non-parametric measure of correlation. When dealing with ordinal data (like VAS scores) and categorical or continuous variables (like age, BMI, income, etc.), Spearman's rank correlation coefficient is often preferred because it doesn't require assumptions about the distribution of the data. If obtained p value is less or equal to 0.05 depicts the significant correlation ($\alpha <= 0.05$). Significant value which was obtained during spearman rank correlation was given in table 5.

According to the test, BMI only show the significant correlation with pain intensity. Other demographic factors did not show any association with pain intensity. There is a increase of tendency of upper back pain among the participants who were in the overweight category which is between 22.5 to 26.9 kg/m^2. Barchart given below shows the pattern between BMI and participants Present pain level.



Graph 3.2 Tendency of Pain intensity among different BMI groups

According to the barchart, given above depicts that there is an increase tendency of pain intensity in VAS Scale among participants who were belong to overweight (22.5 – 26.9kg/m2) and obese (>= 27 kg/m2) category. BMI was categorized according to the south Asian picture.

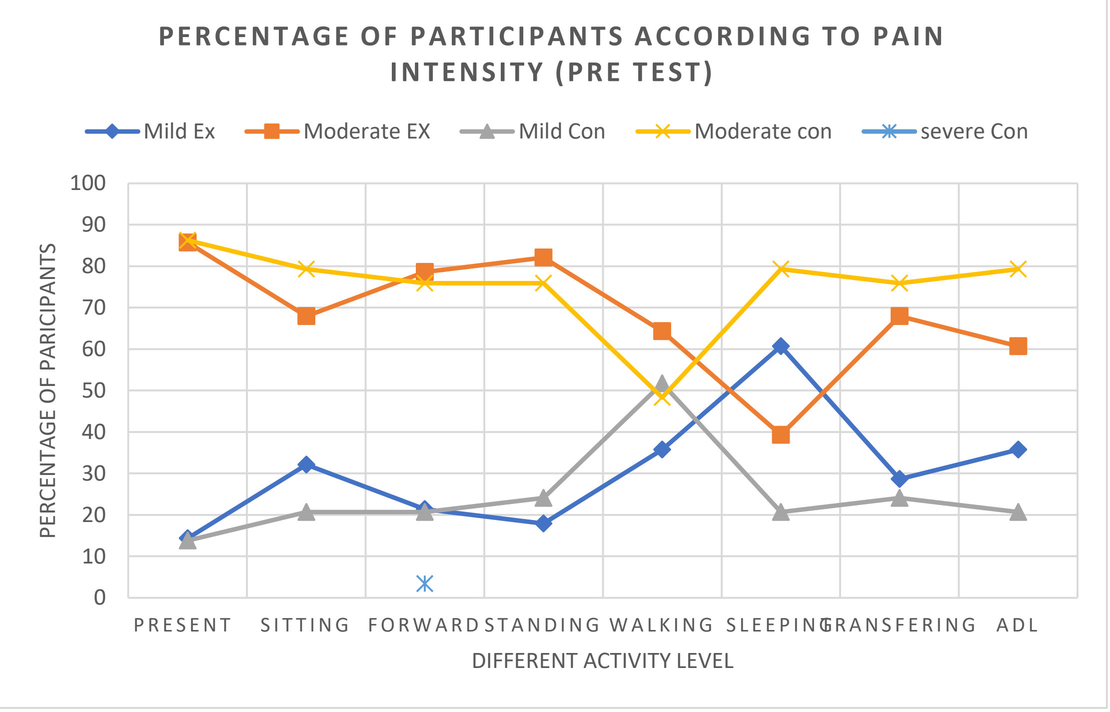
3.3 Comparison between experiment and treatment group at the baseline and after the intervention:

To compare the both group at the baseline and after intervention for each parameters, non-parametric test was used. Pain intensity (VAS sacle), thoracic mobility, muscle strength and PSEQ scale for disability are the variables were compared at the baseline and after intervention.

3.3.1 Pain intensity:

Comparison between the group (Baseline):

Pain intensity in VAS scale was categorized in to three categories such as mild, moderate and severe pain. According to the study conducted in 2014 by AM Boonstra et al, indicate that measurement of chronic and subacute musculoskeletal pain in VAS can be categorized as mild pain range ≤ 3.4, moderate pain in between 3.5 to 7.4 and severe pain ≥ 7.5(Boonstra et al., 2014). Percentage of participants who belongs to mild, moderate and severe pain intensity category in experiment and control group is depicted in the graph below.



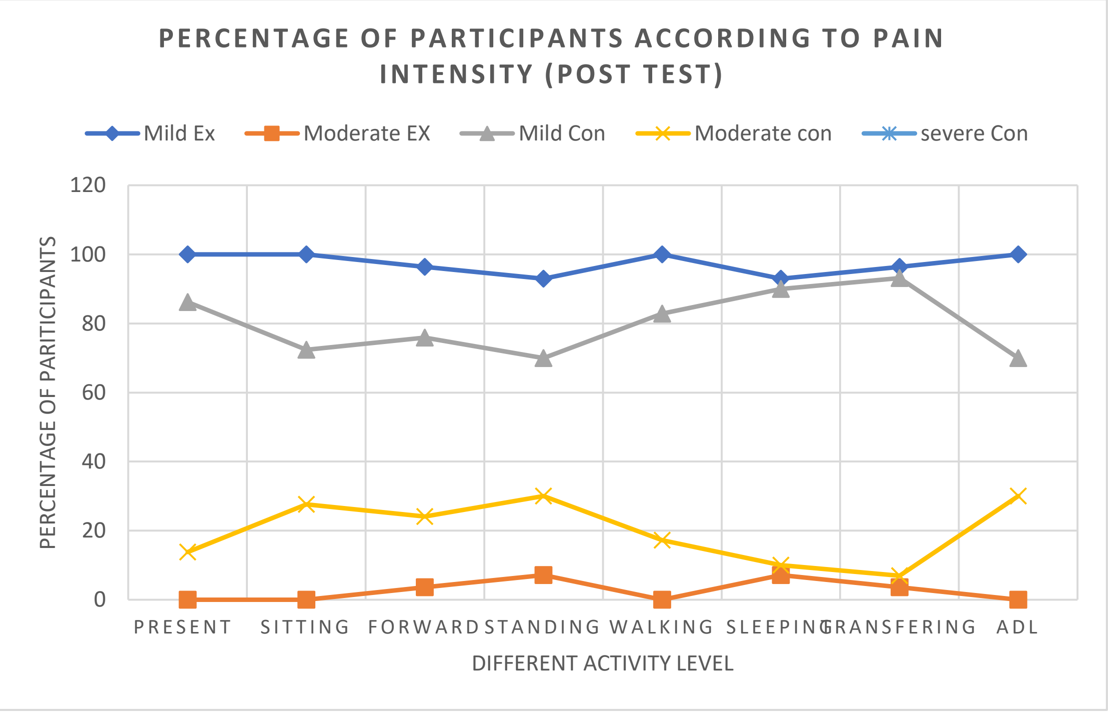
Mild Ex: Mild Pain in Experimental group; Moderate Ex: Moderate Pain in Experimental group; Mild Con: Mild pain in Control group; Moderate Con: Moderate pain in Control group; Severe Con: Severe pain in Control group

Graph 3.3: percentage of participants who belongs to mild, moderate and severe pain category in both control and experiment group in the baseline.

At the Baseline, most of the participants belong to moderate pain intensity between 3.5 to 7.4 in both groups. According to the graph 3, percentage of participants belong to moderate pain intensity level is two times than the participants belong to mild pain in each level (ratio 2:1) in both group. In contrast, during sleeping pain experienced by participants belongs to mild category which is nearly 45 - 50% in both groups. At baseline, pain pattern shows similar path way in both groups.

Comparison between the group: Post test

Graph 3.4 illustrates the percentage of participants in pain intensity level in different situations after the intervention in both groups.



Mild Ex: Mild Pain in Experimental group; Moderate Ex: Moderate Pain in Experimental group; Mild Con: Mild pain in Control group; Moderate Con: Moderate pain in Control group; Severe Con: Severe pain in Control group

Graph 3.4: percentage of participants who belongs to mild, moderate and severe pain category in both control and experiment group in the post test.

According to the graph above shows that there is a dramatically decrease in percentage of participants who belongs to moderate pain intensity level in both control and experimental group in different level of activity after the interventions. However, experimental group participants who belongs to the mild pain category is higher than the control group participants. Therefore thoracic mobility exercise and manual release technique helps to pain intensity level from moderate to mild. Even though, thoracic mobility exercise can reduce the pain intensity when compared to manual release techniques. In contrast, both groups quite similar in percentage at mild and moderate pain intensity which is nearly 85% and 10% respectively during sleeping and transferring in both group.

Even though numerical value similar pattern, it has to be tested statistically. Mann-Whitney U test was used to find the association between groups for the pain intensity at different level, because VAS scale provides rank data. Before test, hypothesis was formulated as follows

H0: experiment group and control group are similar in pain intensity at different levels

Ha : experiment group and control group are not similar in pain intensity at different levels

Statistical analysis was performed using IBM SPSS version 26.0 by assuming significant level α as 0.05 ($\alpha = 0.05$).

Table 6 depicts the p value of pain intensity of each level at baseline between groups

Table 3.3 Association between the group for pain intensity at different level (pre and post test)

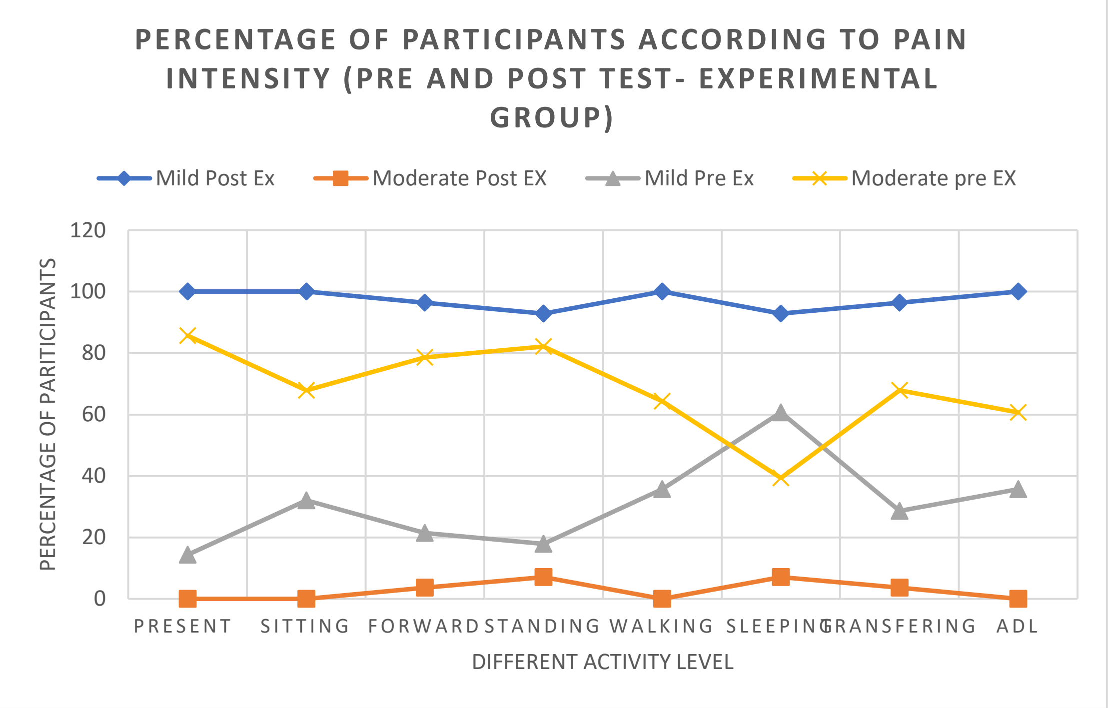
Pain intensity (VAS scale) at different levels	Association between the group: P-value (baseline)	Association between the group: P-value (Post test)
Present	0.958	0.003*
Sitting	0.331	0.006*
Forward Bending	0.759	0.012*
Standing	0.564	0.012*
walking	0.211	0.023*
Sleeping	0.498	0.083
Transferring	0.886	0.161
Activities of Daily Living (ADL)	0.320	0.043*

**significant difference*

According to the pre-test, obtained p value is higher than α ($p \geq 0.05$). Therefore, null hypothesis cannot be rejected. This implies that both groups can be equal at the baseline in terms of pain intensity at the baseline. However, in post-test p value which is obtained for pain intensity in present, sitting, forward bending, standing, walking and during ADL are less than 0.05 which depicts null hypothesis can be rejected. Therefore, experiment group shows a significant difference in pain intensity in present level, during sitting, forward bending, standing, and walking and in ADL. In contrast, p value obtained for sleeping and transferring did not show significant difference which is greater than 0.05 ($p > \alpha$) between groups.

Comparison within Experimental group:

Graph 3.5 illustrates the percentage of participants in pain intensity level in different situations before and after the thoracic mobility exercise in experimental group.



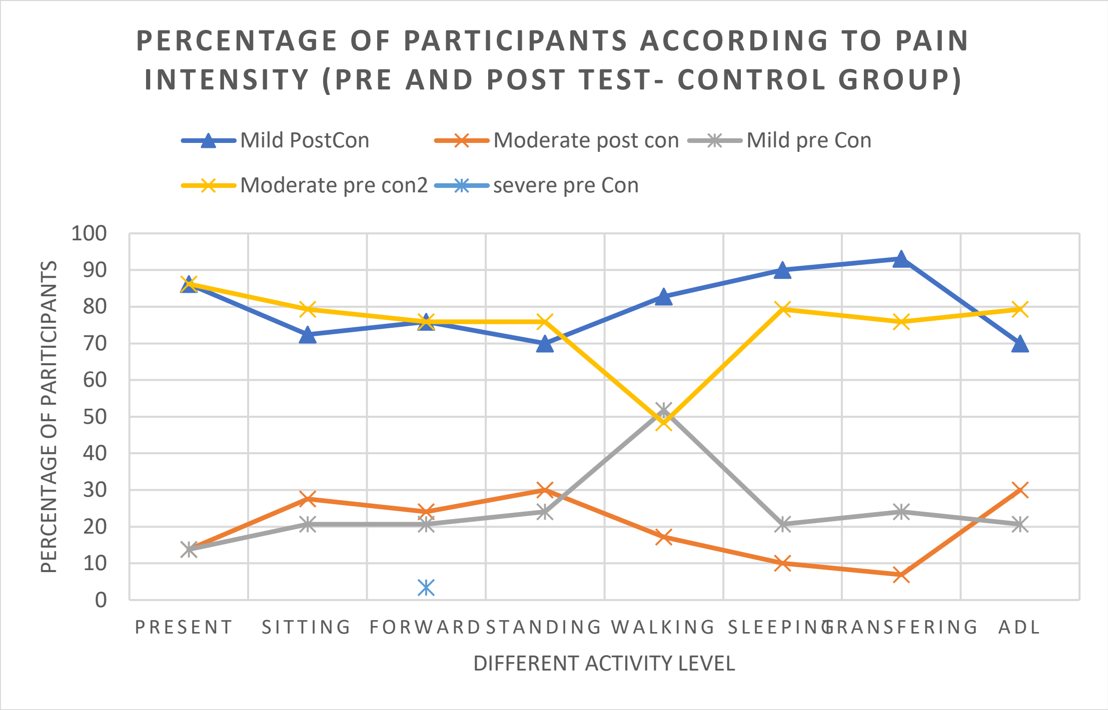
Mild Pre Ex: Mild Pain in Experimental group during pre-test; Moderate pre Ex: Moderate Pain in Experimental group during pre test; Mild post Ex: Mild Pain in Experimental group during post-test; Moderate post Ex: Moderate pain in Experimental group during post-test;

Graph 3.5: percentage of participants who belongs to mild, moderate and severe pain category during pre and post-test in experiment group.

According to the graph 5. During pre-test, participants belongs to mild pain intensity level ranges from 40% to 85%. It was increased above 90% after the intervention. Additionally, 100% of the participants belong to mild pain intensity in VAS scale during present pain intensity, sitting, walking and during ADL after the intervention in experimental group. Likewise, participants belongs to moderate pain intensity level ranges from 10 to 60%. It was decrease dramatically below 10% after the intervention.

Comparison within control group:

Graph 6 illustrates the percentage of participants in pain intensity level in different situations before and after the thoracic mobility exercise in experimental group.



Mild Pre Con: Mild Pain in Control group during pre-test; Moderate pre Con: Moderate Pain in Control group during pre test; Mild post Con: Mild Pain in Control group during post-test; Moderate post Con: Moderate pain in Control group during post-test;

Graph 3.6: percentage of participants who belongs to mild, moderate and severe pain category during pre and post-test in control group.

According to the graph 6. During pre-test, participants belongs to mild pain intensity level ranges from 15% to 50%. It was increased in a range between 70 to 92% after the intervention. Likewise, participants belongs to moderate pain intensity level ranges from 85 to 50%. It was decrease dramatically between 8% to 30% after the intervention. Therefore, there is an improvement in pain intensity level in each activity levels.

However, thoracic mobility exercise and Manual release technique showed improvement in pain in each of the group for Wilcoxon test which was performed separately for each group.

Table 3.4 Association within the group during pre and post-test for pain intensity

Pain intensity (VAS scale) at different levels	P value for pre and post-test in Experiment group	P value for pre and post-test in control group
Present	0.000*	0.05*
. Sitting	0.000*	0.02*
. Forward Bending	0.000*	0.03*
. Standing	0.001*	0.07
. walking	0.000*	0.08
. Sleeping	0.02*	0.025*
. Transferring	0.03*	0.04*
. Activities of Daily Living (ADL)	0.001*	0.000*

**significant difference*

Ho: The intervention is not effective in reducing pain intensity

Ha: The intervention is effective in reducing pain intensity

If obtained p value > α (α = 0.05), null hypothesis can be rejected. According to the obtained p value null hypothesis can be rejected in different instances like present pain, sitting, forward bending, sleeping and ADL. Therefore, it can be concluded that both intervention shows a significant improvement in pain intensity in those levels. Even though, exercise therapy shows significant improvement than manual release technique. However p value obtained for walking and standing in control group is greater than 0.05. Therefore null hypothesis cannot be rejected. It indicate that manual release technique did not show significant difference in pain intensity during standing and walking in control group.

3.3.2 Thoracic mobility:

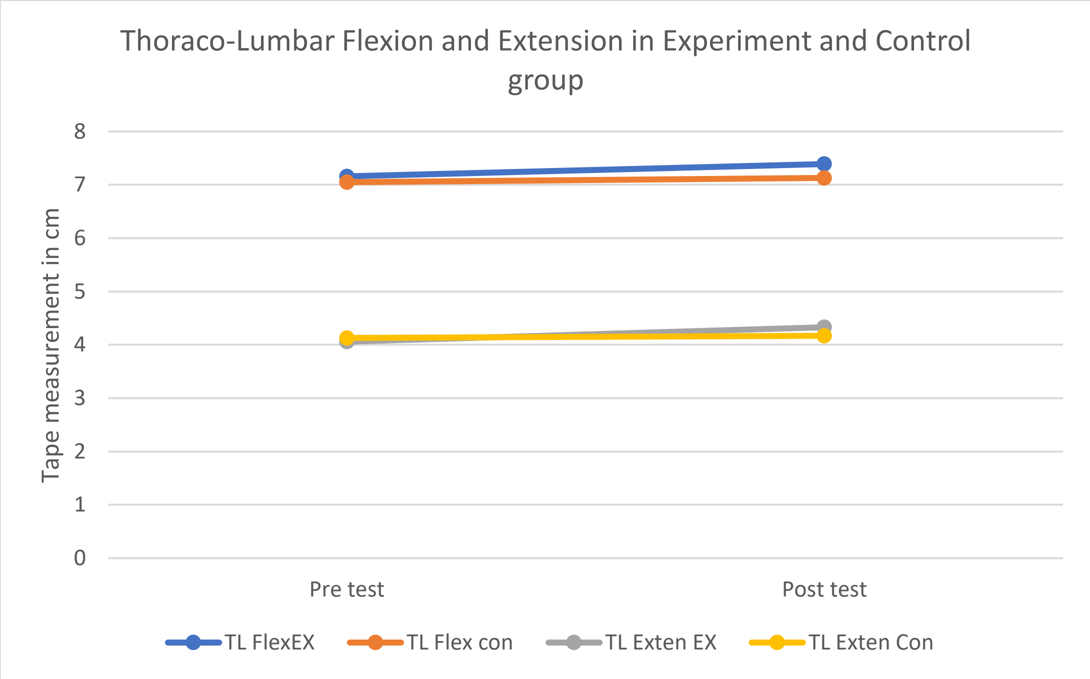
Comparison between the groups:

Thoracic mobility is analysed by measuring thoraco-lumbar flexion and extension. Tape measurement in cm was used to measure the each components. Measurements which was obtained at pre and post-test as follows

Table 3.5 Tape measurement of thoraco-lumbar flexion and extension in both groups

groups		Mean Std. Deviation	
		Pre Test	Post test
Thoraco-lumbar flexion	Experimental	7.16 ±1.38	7.39 ± 1.29
	Control	7.05 ± 0.93	7.13 ± 0.92
Thoraco-lumbar extension	Experimental	4.06 ± 0.32	4.33 ± 0.30
	Control	4.13 ± 0.26	4.17 ± 0.25

According to the table 9, during pre-test, Thoraco-Lumbar flexion values which are obtained for experiment and control group nearly equal (Experimental: 7.16 ± 1.38; Control: 7.05 ± 0.93). Similarly, mean value between both groups for Thoraco-Lumbar extension nearly equal at the baseline (Experimental: 4.06 ± 1.38; Control: 4.13 ± 0.93). It exemplifies that both groups are similar at baseline. During post test, there is an improvement observed in terms of Thoraco-Lumbar Flexion and Extension in both groups when compared to pre test values which has to be statistically tested.



TL FlexEX: Thoraco-lumbar Flexion in experimental group; TL Flex con: Thoraco-lumbar Flexion in Control group; TL Exten Ex: Thoraco-lumbar Extension in experimental group; TL Exten con: Thoraco-lumbar Extension in Control group

Graph 3.7: Averge measurements of thoraco-lumbar flexion and extension

Comparison between two groups has to be statistically tested. Independent sample T-test was used to compare the means between both group at the baseline and after intervention by keeping significant value (α) as 0.05. The mean of thoraco-lumbar flexion and extension in both experimental and control group in during pre and post-test was illustrated in the chart 2 which is given below.

T test was performed by formulating the hypothesis such as,

Ho: there is no differences in means between the two groups

Ha: there is a differences in mean between two groups

Results is shown in the table 10.

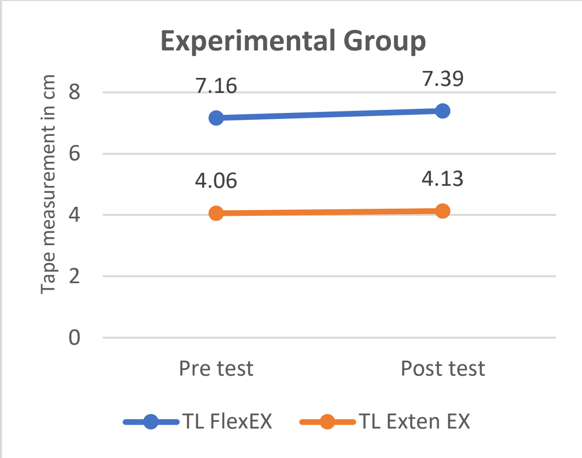
Table 3.6 : Comparison between the group - thoraco-lumbar flexion and extension

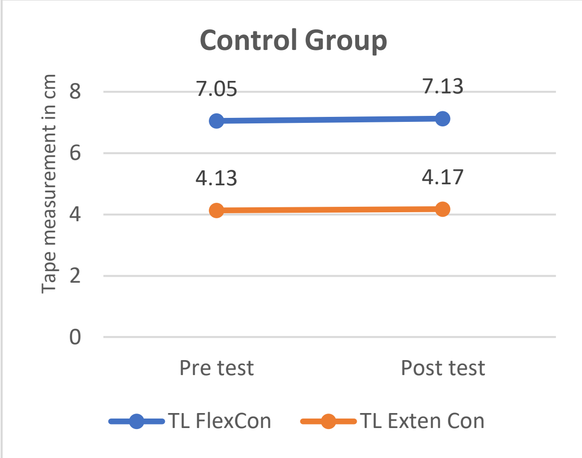
	P value	
	Comparison at Pre-test	Comparison at Post-test
Thoraco-lumbar flexion	0.707	0.386
Thoraco-lumbar extension	0.376	0.036

According to p value, which is obtained for thoraco-lumbar flexion and extension at baseline are 0.707 and 0.376 which are greater than significant value α (α = 0.05). Therefore, null hypothesis cannot be rejected which implies there is no significant differences between both groups at the baseline. However, in post-test p value obtained for thoraco-lumbar extension is 0.036 which is less than significant value α. Therefore, null hypothesis can be rejected which means there is a significant differences in thoraco lumbar extension after intervention in exercise group compared to control group.

Comparison within group:

According to the obtained mean value, In experimental group, there is an improvement in Thoraco-lumbar flexion (from 7.16 cm to 7.39cm) and extension (from 4.06 cm to 4.13 cm). Similarly, improvements noticed in control group as well in both Thoraco-lumbar extension (from 4.13 cm to 4.17cm) and Flexion (7.05 cm to 7.13 cm). Graphs given below depicts the difference in both groups before and after intervention.





Graph 3.8: Thoraco-Lumbar flexion and Extension measurements in Experimental group

Graph 3.9: Thoraco-Lumbar flexion and Extension measurements in Control group

TL FlexEX: Thoraco-lumbar Flexion in experimental group; TL Flex con: Thoraco-lumbar Flexion in Control group; TL Exten Ex: Thoraco-lumbar Extension in experimental group; TL Exten con: Thoraco-lumbar Extension in Control group

Even though, values showed a significant differences, it has to be tested statistically. Paired sample – Test was used in this instance by taking assumption of data set follow the normal distribution. Hypothesis for this test:

Ho: The intervention is not effective in significantly increasing in Thoraco-Lumbar ROM

Ha: The intervention is effective in significantly increasing Thoraco-Lumbar ROM

P values are depicted in the table below:

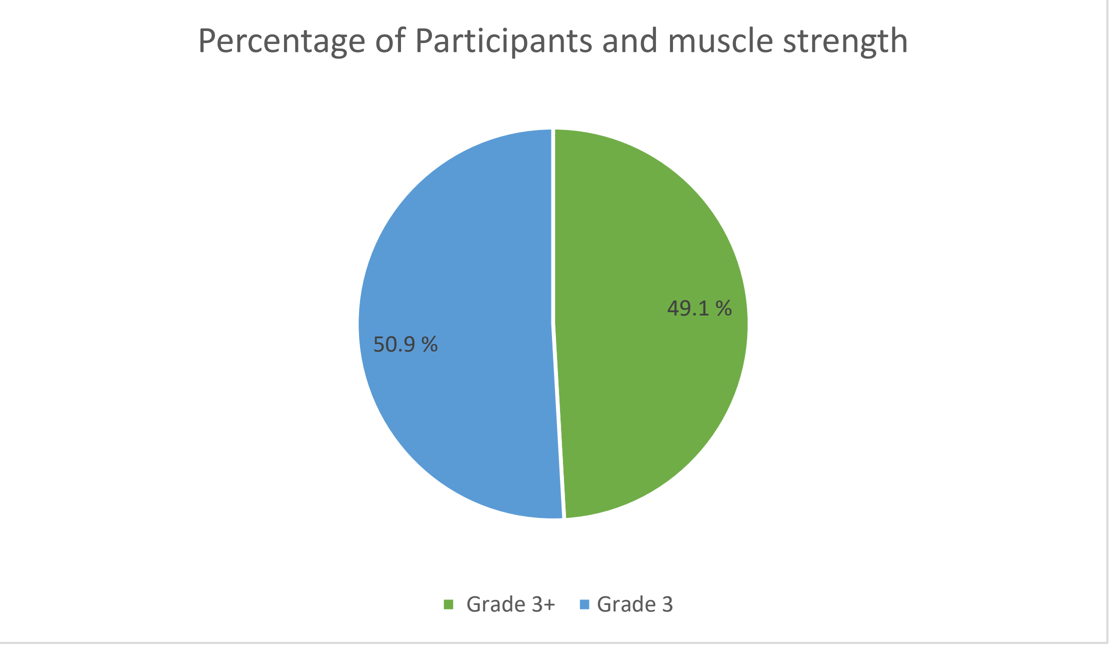
Table 3.7 : Comparison of within the groups for thoraco-Lumbar flexion and Extension

	Comparison between pre and post-test - P value	
	Experiment	Control
Thoraco-lumbar flexion	0.000*	0.000*
Thoraco-lumbar extension	0.000*	0.054
**significant difference*		

According to the p value obtained from paired sample t test during pre and post-test in experimental group, P values for thoraco-lumbar flexion and extension are 0.000 which is less than 0.05. Therefore, there is a significant increase in Thoraco-Lumbar flexion and extension in experimental group after post-test than pre-test. In control group, P value for thoraco-lumbar flexion is 0.000 which is less than 0.05. There is a significant difference in Thoraco-Lumbar flexion pre-test than post-test. However, P value obtained for Thoraco-Lumbar extension is 0.054 which is greater than α. Therefore, there is no significant differences in Thoraco-Lumbar extension in pre and post test.

3.3.3 Muscle strength

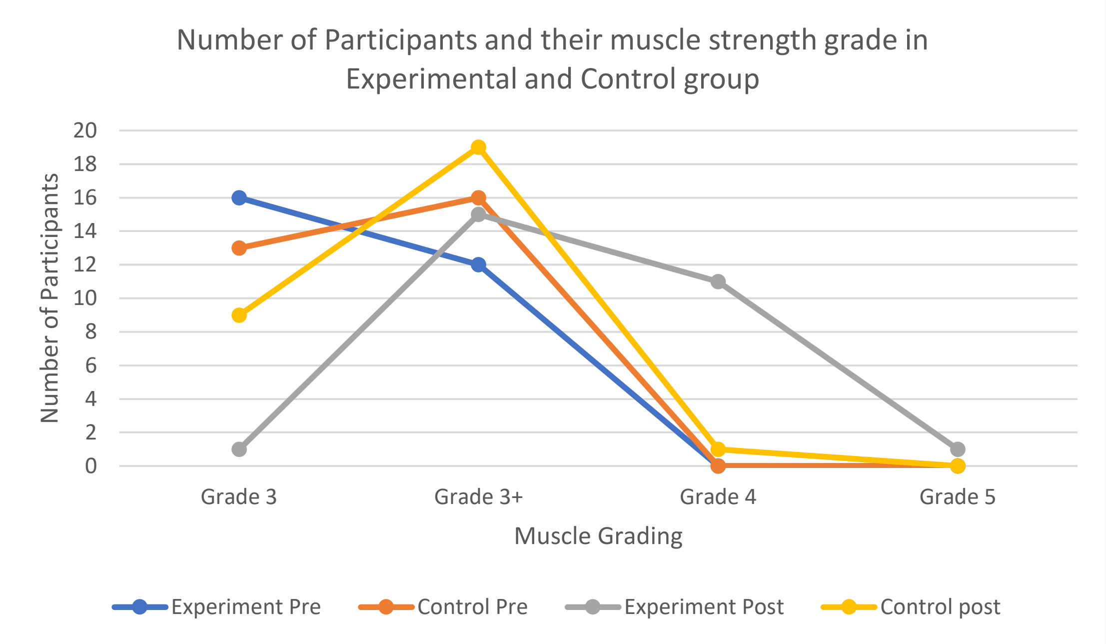
Muscle strength of upper muscle extensors which is measured using Manual Muscle test-Oxford grading scale which includes from 0 to 5 scales. Among the participants, nearly 49.1% have the muscle strength of 3^+ and 50.9% have the muscle strength of 3 in oxford grading scale due to UBP. Graph 10 shows the percentage of participants belongs to different muscle strength category.



Graph 3.10 percentage of participants who belongs to different muscle strength grading – pre-test

Comparison between groups:

Participants in both groups belongs grade 3 and 3+ category in oxford grading scale. However, after the treatment session in experiment group, number of participants belongs to grade 3 category reduced when compared to pre intervention stage. After the exercise 15 and 11 participants muscle strength improved to grade 3+ and grade 4 category. In contrast, number of participants in control group in grade 4 category is , its quite low when compared to experimental group. Even though both groups show improvement in muscle strength according to the graph 10.



Experiment pre: Pre-test muscle strength grading of participants in Experimental group; Control Pre: Pre-test muscle strength grading of participants in Control group; Experiment Post: Post-test muscle strength grading of participants in Experimental group; Control Post: Post-test muscle strength grading of participants in Control group;

Graph 3.11: Participants muscle strength grading in Experimental and control groups

To find out the significance in difference, Mann-Whitney U test was used to compare the both group muscle strength at baseline and post-test by taking significant value as 0.05 (α=0.05). Following hypothesis was formulated before conducting the test, which was

Ho: There is no significant difference in muscle strength between both groups

Ha: There is a significant difference in muscle strength between both groups

Following table illustrates the test value obtained

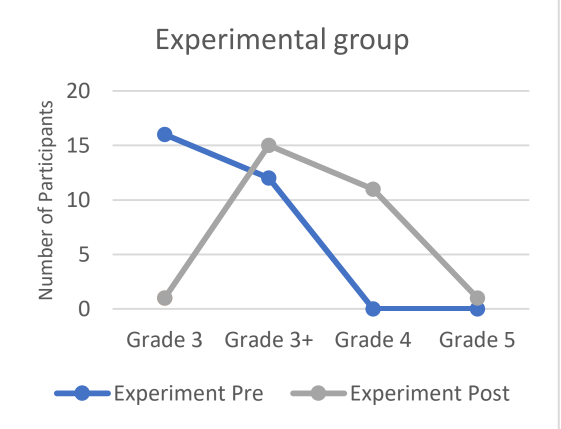
Table 3.8 – Comparison for Muscle strength between the group in pre and post test

	P value
MMT_Pre-test	0.357
MMT_Post-test	0.000*
**Significant difference, (MMT- Manual Muscle Test)*	

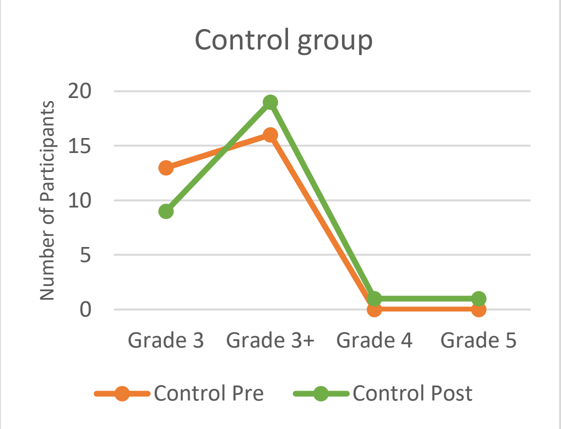
According to the obtained p value, baseline depicts there is no difference in between both group because p value is less than 0.05 (0.357 > α). Therefore, null hypothesis is not rejected. In contrast, after the intervention there is a significant differences in muscle strength of experimental group when compared to control group because p value is less than 0.05 (0.000 < α). Therefore, there is a significant improvement in the muscle strength of extensors after the exercise in experimental group.

Comparison within group:

In Experimental group, 16 and 12 participants belong to grade 3 and 3+ category which shifted to 1, 15, 11 and 1 in Grade 3, 3+, 4 and 5 category respectively. This shows a significant improvement in experimental group. In control group, 13 and 16 participants belong to grade 3 and 3+ category which shifted to 9, 19, 1 and 0 in Grade 3, 3+, 4 and 5 category respectively. Control group showed a certain level of improvement compared to pre-test level (need to be statistically tested). Graph 11 and 12 shows the changes occurred after interventions from the pre-test level.



Graph 3.12: Muscle strength grading of participants during Pre and Post-test in experimental group



Graph 3.13: Muscle strength grading of participants during Pre and Post-test in Control group

Experiment pre: Pre-test muscle strength grading of participants in Experimental group; Control Pre: Pre-test muscle strength grading of participants in Control group; Experiment Post: Post-test muscle strength grading of participants in Experimental group; Control Post: Post-test muscle strength grading of participants in Control group;

Eventhough, value showed that there is an improvement in pre and post test in both groups it has to be tested statistically. Wilcoxon test was used to find the difference in pre and post-test values in both groups. The following hypothesis was made to perform the test,

Ho: There is no significant difference in muscle strength within the group in pre and post test

Ha: There is a significant difference in muscle strength within the group in pre and post test

Results obtained was depict in the table 13,

Table 3.9: comparison within the group for muscle strength for pre and post test

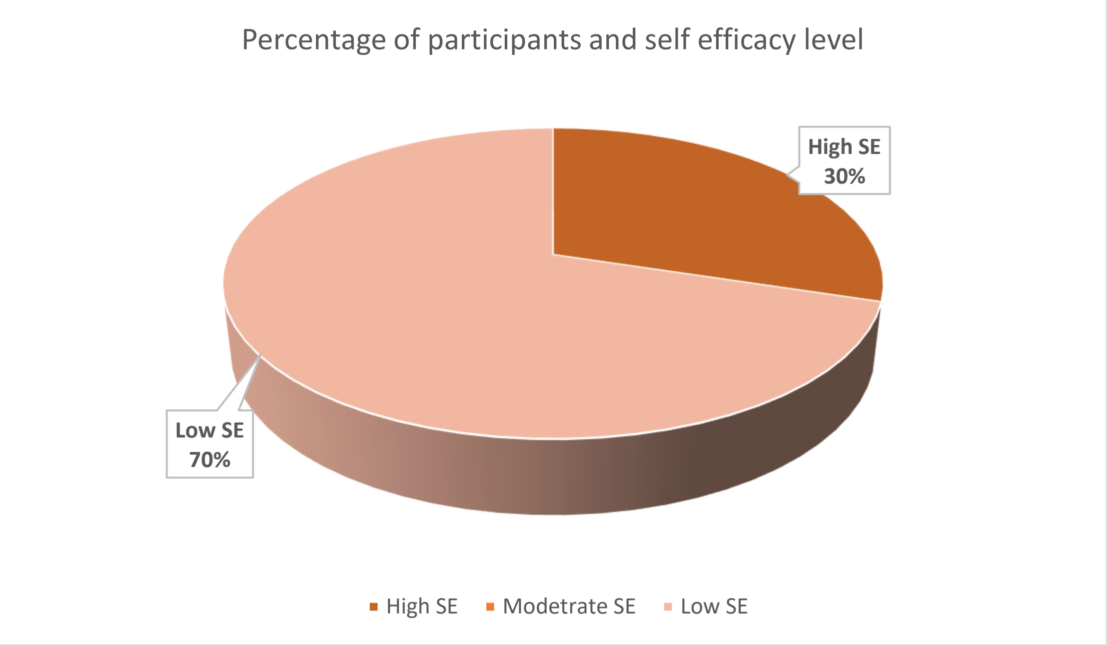
	P value
MMT_Experimental	0.000*
MMT_Control	0.065

**significant difference (MMT- Manual Muscle Test)*

Muscle strength according to MMT – oxford grading scale in experiment group significant improvement after thoracic mobility exercise with the p value of 0.000 in Wilcoxon test. In contrast, control group did not show a significant improvement in muscle strength with the p value of 0.065 respectively in Wilcoxon test ($\alpha = 0.05$). Therefore, thoracic mobility showed a significant improvement in experimental group.

3.3.4 self-efficacy

Participants were administered by a Pain Self Efficacy Questionnaire (PSEQ) to measure their self-perceived disability level. Total score of the questionnaire was used to compare the self-efficacy level at the both baseline and after the intervention. According to the total score, participants who is having total score ≥ 40 indicates high self-efficacy, 39-30 indicates the moderate self-efficacy and < 30 indicates low self-efficacy. Among the participants nearly 70% of participants perceived low self-efficacy because of UBP when doing day to day task and 30% of participants perceived high self-efficacy. Pie chart given below illustrate the percentages of participants and there self-efficacy level.



High SE: Percentage of Participants perceived High Self-efficacy; Moderate SE: Percentage of Participants perceived Moderate Self-efficacy; Low SE: Percentage of Participants perceived Low Self-efficacy

Graph 3.14: Percentage of participants and their perceived level of self-efficacy pre test

Comparison within the group:

Participants in both groups nearly equal at the baseline in there self-efficacy level. In experimental group, 36.8% and 12.3% belongs to low and high self-efficacy level category. In control group, 33.3% and 17.5% belongs to low and high self-efficacy level. After the treatment, all the participants in both group perceived high self efficacy.

Mann-Whitney U test was used to compare the both groups at baseline and post-test by taking significant value as 0.05 (α=0.05). Following hypothesis was formulated before conducting the test, which was

Ho: There is no significant difference between both groups

Ha: There is a significant difference between both groups

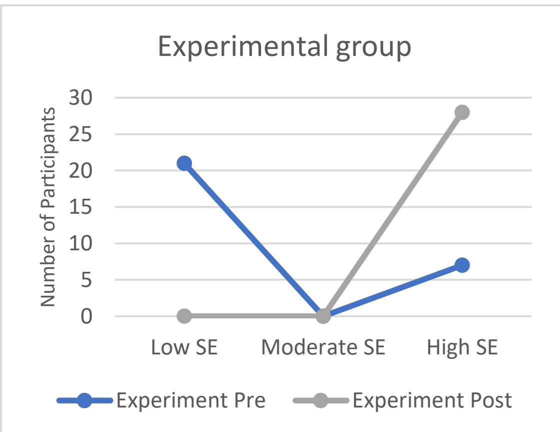
Table 3.10: comparison between both group in terms of self-efficacy pre and post test

	P value
PSEQ Pre Test	0.438
PSEQ_Post-test	1.000

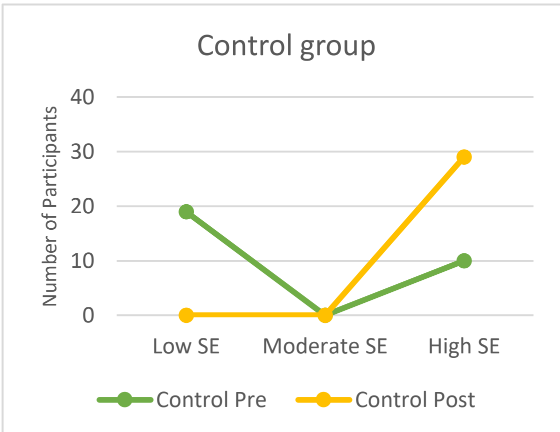
According to the Table 14, obtained p value for baseline comparison depicts there is no difference in between both group because p value is greater than 0.05 (0.438 > α). Therefore, null hypothesis is not rejected. Similarly, after the intervention there is no significant differences in PSEQ total score of experimental group when compared to control group because p value is greater than 0.05 (1.000 < α).

Comparison within the group:

Both groups showed improvement in the self-efficacy after the intervention. Graph 14 given below shows the results of comparison within the group.



Graph 3.15: Number of participants and their self-efficacy level during Pre and Post-test in experimental group



Graph 3.16: Number of participants and their self-efficacy level during Pre and Post-test in control group

High SE: Participants perceived High Self-efficacy; Moderate SE: Participants perceived Moderate Self-efficacy; Low SE: Participants perceived Low Self-efficacy; Experiment pre: Experimental group – pre-test; Experiment post: Experimental group – post-test; Control pre: Control group – pre-test; Control post: Control group – post-test

Even though, there is an improvement in number of participants but it has to be tested statistically. Wilcoxon test, was performed to find the significant difference during pre and post-test within both groups by taking following hypothesis,

Ho: There is no significant difference in self-efficacy within the group in pre and post test

Ha: There is a significant difference in self-efficacy within the group in pre and post test

Table 3.11: comparison within both group in terms of self-efficacy during pre and post-test

	P value
Self-Efficacy Experimental	0.000*
Self-Efficacy Control	0.000*
**significant difference*	

In both groups showed a significant improvement in self-efficacy in when compared to pre-test with thoracic mobility exercises and manual release technique individually with p value of 0.000 by taking significant value as 0.05.

CHAPTER IV

DISCUSSION

4.1 Discussion

Undergraduates in Sri Lanka has high academic work load with long lecture hours, assignment submission deadline and perceived stress or burnouts were reported in studies conducted in Sri Lanka (Premarathna et al., 2020; Weerasinghe et al., 2012). However, musculoskeletal disorders associated with this academic workload or stress is understudied among undergraduates in Sri Lanka. Even though, few studies reported about the musculoskeletal symptoms such as head ache, shoulder pain associated with screening among undergraduates in Sri Lanka (Patterson & Warnakulasuriya, 2022). Occurrence of musculoskeletal disorders among undergraduates reported in other countries like Ethiopia and Pakistan(Fatima et al., 2019; Yirdaw et al., 2021). In case of UBP, it is self-reported by students and treated by therapist in university mainly at university of Peradeniya. Conversely, it has poor attention in worldwide literature. This study mainly focus on physiotherapy treatment method and active exercises for upper back pain among undergraduates.

Undergraduates who complained about Upper Back Pain were screened according to eligibility criteria was selected to participate in this study. Initial sample size was 60. However, three participants left the study without any reason which implies final sample size was 57. Participants demographic details was depicted in table 3.1. The demographic details of the overall participants, comprising 57 individuals experiencing upper back pain, reveal a comprehensive snapshot of the study population. On average, participants were approximately 22.37 years old (±1.75), indicating a relatively young cohort. Their average BMI stood at 20.99 (±3.37), suggesting a diverse range of body compositions within the group. Monthly income varied widely, with an average of Rs56,561.40 (± 52,749.41), indicating a broad socioeconomic spectrum among participants. The average family size was 4.42 (±1.12), reflecting diverse familial structures within the sample. Additionally, participants reported an average pain duration of 9.59 months (±11.32), indicating a considerable variability in the chronicity of their upper back pain experiences. This variation in the duration of pain emphasizes the diverse nature of upper back pain, highlighting the need to adopt personalized treatment and management strategies. The experimental group included 28 participants with an average age of 22.61 years (±1.892) and a mean BMI of 21.289 (±3.144). They had an average family size of 4.32 (±1.124) and a monthly income averaging Rs 47,928.57 (± Rs 22,835.53). Conversely, the control group had 29 participants who were slightly younger with an average age of 22.14 years (±1.597) and a marginally lower mean BMI of 20.695 (±3.611). Their average family size was slightly larger at 4.52 (±1.122), and they reported a higher monthly income of Rs 64,896.55 (± Rs 70,111.82). These demographic details provide insights into the characteristics of the participants in both groups. The demographic profiles of the experimental and control groups reveal only a subtle differences in numerical value. Both groups have comparable mean in ages, BMIs, family income and family size, indicating a balanced distribution.

The study collected data on various factors potentially influencing UBP among participants. Among them, gender distribution showed a majority of males (75.4%) compared to females (24.6%). Groups were structured with a balanced gender ratio to ensure equality. Regarding family dynamics, most families had four members (49.1%), with fathers predominantly serving as the breadwinners (73.7%) and contributing significantly to financial support (63.2%). Interestingly, a small percentage of families had all members contributing financially (5.3%). Notably, a significant portion of participants (75%) did not receive any previous treatment for UBP, with only a minority consulting physicians (3.5%) or resorting to local anesthesia or medication (19.2%). Additionally, awareness about the benefits of exercise was low, with only one participant reporting awareness. These findings underscore the need for further exploration into the interplay of familial and treatment-related factors in understanding and addressing UBP.

Statistical analysis was performed using IBM SPSS version 26.0 to identify factors contributing to UBP among the participants. Pain intensity was measured with the Visual Analog Scale (VAS), a widely used tool for evaluating pain severity. Spearman's rank correlation coefficient was used for this analysis because it is well-suited for examining ordinal data (such as VAS scores) alongside categorical or continuous variables like age, Body Mass Index (BMI), and income, without assuming a specific data distribution.

The findings, displayed in Table 3.2, revealed that only BMI had a significant correlation with pain intensity, with a p-value of 0.006. This suggests a relationship between BMI and UBP severity. Specifically, participants classified as overweight, with a BMI between 22.5 and 26.9 kg/m^2, tended to have higher pain intensity levels. Additionally, the pattern shown in the graph 3.1 highlights this trend, indicating that both overweight and obese participants (BMI ≥ 27 kg/m^2) experienced greater pain intensity on the VAS scale.

The data suggest a potential association between higher BMI and increased UBP severity, particularly among individuals categorized as overweight or obese. The South Asian categorization of BMI is notable here, as it reflects the specific demographic context of the study population, potentially highlighting cultural or physiological factors influencing UBP. However, it's crucial to note that other demographic factors assessed in the study, including age, gender, family size, monthly income, and breadwinner status, did not demonstrate a significant correlation with pain intensity. This suggests that while BMI plays a role in UBP severity, other demographic variables may not directly influence pain levels in this context.

According to the world wide literature prevalence of UBP was common among youngsters due to stress, lack of physical activity(Hanvold et al., 2010). Further, UBP is prevailed not only during youngsters but also even primary school children was affected due to carrier bags(Mohd Azuan et al., 2010). Moreover, few studies explicit that UBP prevailed among geriatric population (Edmond & Felson, 2003; Spencer et al., 2019). Therefore, a wide range of prevalence of UBP without any age relations can be observed among population due to several causative factors. Few surveys provide the details about the impact of socioeconomic factors among back pain patient without specify the area of the spine. In those studies female gender more affected by pain rather than male (Fatima et al., 2019; Spencer et al., 2019). A study conducted among physiotherapy undergraduates, depicts that nearly 45% reported symptoms of UBP and 71% of them were female students (Fatima et al., 2019). Another study conducted in Bangladesh among school children depicts that female children experiences more pain than male in nearly two times because of their back bag (Mohd Azuan et al., 2010). In contrast, UBP was common among men in south Korean workers when compared to female through different occupations in South Korea because of ergonomic factors (J. Park et al., 2017). Therefore literature suggests that both gender affected by UBP.

In this study context, BMI shows the association with pain prevalence and increase in tendency among overweight and obese participants. This result was evident in previous studies. A systematic review conducted in 2021 suggest that BMI showed a significant association in back pain among adolescents those who are overweight and obese(Onan & Ulger, 2021). A study from 2013 found that a higher BMI is associated with back pain and other musculoskeletal pain syndromes, potentially due to chronic systemic inflammation. It also recommends that patients with a higher BMI be evaluated for inflammatory factors related to adiposopathy, such as metabolic syndrome, which may contribute to back pain and other musculoskeletal pain syndromes (Seaman, 2013). Another evident indicates that obesity reduce the spinal movement such as thoracic flexion and extension as well as increase kyphosis posture (Bayartai et al., 2023). In contrast, a review suggest that taller structure and Low body mass lead to scoliosis but the reason was unrevealed (Scaturro et al., 2022). In this study context, high BMI contributes to the UBP because of increase in mechanical work load to the upper back as well as sedentary life style reduce the mobility of spine and increase the stiffness in pain leads to increase the BMI which act as a vicious cycle.

In case of socioeconomic status of few studies indicate that low economic status also a contributing factors for back pain(Deyo & Tsui-Wu, 1987). A study conducted in France depicts that overall professionals complaints less pain than other workers (non-professionals) due to increase of work load(Leclerc et al., 2016). However connective factor for low socioeconomic status and UBP was not revealed. In present study context most of undergraduates' family did not show any difference in socioeconomic status among the participants. Therefore, it did not show any significant correlation with UBP. Additionally, a study conducted in Russia indicates that the prevalence of low back pain, thoracic spine pain, and neck pain in the Russian population is associated with factors such as being female, younger age, higher body mass index, elevated anxiety levels, a history of cardiovascular disease, reduced participation in vigorous activities, and extended periods of sitting or reclining (Bikbov et al., 2020).

These findings have implications for both clinical practice and public health interventions targeting UBP. Healthcare professionals may need to pay particular attention to individuals with higher BMI when assessing and managing UBP, potentially incorporating weight management strategies into treatment plans. Additionally, public health efforts aimed at preventing and managing UBP could prioritize interventions addressing obesity and overweight, considering the demonstrated association between BMI and pain intensity. Further research exploring the mechanisms underlying this relationship and potential interventions is warranted to develop more effective strategies for UBP management and prevention.

The study delves into a comparative analysis between two groups: one subjected to thoracic mobility exercises and the other to thoracic mobilization and trigger point release technique. The aim is to assess the comparison of thoracic mobility exercises in combination with breathing in reducing pain intensity across various activities of daily living compared to the control group, shedding light on the potential benefits of incorporating targeted exercise interventions in pain management protocols. The participants in both groups belongs to mild (≤ 3.4) and moderate pain intensity (3.5 – 7.4) in VAS. However, According to the graph, 3.3 percentage of participants belong to moderate pain intensity is greater than mild intensity in both group in almost all the activities except sleeping and walking. Intervention was aim to reduce present pain intensity as well as pain intensity in different levels.

When evaluating the post-intervention results, there is a noteworthy reduction in pain intensity experienced by the experimental group compared to the control group. It underscores the importance of targeted exercises in addressing musculoskeletal pain, particularly within the thoracic region, which is often implicated in conditions such as low back pain and neck pain. The observed reductions in percentage of participants in moderate pain intensity and increased percentage of participants in mild pain intensity in VAS. Percentage of participants belongs to mild intensity comparably high in experimental group in almost all activities rather than sleeping and transferring (graph 3.4). Thoracic mobility exercises when in combination breathing increases the mobility between thoracic vertebrae and thoracic cage mobility by improving lung expansion. Further, increases the oxygen supply to the body by enhancing the deep breathing promotes which promotes immediate pain reduction. Moreover, it increases the muscle activation of thoracic extensors which leads to postural correction during sitting and standing. Usually, Excessive muscle strain, stiffness in thoracic region lead to pain in upper back area. By improving mobility and muscle activation of thoracic region pain reduction is possible.

A study conducted in 2017, a randomized controlled trail in improving forward head posture by providing thoracic mobility exercises and thoracic mobilization shows a significant improvement in pain, craniovertebral angle and neck disability index when compared to cervical group(Cho et al., 2017). Additionally, thoracic mobilization in combination exercises improves the shoulder function and thoracic alignment among sub acromial impingement patients (S. J. Park et al., 2020). Evidences suggest that combination of thoracic mobility exercise with thoracic mobilization improves the spinal alignment and posture. However its focus on upper back pain in different level was under researched. In this context, solely, thoracic mobility exercise showed a significant improvement in pain intensity of UBP.

Additionally, Both group showed significant improvement in pre and post-test. However, in control group pain intensity during walking and sleeping did not show significant improvement. Manual release technique mainly focus on reduce stiffness in spine and did not focus on improving muscle strength(Ożóg et al., 2023). According to study conducted in Ozog et al, in 2023 indicate that myofascial release technique did not improve thoracic stability among low back pain (Ożóg et al., 2023). Lack of evidence about thoracic stability and manual release technique. It could be possible reason that participants in this study did not show a significant improvement in pain intensity during walking and standing.

Tape measurements were used to measure the thoraco-lumbar flexion and extension. According to a study conducted in 2021, indicated that tape measurements and goniometer measurements are reliable in measuring spinal motions such as flexion, extension, lateral flexion and rotation with the inter reliability score between 0.95 to 0.999(Johnson & Mulcahey, 2021). Therefore tape was used to measure the thoracic lumbar flexion and extension. Available evidence for the average tape measurement for thoraco-lumbar flexion and extension among adults mainly among south Asians. According to Cynthia's "Measurement of Joint motion" 3rd edition depicts that average measurement of thoraco lumbar flexion and extension was as follows (Motion, n.d.)

Recent, research evidence was not available for the references. According to this study context, thoraco-lumbar flexion in experiment group and control group at baseline was 7.16 ±1.38 and 7.04 ± 0.93 respectively and thoraco-lumbar extension in experiment and control group at baseline was 4.06 ±0.32 and 4.13 ± 0.26 which values are lower than reference value due to muscle guard of pain or stiffness. After the intervention, it was increased dramatically in experimental than control group as depicted in graph 3.8 and 3.9. However, both groups showed improvement in thoracolumbar flexion and extension, Control group did not show statistical significance in thoraco-lumbar extension (p=0.054).

According a study conducted in university of texas in 2023, thoracic mobility exercise increased thoracic spine flexion and extension among physically active individuals(Leak, 2023). Further, another study conducted among low back pain patients showed a significant improvement in thoracic flexion for stabilization exercises than thoracic mobilization group(S.-R. Yang et al., 2015). Moreover, a study conducted by Juhani Maatta et al indicated that increase in thoracic mobility leads to reduction in thoracic spine pain (Määttä et al., 2022). Few studies shows that manual therapy which did not specify about the therapy improves the thoracic extension and hyper kyphosis (Jung et al., 2020). Another study conducted in Korea, thoracic mobilization technique alone did not show significant improvement in thoraco-lumbar flexion, extension and side bending among low back pain patients (J. Yang & Kim, 2015). However, thoracic mobility exercises which focus on thoracic spine pain was statistically not proven in previous literature.

Thoracic mobility exercises play a crucial role not only in enhancing flexibility and range of motion but also in fortifying muscle strength throughout the thoracic region. These exercises target the muscles surrounding the thoracic spine, including the erector spinae, rhomboids, and trapezius, among others, thereby promoting a balanced and robust musculature. This study examines the effectiveness of thoracic mobility exercise and manual release technique in muscle strength of thoracic extensors. Significant improvement only observed in the muscle strength in experiment group when compare to control group. Additionally, for Wilcoxon test, there is a significant improvement noted in experiment group (p = 0.000) but not in control group (p=0.065)

In this study context, thoracic mobility exercises often involve stretching and lengthening the muscles and connective tissues around the thoracic spine, such as the erector spinae, which are vital for both flexion and extension. By enhancing the flexibility of these structures, the spine gains a wider range of motion in both directions. Additionally, these exercises target the facet joints of the thoracic spine, promoting better joint mobility and reducing stiffness, which further facilitates flexion and extension movements. Furthermore, engaging core muscles like the abdominals and obliques during these exercises helps stabilize the spine and pelvis, enabling more efficient movement patterns. Correcting poor posture, often a result of excessive thoracic curvature, is another focus of thoracic mobility exercises. As posture improves, the spine can move more freely through its full range of motion. Lastly, consistent practice of these exercises leads to neuromuscular adaptations, improving the coordination and control of flexion and extension movements over time. Together, these biomechanical effects contribute to a healthier, more functional thoracic spine. Application of thoracic spine exercise even though it is guided by therapist, it can be done by patient or every individual at home to improve their spine health rather than spinal mobilization.

According to the available literature Thoracic mobility exercises and manual therapy can increase the muscle strength in long term after 12 weeks was indicated (Jung et al., 2020). A study conducted among chronic patients increases muscle strength of trunk flexors and extensors with the 12 weeks of stabilization training when compared to thoracic mobilization group(S.-R. Yang et al., 2015). Another study among sub acromial impingement patient, 4 weeks of thoracic mobilization improves muscle tone and strength of upper back(S. J. Park et al., 2020). According to the research, neural adaptation of muscle strength and muscle strength gains will occur from 2 weeks (GABRIEL et al., 2001; Mofatteh, 2021). This study examines the administration of exercises for two weeks 5 days per week to improve the muscle strength. It shows a significant improvement in improvement in muscle strength of thoracic spine extensors. There is a lack of study about the impact of thoracic mobilization in improving muscle strength. This study also did not show a significant improvement in muscle strength ($p = 0.065$) in control group who receives thoracic mobilization and trigger point release technique.

In conclusion, the findings of this study underscore the significant role of thoracic mobility exercises in enhancing muscle strength within the thoracic region. The observed improvement in muscle strength among participants in the experimental group, compared to the control group, highlights the efficacy of incorporating thoracic mobility exercises into rehabilitation and strength training programs. By targeting muscles surrounding the thoracic spine, including the erector spinae, rhomboids, and trapezius, these exercises contribute to a balanced and robust musculature. Moreover, the multifaceted impact of thoracic mobility exercises on musculoskeletal health, including improved biomechanics, reduced pain, and enhanced movement coordination, underscores their importance in promoting long-term musculoskeletal health and resilience. Although further research is warranted to explore the optimal duration and frequency of thoracic mobility exercises, the results of this study support their inclusion as a valuable component of rehabilitation strategies aimed at improving muscle strength and function in individuals with thoracic spine-related conditions.

The Pain Self-Efficacy Questionnaire (PSEQ) is a tool commonly used in the assessment and management of chronic pain. Developed by Michael J.L. Sullivan, PhD, and colleagues, it is designed to measure an individual's confidence in their ability to perform activities despite experiencing pain. The questionnaire typically consists of a series of statements related to various activities, and respondents are asked to rate their level of confidence in performing each activity despite pain on a scale from 0 to 6, with 0 being "not at all confident" and 6 being "completely confident". The PSEQ helps healthcare providers assess a patient's perceived ability to manage pain and function effectively in their daily lives despite experiencing pain. According to interpretation, if total score ≥ 40 depicts high self-efficacy and ≤ 30 depicts low efficacy. It has been shown to be a useful tool in predicting treatment outcomes and guiding interventions for chronic pain management. According to a study conducted in 2021, indicate that PSEQ questionnaire have excellect validity, reliability and responsiveness with intra-class correlation coefficient of 0.86 for test–retest reliability (Dubé et al., 2021).

Chronic pain poses significant challenges to individuals' physical and psychological well-being, often leading to a diminished quality of life and functional limitations. The study sought to address these challenges by investigating the efficacy of an intervention aimed at managing self-perceived disability levels among individuals with chronic pain. Through the implementation of the Pain Self-Efficacy Questionnaire (PSEQ), the study provided valuable insights into participants' confidence in managing daily activities despite pain, both before and after the intervention. The baseline assessment revealed no significant differences in of PSEQ total scores between the experimental and control groups. 70% of participants belong to low self-efficacy group and 30% of participants belong to high self-efficacy group in pre-test.

In post-intervention assessments, all most all the participants belongs to the high self-efficacy group in both experimental and control group. Additionally there is no significant difference observed in post test.Worldwide, there are few research on perception of pain or its influence on daily function on individuals. A systemic review conducted in 2020 indicate that, PSEQ is suitable assessment to indicate self-efficacy of patients or participants who are suffering with back pain before administering an intervention(Vergeld & Utesch, 2020). There were few studies measure pain self-efficacy using PSEQ for chronic low back and neck pain(Ahmed et al., 2019). According PSEQ tool, maximum total score is 60. If total score > 40 indicates high self-efficacy and < 30 indicates low self-efficacy(Dubé et al., 2021).

The observed improvement in self-perceived disability levels among participants in the experimental group and control group underscores the importance of adopting a holistic approach by including both therapies to pain management. Beyond solely targeting pain reduction, interventions should aim to empower individuals to regain control over their lives and engage in meaningful activities despite pain. The intervention evaluated in this study likely incorporated a combination of therapeutic modalities, such as thoracic mobility exercises and manual release techniques, which have been shown to enhance functional capacity and reduce disability in individuals with chronic pain.

4.2 Limitations:

Primary challenges encountered in this study pertains to the difficulty in engaging participants amidst their demanding academic workloads. Sri Lankan undergraduates often face rigorous academic schedules, making it challenging to allocate time for participation in research activities. Consequently, therapists providing interventions experienced prolonged waiting times, as participants struggled to balance their academic commitments with study participation. Navigating institutional permissions posed another significant hurdle at the onset of the study. Securing approval from university authorities required persistence and strategic negotiation. Initially, obtaining permission proved elusive, with bureaucratic processes impeding progress.

Methodological limitations also warrant attention, particularly regarding participant selection and measurement techniques. Initially, the study intended to screen participants for abnormalities using X-ray imaging before enrolment. However, logistical and financial constraints rendered this approach unfeasible, necessitating alternative selection criteria. Similarly, the utilization of a twin-axis electro-goniometer for back measurements posed challenges due to its prohibitive cost, particularly for researchers in developing countries.

CHAPTER V

CONCLUSION

5.1 Conclusion:

The comprehensive study presented sheds light on the significant impact of thoracic mobility exercises and manual release techniques in the management of upper back pain (UBP) among undergraduate students. By addressing the multifaceted aspects of UBP, including its demographic correlates, associated factors, and therapeutic interventions, the study contributes valuable insights into understanding and managing this prevalent issue within the student population in Sri Lanka.

The findings highlight the diverse demographic characteristics of the participants experiencing UBP, reflecting the heterogeneous nature of the condition. Despite subtle differences between the both groups in terms of age, BMI, family size, and income, both groups exhibited comparable baseline characteristics. Importantly, the study identifies a noteworthy association between BMI and UBP severity, with overweight participants showing an increased tendency for higher pain intensity levels. This underscores the role of lifestyle factors, such as sedentary behaviour and increased mechanical workload, in contributing to UBP among students. Furthermore, the lack of substantial correlation with other demographic variables suggests the need for targeted interventions addressing specific risk factors associated with UBP.

The effectiveness of thoracic mobility exercises and manual release techniques in reducing pain intensity in different levels such as sitting, forward bending, standing, walking and during activities of daily living is a noteworthy finding. The observed improvements in thoraco-lumbar extension and muscle strength of thoracic extensors, highlight the therapeutic potential of these interventions. By targeting key musculoskeletal structures and promoting optimal biomechanics, these interventions offer a promising avenue for UBP management.

Furthermore, the study's focus on enhancing self-perceived disability levels through the Pain Self-Efficacy Questionnaire (PSEQ) underscores the importance of addressing psychosocial factors in pain management. The significant improvement in self-perceived disability levels among participants in both group highlights the efficacy of the interventions in empowering individuals to manage daily activities despite experiencing pain. This holistic approach to pain management aligns with current recommendations emphasizing the importance of addressing both physical and psychosocial aspects of pain.

Overall, the study contributes valuable insights into the complex interplay of factors influencing UBP among undergraduate students in Sri Lanka. By identifying demographic correlates, associated factors, and effective therapeutic interventions, the study provides a foundation for developing tailored interventions to address UBP within this population. Moving forward, further research exploring the long-term efficacy and optimal delivery of these interventions is warranted to inform evidence-based practice and improve outcomes for individuals experiencing UBP.

5.2 **Recommendations:**

The focal point of this study lies within the therapeutic territory of undergraduate back pain (UBP), prompting the necessity to establish the prevalence of UBP among university students through a cross-sectional study. Understanding the prevalence serves as a foundational step in addressing the multifaceted dimensions of UBP within educational settings. Moreover, future investigations ought to extend beyond mere prevalence rates to explore into the intricate interplay between mental health factors such as stress and depression, which can significantly contribute to UBP among undergraduates. Furthermore, prospective studies should incorporate assessments of muscle activation patterns during periods of heavy academic workload and heightened stress levels, as these factors are closely intertwined with UBP among the student population. By illuminating the physiological responses associated with academic stressors, researchers can inform targeted interventions tailored to mitigate muscle strain and reduce the incidence of UBP. Additionally, interventions aimed at upgrading ergonomic issues within educational institutions, such as providing appropriate seating arrangements and optimizing the alignment of multimedia resources during lectures, are vital.

CHAPTER VI

BIBLIOGRAPHY

Ahmed, S. A., Shantharam, G., Eltorai, A. E. M., Hartnett, D. A., Goodman, A., & Daniels, A. H. (2019). The effect of psychosocial measures of resilience and self-efficacy in patients with neck and lower back pain. *The Spine Journal*, *19*(2), 232–237.

Ajimsha, M. S. (2011). Effectiveness of direct vs indirect technique myofascial release in the management of tension-type headache. *Journal of Bodywork and Movement Therapies*, *15*(4), 431–435.

Akulwar-Tajane, I., Darvesh, M., Ghule, M., Deokule, S., Deora, B., & Mhatre, V. (2021). Effects of COVID-19 pandemic lock down on posture in physiotherapy students: A cross-sectional study. *Medical & Clinical Research*, *6*(1), 91–102.

Alagesan, J., Suganthirababu, P., & Anbarason, A. (2024). Effectiveness of Core Muscle Strengthening in Bus Drivers having Low Back Pain using McGill Pain Questionnaire: Experimental Study. *Indian Journal of Physiotherapy & Occupational Therapy*, *18*.

Ansari, S., Haboubi, H., & Haboubi, N. (2021). Obesity management for the gastroenterologist. *Frontline Gastroenterology*, *12*(3), 235–245.

Arbane, G., Tropman, D., Jackson, D., & Garrod, R. (2011). Evaluation of an early exercise intervention after thoracotomy for non-small cell lung cancer (NSCLC), effects on quality of life, muscle strength and exercise tolerance: randomised controlled trial. *Lung Cancer*, *71*(2), 229–234.

Bayartai, M.-E., Luomajoki, H., Tringali, G., De Micheli, R., Abbruzzese, L., & Sartorio, A. (2023). Differences in spinal posture and mobility between adults with obesity and normal weight individuals. *Scientific Reports*, *13*(1), 13409.

Begum, M. R., & Hossain, M. A. (2019). Validity and reliability of visual analogue scale (VAS) for pain measurement. *Journal of Medical Case Reports and Reviews*, *2*(11).

Bikbov, M. M., Kazakbaeva, G. M., Zainullin, R. M., Salavatova, V. F., Gilmanshin, T. R., Arslangareeva, I. I., Nikitin, N. A., Mukhamadieva, S. R., Yakupova, D.

F., & Panda-Jonas, S. (2020). Prevalence of and factors associated with low Back pain, thoracic spine pain and neck pain in Bashkortostan, Russia: the Ural Eye and Medical Study. *BMC Musculoskeletal Disorders*, *21*, 1–14.

Boonstra, A. M., Preuper, H. R. S., Balk, G. A., & Stewart, R. E. (2014). Cut-off points for mild, moderate, and severe pain on the visual analogue scale for pain in patients with chronic musculoskeletal pain. *Pain®*, *155*(12), 2545–2550.

Borghuis, J., Hof, A. L., & Lemmink, K. A. P. M. (2008). The importance of sensory-motor control in providing core stability: implications for measurement and training. *Sports Medicine*, *38*, 893–916.

Boström, M., Dellve, L., Thomée, S., & Hagberg, M. (2008). Risk factors for generally reduced productivity—a prospective cohort study of young adults with neck or upper-extremity musculoskeletal symptoms. *Scandinavian Journal of Work, Environment & Health*, 120–132.

Briggs, A. M., Bragge, P., Smith, A. J., Govil, D., & Straker, L. M. (2009). Prevalence and associated factors for thoracic spine pain in the adult working population: A literature review. *Journal of Occupational Health*, *51*(3), 177–192. https://doi.org/10.1539/joh.K8007

Bronfort, G., Haas, M., Evans, R. L., & Bouter, L. M. (2004). Efficacy of spinal manipulation and mobilization for low back pain and neck pain: a systematic review and best evidence synthesis. *The Spine Journal*, *4*(3), 335–356.

Brox, J. I. (2003). Shoulder pain. *Best Practice & Research Clinical Rheumatology*, *17*(1), 33–56.

Chen, Z., Wu, J., Wang, X., Wu, J., & Ren, Z. (2021). The effects of myofascial release technique for patients with low back pain: A systematic review and meta-analysis. *Complementary Therapies in Medicine*, *59*, 102737.

Cho, J., Lee, E., & Lee, S. (2017). Upper thoracic spine mobilization and mobility exercise versus upper cervical spine mobilization and stabilization exercise in individuals with forward head posture: a randomized clinical trial. *BMC Musculoskeletal Disorders*, *18*(1), 1–10.

Choi, E.-H., Hur, J.-K., Yang, J.-I., & Park, D.-S. (2005). Poster 98: The effect of thoracic exercise program on thoracic pain, kyphosis, and spinal mobility. *Archives of Physical Medicine and Rehabilitation*, *86*(9), e23.

Collins, J. J., Baase, C. M., Sharda, C. E., Ozminkowski, R. J., Nicholson, S., Billotti, G. M., Turpin, R. S., Olson, M., & Berger, M. L. (2005). The assessment of chronic health conditions on work performance, absence, and total economic impact for employers. *Journal of Occupational and Environmental Medicine*, 547–557.

Dagenais, S., Caro, J., & Haldeman, S. (2008). A systematic review of low back pain cost of illness studies in the United States and internationally. *The Spine Journal*, *8*(1), 8–20.

Desai, M. J., Bean, M. C., Heckman, T. W., Jayaseelan, D., Moats, N., & Nava, A. (2013). Treatment of myofascial pain. *Pain Management*, *3*(1), 67–79.

Deyo, R. A., & Tsui-Wu, Y. (1987). Functional disability due to back pain. A population-based study indicating the importance of socioeconomic factors. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*, *30*(11), 1247–1253.

Divya, Parveen, A., Nuhmani, S., Ejaz Hussain, M., & Hussain Khan, M. (2021). Effect of lumbar stabilization exercises and thoracic mobilization with strengthening exercises on pain level, thoracic kyphosis, and functional disability in chronic low back pain. *Journal of Complementary and Integrative Medicine*, *18*(2), 419–424.

Dubé, M.-O., Langevin, P., & Roy, J.-S. (2021). Measurement properties of the Pain Self-Efficacy Questionnaire in populations with musculoskeletal disorders: a systematic review. *Pain Reports*, *6*(4), e972.

Edmond, S. L., & Felson, D. T. (2003). Function and back symptoms in older adults. *Journal of the American Geriatrics Society*, *51*(12), 1702–1709.

Ekstrum, J. A., Black, L. L., & Paschal, K. A. (2009). Effects of a thoracic mobility and respiratory exercise program on pulmonary function and functional capacity in older adults. *Physical & Occupational Therapy in Geriatrics*, *27*(4), 310–327.

Elpeze, G., & Usgu, G. (2022). The effect of a comprehensive corrective exercise program on kyphosis angle and balance in kyphotic adolescents. *Healthcare*, *10*(12), 2478.

Exelby, L. (2011). Examination of the thoracic region. *Neuromuscular Examination and Assessment. A Handbook for Therapists*, 235–252.

Fatima, S., Arsh, A., Daud, M., Gohar, M., Ahmad, A., & Shah, A. M. (2019). Upper Back Pain among Physical Therapy Students and Its Association with Gender, Body Mass Index, Study Hours and Use of cell Phones. *Physikalische Medizin, Rehabilitationsmedizin, Kurortmedizin*, *29*(03), 156–160.

Fouquet, N., Bodin, J., Descatha, A., Petit, A., Ramond, A., Ha, C., & Roquelaure, Y. (2015). Prevalence of thoracic spine pain in a surveillance network. *Occupational Medicine*, *65*(2), 122–125.

French, P., Flora, L. F. W., Ping, L. S., Bo, L. K., & Rita, W. H. Y. (1997). The prevalence and cause of occupational back pain in Hong Kong registered nurses. *Journal of Advanced Nursing*, *26*(2), 380–388.

Fruth, S. J. (2006). Differential diagnosis and treatment in a patient with posterior upper thoracic pain. *Physical Therapy*, *86*(2), 254–268.

GABRIEL, D. A., BASFORD, J. R., & AN, K.-N. (2001). Neural adaptations to fatigue: implications for muscle strength and training. *Medicine & Science in Sports & Exercise*, *33*(8), 1354–1360.

Graham, S. (2015). *Biomechanical comparisons considering risk to the lumbar spine: walking with no load, a backpack, and a person on the back*.

Gross, A., Miller, J., D'Sylva, J., Burnie, S. J., Goldsmith, C. H., Graham, N., Haines, T., Brønfort, G., & Hoving, J. L. (2010). Manipulation or mobilisation for neck pain: a Cochrane Review. *Manual Therapy*, *15*(4), 315–333.

Hanvold, T. N., Veiersted, K. B., & Wærsted, M. (2010). A prospective study of neck, shoulder, and upper back pain among technical school students entering working life. *Journal of Adolescent Health*, *46*(5), 488–494.

Harithasan, D., Singh, D. K. A., Abd Razak, N. A. B., & Baharom, N. B. (2022). Personal, Academic Stressors and Environmental Factors Contributing to Musculoskeletal Pain among Undergraduates Due to Online Learning: A Mixed

Method Study with Data Integration. *International Journal of Environmental Research and Public Health*, *19*(21), 14513.

Henderson, K. A. (2012). Promoting Health through Physically Active Leisure. *12th International Sport Sciences Congress*, 61.

Heneghan, N. R., Baker, G., Thomas, K., Falla, D., & Rushton, A. (2018). What is the effect of prolonged sitting and physical activity on thoracic spine mobility? An observational study of young adults in a UK university setting. *BMJ Open*, *8*(5), e019371.

Heneghan, N. R., Lokhaug, S. M., Tyros, I., Longvastøl, S., & Rushton, A. (2020). Clinical reasoning framework for thoracic spine exercise prescription in sport: a systematic review and narrative synthesis. *BMJ Open Sport & Exercise Medicine*, *6*(1), e000713.

Hwangbo, P.-N., Hwangbo, G., Park, J., & Lee, S. (2014). The effect of thoracic joint mobilization and self-stretching exercise on pulmonary functions of patients with chronic neck pain. *Journal of Physical Therapy Science*, *26*(11), 1783–1786.

Inder, A. (2020). *A secondary analysis of the prevalence and risk factors associated with musculoskeletal disorders in medical imaging and radiation sciences undergraduate students at the University of Johannesburg*. University of Johannesburg (South Africa).

Johnson, M., & Mulcahey, M. J. (2021). Interrater reliability of spine range of motion measurement using a tape measure and goniometer. *Journal of Chiropractic Medicine*, *20*(3), 138–147.

Jun, Y. W., So, H. J., Jeong, Y. Do, & Um, S. H. (2015). The effects of upper thoracic joint mobilization technique using Kaltenborn-Evjenth concept on cervicothoracic ROM and pain in patients with chronic neck pain. *Journal of the Korean Society of Radiology*, *9*(7), 479–486.

Jung, S., Hwang, U., Ahn, S., Kim, J., & Kwon, O. (2020). Effects of manual therapy and mechanical massage on spinal alignment, extension range of motion, back extensor electromyographic activity, and thoracic extension strength in individuals with thoracic hyperkyphosis: a randomized controlled trial. *Evidence-*

Based Complementary and Alternative Medicine, *2020*.

Kanchanomai, S., Janwantanakul, P., & Jiamjarasrangsi, W. (2013). One-year incidence and risk factors of thoracic spine pain in undergraduate students. *Journal of Physical Therapy Science*, *25*(1), 15–20.

Ko, T., Jeong, U., & Lee, K. (2010). Effects of the inclusion thoracic mobilization into cranio-cervical flexor exercise in patients with chronic neck pain. *Journal of Physical Therapy Science*, *22*(1), 87–91.

Kostadinović, S., Milovanović, N., Jovanović, J., & Tomašević-Todorović, S. (2020). Efficacy of the lumbar stabilization and thoracic mobilization exercise program on pain intensity and functional disability reduction in chronic low back pain patients with lumbar radiculopathy: A randomized controlled trial. *Journal of Back and Musculoskeletal Rehabilitation*, *33*(6), 897–907.

Lasanthika, T. L. C., & Hettiaratchi, U. P. K. (2022). Mobile Phone Usage Pattern and Incidence of Self-Reported Health Problems among a Selected Population of University Students in Sri Lanka: A Cross Sectional Study. *Indian Journal of Public Health Research & Development*, *13*(2).

Leak, M. D. (2023). *Effect of Thoracic Mobility Exercise on Respiratory Function, Thoracic Spine, and Thoracolumbar Mobility in Young, Healthy, Physically Active Adults*. The University of Texas at San Antonio.

Leclerc, A., Chastang, J.-F., Taiba, R., Pascal, P., Cyr, D., Plouvier, S., & Descatha, A. (2016). Musculoskeletal pain at various anatomical sites and socioeconomic position: results of a national survey. *Revue d'epidemiologie et de Sante Publique*, *64*(5), 331–339.

Lee, K.-S., & Lee, J.-H. (2017). Effect of maitland mobilization in cervical and thoracic spine and therapeutic exercise on functional impairment in individuals with chronic neck pain. *Journal of Physical Therapy Science*, *29*(3), 531–535.

Lee, K.-W., & Kim, W.-H. (2016). Effect of thoracic manipulation and deep craniocervical flexor training on pain, mobility, strength, and disability of the neck of patients with chronic nonspecific neck pain: a randomized clinical trial. *Journal of Physical Therapy Science*, *28*(1), 175–180.

Lin, I., Wiles, L., Waller, R., Goucke, R., Nagree, Y., Gibberd, M., Straker, L., Maher, C. G., & O'Sullivan, P. P. B. (2020). What does best practice care for musculoskeletal pain look like? Eleven consistent recommendations from high-quality clinical practice guidelines: systematic review. *British Journal of Sports Medicine*, *54*(2), 79–86.

Linaker, C. H., & Walker-Bone, K. (2015). Shoulder disorders and occupation. *Best Practice & Research Clinical Rheumatology*, *29*(3), 405–423.

Määttä, J., Takatalo, J., Leinonen, T., Pienimäki, T., Ylinen, J., & Häkkinen, A. (2022). Lower thoracic spine extension mobility is associated with higher intensity of thoracic spine pain. *Journal of Manual & Manipulative Therapy*, *30*(5), 300–308.

Maitland, G. D. (1986). *Vertebral manipulation*. Elsevier Health Sciences.

Maselli, F., Palladino, M., Barbari, V., Storari, L., Rossettini, G., & Testa, M. (2022). The diagnostic value of Red Flags in thoracolumbar pain: A systematic review. *Disability and Rehabilitation*, *44*(8), 1190–1206.

Melzack, R. (1996). Gate control theory: On the evolution of pain concepts. *Pain Forum*, *5*(2), 128–138.

Middleditch, A., & Oliver, J. (2005). *Functional anatomy of the spine*. Elsevier Health Sciences.

Mofatteh, M. (2021). Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health*, *8*(1), 36.

Moffett, J., & McLean, S. (2006). The role of physiotherapy in the management of non-specific back pain and neck pain. *Rheumatology*, *45*(4), 371–378.

Mohd Azuan, K., Zailina, H., Shamsul, B. M. T., Nurul Asyiqin, M. A., Mohd Azhar, M. N., & Syazwan Aizat, I. (2010). Neck, upper back and lower back pain and associated risk factors among primary school children. *J Appl Sci*, *10*(5), 431–435.

Motion, J. (n.d.). *Measurement of Joint Motion*.

Norris, C. M. (2008). *Back stability: integrating science and therapy*. Human

Kinetics.

O'leary, S., Falla, D., Elliott, J. M., & Jull, G. (2009). Muscle dysfunction in cervical spine pain: implications for assessment and management. *Journal of Orthopaedic & Sports Physical Therapy*, *39*(5), 324–333.

Onan, D., & Ulger, O. (2021). Investigating the relationship between body mass index and pain in the spine in children or adolescents: a systematic review. *Childhood Obesity*, *17*(2), 86–99.

Ożóg, P., Weber-Rajek, M., Radzimińska, A., & Goch, A. (2023). Analysis of Postural Stability Following the Application of Myofascial Release Techniques for Low Back Pain—A Randomized-Controlled Trial. *International Journal of Environmental Research and Public Health*, *20*(3), 2198.

Park, J., Han, B., & Kim, Y. (2017). Gender differences in occupations and complaints of musculoskeletal symptoms: Representative sample of South Korean workers. *American Journal of Industrial Medicine*, *60*(4), 342–349.

Park, S.-J., Lee, J.-H., & Min, K.-O. (2017). Comparison of the effects of core stabilization and chest mobilization exercises on lung function and chest wall expansion in stroke patients. *Journal of Physical Therapy Science*, *29*(7), 1144–1147.

Park, S. J., Kim, S. H., & Kim, S. H. (2020). Effects of thoracic mobilization and extension exercise on thoracic alignment and shoulder function in patients with subacromial impingement syndrome: A randomized controlled pilot study. *Healthcare*, *8*(3), 316.

Patterson, N. M., & Warnakulasuriya, S. S. P. (2022). Screen Time and Associated Health Problems Among Undergraduates of University of Sri Jayewardenepura, Sri Lanka. *Sri Lankan Journal of Nursing*, *1*(1).

Peek, A. L., Miller, C., & Heneghan, N. R. (2015). Thoracic manual therapy in the management of non-specific shoulder pain: a systematic review. *Journal of Manual & Manipulative Therapy*, *23*(4), 176–187.

Pesco, M. S., Chosa, E., & Tajima, N. (2006). Comparative study of hands-on therapy with active exercises vs education with active exercises for the management of upper back pain. *Journal of Manipulative and Physiological Therapeutics*, *29*(3), 228–235.

Premarathna, H., Madushani, J. S., Tennakoon, T., & Sudeshika, T. (2020). *Prevalence of Headaches Among Undergraduates in Sri Lanka: Cross-Sectional Analysis*.

Risetti, M., Gambugini, R., Testa, M., & Battista, S. (2023). Management of non-specific thoracic spine pain: a cross-sectional study among physiotherapists. *BMC Musculoskeletal Disorders*, *24*(1), 398.

Salik Sengul, Y., Yilmaz, A., Kirmizi, M., Kahraman, T., & Kalemci, O. (2021). Effects of stabilization exercises on disability, pain, and core stability in patients with non-specific low back pain: A randomized controlled trial. *Work*, *70*(1), 99–107.

Scaturro, D., Balbo, A., Vitagliani, F., Stramazzo, L., Camarda, L., & Letizia Mauro, G. (2022). Is there a relationship between idiopathic scoliosis and body mass? A Scoping Review. *Nutrients*, *14*(19), 4011.

Seaman, D. R. (2013). Body mass index and musculoskeletal pain: is there a connection? *Chiropractic & Manual Therapies*, *21*, 1–9.

Sergienko, S., & Kalichman, L. (2015). Myofascial origin of shoulder pain: a literature review. *Journal of Bodywork and Movement Therapies*, *19*(1), 91–101.

Spencer, L., McKenna, L., Fary, R., Jacques, A., & Briffa, K. (2019). Upper back pain in postmenopausal women and associated physical characteristics. *PLoS One*, *14*(7), e0220452.

Takatalo, J., Ylinen, J., Pienimäki, T., & Häkkinen, A. (2020). Intra-and inter-rater reliability of thoracic spine mobility and posture assessments in subjects with thoracic spine pain. *BMC Musculoskeletal Disorders*, *21*, 1–13.

Vasudevan, S. (2015). Multidisciplinary management of chronic pain. *Riverport, Ln: Springer International Publishing AG*.

Vergeld, V., & Utesch, T. (2020). Pain-related self-efficacy among people with back pain: a systematic review of assessment tools. *The Clinical Journal of Pain*, *36*(6), 480–494.

Weerasinghe, T. D., Batagod, C. K., Chandrika, K. A. C., & Siriwardans, W. (2012). Prevalence and determinants of stress among undergraduates: A study of public universities in Colombo region. *Proceedings of the 7th International Research Conference on Management and Finance. University of Colombo, Sri Lanka*, 478–492.

Werenski, J. (2011). The effectiveness of Myofascial release technique in the treatment of Myofascial pain. *Lit. Rev, 32*, 440–450.

Yang, J., & Kim, S. (2015). The Effect of thoracic joint mobilization on pain, proprioception and static balance in patients with chronic low back pain. *Physical Therapy Korea*, *22*(3), 1–11.

Yang, J., Lee, B., & Kim, C. (2015). Changes in proprioception and pain in patients with neck pain after upper thoracic manipulation. *Journal of Physical Therapy Science*, *27*(3), 795–798.

Yang, S.-R., Kim, K., & Park, S.-J. (2015). The effect of thoracic spine mobilization and stabilization exercise on the muscular strength and flexibility of the trunk of chronic low back pain patients. *Journal of Physical Therapy Science*, *27*(12), 3851–3854.

Yirdaw, G., Lamore, Y., Lette, A., & Daba, S. (2021). Back and upper body musculoskeletal pain and associated factors among medicine and nursing practicing students at university of Gondar, Ethiopia. *African Journal of Medical and Health Sciences*, *20*(7), 88–97.

APPENDIX

ANNEX I: **Informed Consent**

I am a postgraduate student of Bangladesh Health Professional Institute currently following Masters in Rehabilitation Science program conducting a research on "Effectiveness of thoracic mobility exercises versus manual release technique in minimizing mechanical upper back pain among undergraduates - A Randomized Control Trail." This study will help to identify the effect of thoracic mobility exercises versus manual release techniques which are used to treat upper back pain among undergraduates. Further, this study will help to identify which treatment method is superior among both treatment methods in reduce pain in upper back in different positions such as sitting, standing, walking, sleeping and transferring, improve muscle strength and improve mobility or movement of upper back.

This form provides you information regarding the above mentioned research and invites you to be a part of this research. You may discuss the research with anyone you are comfortable with before making a decision to participate or not. This form may contain certain words that you may not clearly understand. Please do not hesitate to stop us to inquire from us at any point if you have any questions or need clarification. If any questions/doubts arise at a later time, you may inquire from us at any time during this research.

Information sheet

Academic work load among undergraduates of Sri Lanka is most significantly noticed in renounced universities. Due to increase workload and stress most of the students complained upper back pain. Increased study hours, wrong position which they are following during their studies trigger upper back pain and neck pain among undergraduates. In addition, in Sri Lankan university setting most of the exams are following in hand written method, continuous writing, ergonomic issues in writing and sitting act as provoking factors for upper back pain. Students who are suffered with upper back pain complained poor performance in academics as well as effectiveness in study period also reduced. Even though numerous physiotherapy treatments are available for upper back pain. Students showed improvements in particular treatments. This study is going to evaluate the most effective treatment method for upper back pain. This study will help for physiotherapists to identify the best treatment method to treat upper back pain. Further, prevalence of upper back pain among undergraduates also will be minimized as well as helps to improve the academic achievement of the undergraduates in Sri Lanka.

Procedure of the Research:

After obtaining your consent to participate in the study, we will assess you and you will be given physiotherapy treatment.

Measurement	Procedure
Pain	You will be given a scale numbered 0-10. Number “0” indicates “no pain at all”, while number “10” indicates “the worst pain ever possible”. You have to mark a number between 0 – 10 which best describes the amount of pain you have in different positions such as sitting, standing, walking, sleeping and transfering.
Range of Motion	The available range of motion of the back in Forward bending and backward bending will be measured using a small plastic equipment called “inclinometer” and measuring tabe. You will be positioned appropriately by the physiotherapist, and then the measurements of the movements will be taken
Muscle strength	You will be positioned by the therapist in an appropriate way and strength of back muscle will be examined by the therapist.
Function or Disability	“Pain Self-Efficacy Questionnaire” will be given to assess the confidence to perform a set activities, despite of pain. It consist of 10 questions about the actions on can do in daily life which was rated by using Likert scale from 0 to 6. Here, “0” represents no confidence at all and “6” represents completely confidents. You have to mark your confidence level to perform each actions.

The treatment will include manual therapy and exercises which is a routinely practiced treatment approach in physiotherapy clinics to reduce pain, improve mobility and muscle strength in upper back. Proper instructions and demonstrations will be provided prior to each treatment session. This treatment will be delivered three times weekly for two weeks. One session will last for at least 20 mins. At the end of the two weeks, you will be assessed again to check for any progressions. COVID19 guidelines will be followed during assessments and treatments.

Participant selection and voluntary participation:

If you are an undergraduate of any universities in Sri Lanka who is having Upper back pain more or equal to 7 days, you could engage in this study. Your participation in this research is entirely voluntary. If you choose not to participate in this research project, please do not hesitate to let us know of your decision. You can change your mind at any time during this research and stop participating even if you agreed to participate now.

Duration:

Treatment duration will be 2 weeks. You will receive the treatments three times per week, and a minimum of 20 minutes of treatment per day.

Risks/Hazards/Benefits:

You would be able to improve your health status (reducing the pain in upper back) and quality of life by participating in this research, also your participation is likely to help us find the answers to the research question.

You may feel mild discomfort during manual therapy. If you possess any contraindication for the treatments, you will be excluded.

Reimbursement:

We are unable to reimburse you for your participation in this research either monetarily or by any other form of gift(s). We are grateful for your participation.

Confidentiality:

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one but the researchers will be able to see it. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with anyone else. Privacy will be maintained when applying the treatments.

Right to Refuse or Withdraw:

You do not have to take part in this research if you do not wish to do so and your decision will not affect any services you may receive at this facility by us as. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will still be respected.

Whom to Contact:

If you have any questions, you may ask us now or later, even after the study has started. If you wish to ask questions later, you may contact any time through the following contact details.

Name with tittle: Ms Vithursha Sivakumar (researcher)

Contact details: 0764168500

ANNEX II: Pre Test Questionnaire

Effectiveness of Thoracic mobility exercises versus manual release technique in minimizing mechanical upper back pain among undergraduates in Sri Lanka

1. Personal Details

1.1 Name : ……………………..………………………..

1.2 Address: …………………………………………......

1.3 Permanent Address: ………………………………………………

1.4 Phone / Mobile No: ……………………………………………….

Code No:………………………………..

Effectiveness of Thoracic mobility exercises versus manual release technique in minimizing mechanical upper back pain among undergraduates in Sri Lanka

Code No:……………………………

2. Demographic Data

2.1 Age : ………………………………………………

2.2 Gender : ………………………………………………

2.3 Height : ………………………………………………

2.4 Weight : ………………………………………………

2.5 BMI : ………………………………………………

2.6 Family Size : ………………………………………………

2.7 Bread Winner of the family:………………………………………..

2.8 Monthly Income : ………………………………………………

2.9 Financial support for study:………………………………………...

Pre Test Questionnaire

3. Pain related questions:- Baseline

3.1 How long have you been experiencing Upper back or thoracic pain?

………………………………………………………………………..

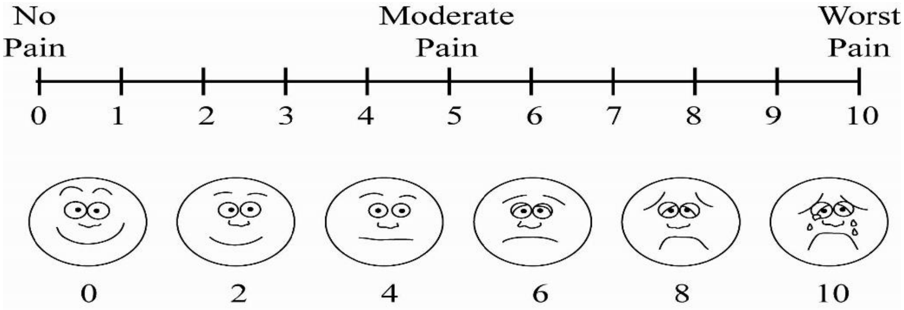
3.2 When did your pain occur for the first time?

…………………………………………………………………………

3.3 What are the treatments that you underwent so far?

………………………………………………………………………….

In the following scale, mark a number which best describes your pain. Number "0" indicates "no pain at all", and number 10 indicates "the worst pain ever possible".You have to denote the number which best describes your pain in following instance and please denote the number respective to each activity in the following chart.



4. Range of Motion (ROM) – Base Line

Aspect	VAS/ Pain scale number
3.4 Present Pain Intensity	
3.5 Sitting	
3.6 forward Bending	
3.7 Standing	
3.8 Walking	
3.9 Sleeping	
3.10 Transferring	
3.11 Performing day to day activities	

Joint	**Movement**	**ROM**
Thoraco- Lumbar	Flexion	
	extension	

5. Muscle Strength – Base Line

Muscle strength of Thoracic spine extension	MMT Scale (Oxford- Grading Scale)

6. Pain- Self- efficacy Questionnaire (PSEQ) – Baseline

Please rate how confident you are that you can do the following things at present, despite the pain. To indicate your answer tap one of the options on the scale under each item, from "not at all confident" to "completely confident".

(Fill the appropriate field only)

	0 “not at all confident”	1	2	3	4	5	6 "completely confident"
I can enjoy things, despite the pain.							
I can do most of the household chores (e.g. tidying-up, washing dishes, etc.), despite the pain.							
I can socialise with my friends or family members as often as I used to do, despite the pain.							
I can cope with my pain in most situations.							
I can do some form of work, despite the pain. ('work' includes housework, paid and unpaid work).							
I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain.							

I can cope with my pain without medication.							
I can still accomplish most of my goals in life, despite the pain.							
I can live a normal lifestyle, despite the pain.							
. I can gradually become more active, despite the pain.							

ANNEX III: Post Test Questionnaire

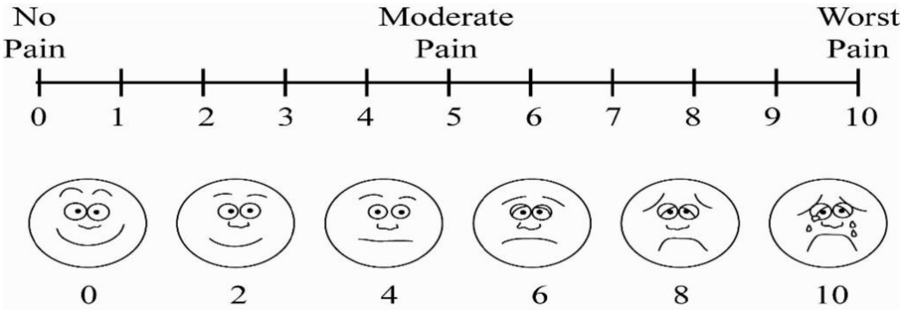
Effectiveness of Thoracic mobility exercises versus manual release technique in minimizing mechanical upper back pain among undergraduates in Sri Lanka

Post Test Questionnaire

Code No:……………………………

1. Pain related questions:

In the following scale, mark a number which best describes your pain. Number "0" indicates "no pain at all", and number 10 indicates "the worst pain ever possible". You have to denote the number which best describes your pain in following instance and please denote the number respective to each activity in the following chart



Aspect	VAS/ Pain scale number
1.1Present Pain Intensity	
1.2Sitting	
1.3forward Bending	
1.4Standing	
1.5Walking	
1.6Sleeping	
1.7Transferring	
1.8Performing day to day activities	

2. Range of Motion (ROM)

Joint	Movement	ROM
Thoraco- Lumbar	Flexion	
	extension	

5. Muscle Strength

Muscle strength of Thoracic spine extension	MMT Scale (Oxford- Grading Scale)

6. Pain- Self- efficacy Questionnaire (PSEQ)

Please rate how confident you are that you can do the following things at present, despite the pain. To indicate your answer tap one of the options on the scale under each item, from "not at all confident" to "completely confident".

(Fill the appropriate field only)

	0 “not at all confident”	1	2	3	4	5	6 "completely confident"
. I can enjoy things, despite the pain.							
. I can do most of the household chores (e.g.							

tidying-up, washing dishes, etc.), despite the pain.							
I can socialise with my friends or family members as often as I used to do, despite the pain.							
I can cope with my pain in most situations.							
I can do some form of work, despite the pain. ('work' includes housework, paid and unpaid work).							
I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain.							
I can cope with my pain without medication.							
I can still accomplish most of my goals in life, despite the pain.							
I can live a normal lifestyle, despite the pain.							
I can gradually become more active, despite the pain.							

Annex IV: Treatment Protocol

Experimental Group:

Thoracic Mobility exercises

1. Cat and Camel exercise:

   Subject has to position himself on their hands and knees on the floor. Head has to be in relaxed position and allowed to drop down (figure IV.I). First, Subject has to round his back toward the ceiling until he or she feel a nice stretch in his or her upper and middle back. When Perform this technique subject has to inhale (figure IV.II). Hold this stretch for 10 seconds. Then subject has to return to the starting position with flat back. While doing this subject has to exhale. Subject has to let his back sway by pressing his or stomach toward the floor (Figure IV.III). Hold this Position for 10 seconds. Repeat for 5 times.

Figure IV.I

Figure IV.II

Figure IV.III

2. Horizontal Chest Expansion:

   Subject has to stand shoulder width apart. Bring the hands in front of the body to the shoulder level and palm of each hand to be touched each other (parallel to the floor)(figure IV.IV). While breathing in or inhaling bring both hands apart from each other to the side and go beyond the side of the body (Figure IV.V). After that, This Position has to hold for 10 seconds. Then, while exhaling hands have to return back to the normal position. Exercise has to repeat for 5 times.

Figure IV.IV

Figure IV.V

3. Cross arm chest expansion:

Subject has to stand shoulder width apart. Subject has to gently cross arms, so that finger tips point to the opposite shoulder. Then, Subject has to keep the lower body stable and turn the upper body from side to side allowing with head to follow the movement. Subject has to keep the movement controlled and smooth (figure IV.VI). Repeat 5 times.

Figure IV.VI

Subjects has to perform these exercise two times a day. Exercise has to be performed with 5 minutes break for up to two weeks. Participants to be examined 3 times in a week whether they performed correctly.

Control Group:

Myofascial release:

Participants will be properly placed in prone lying position and adequate Therapist will palpate the muscle (spinal extensors) and trigger points will be identified. Constant pressure will be applied for 90 seconds to release the painful points as illustrated in Figure IV.VII

Figure IV.VII

Thoracic Spine Mobilization (Maitland technique):

Postero-anterior central vertebral pressure:

Starting position:

Subject will be positioned in prone with forehead relaxed in the back of the hands. For mobilizing upper thoracic spine (T1-T5). Therapist positioned himself to the right angle to the mobilizing surface area of the body. The pads of the thumbs are placed on the spinous process, pointing transversely across the vertebral column, and the fingers of each hand are spread out over the posterior chest wall to give stability to the thumbs. The pressure should be transmitted through the thumbs so that the interphalangeal joints are hyperextended with a slight degree of Flexion in the metacarpophalangeal joints (as illustrated in figure IV.VIII - C).

To mobilize the mid-thoracic spine (T5–9), the physiotherapist should stand at the patient's side at the waist level with her thumbs placed longitudinally along the vertebral column so that they point towards each other. The fingers can then spread out over the posterior chest wall, to each side of the vertebral column above and below the thumbs (as illustrated in Figure IV.VIII -A).

For the lower thoracic spine (T10–12), the physiotherapist's position depends upon the shape of the patient's chest. Either of the latter two positions described above may be used, but the essential factor is that the direction of the pressure must be at right angles to the body surface at the level (as illustrated in Figure IV.VIII -B).

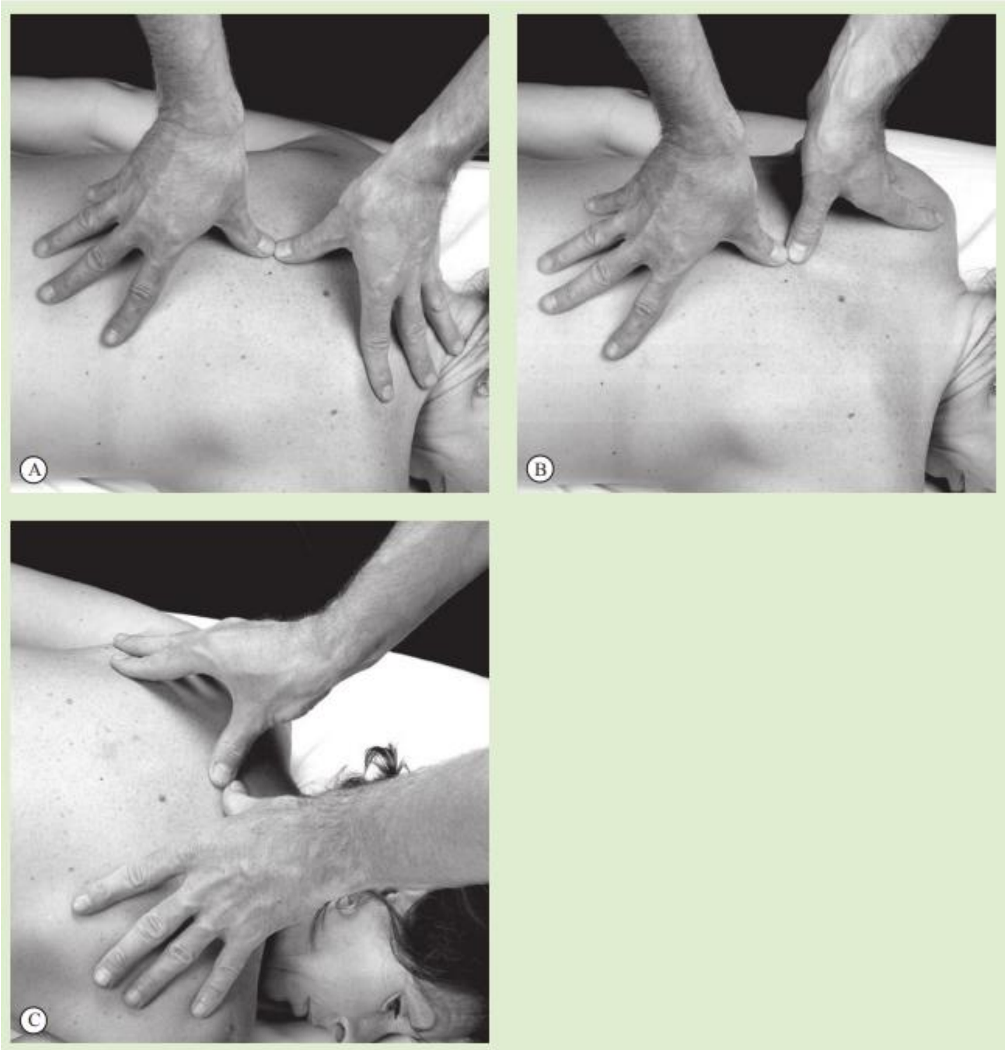


Figure IV.VIII

Method:

The mobilizing is carried out by an oscillating pressure on the spinous processes, produced by the body and transmitted through the arms to the thumbs. It is important that this pressure is applied by the body weight over the hands and not by a squeezing action with the thumbs themselves.

According to the Maitland's concept of joint mobilization technique, Grade I will be provided to improve pain, Grade II mobilization will be provided to improve pain and Range of motion and Grade III mainly applied for mainly to improve range of motion. Therefore, according to the pain intensity of the patient therapist will decide the grades (Hengeveld & Banks, 2014).

ANNEX IV: Permission letter for University of Peradeniya

Ms. Vithursha Sivakumar
Department of Rehabilitation Science,
Bangladesh Health Professional Institute (BHPI),
University of Dhaka,
Bangladesh.
18/10/2023

Dean,
Faculty of Faculty of Allied Health Sciences,
University of Peradeniya.

Dear Sir,

<u>REQUESTING PERMISSION FOR DATA COLLECTION FOR THE RESEARCH</u>

I am Vithursha Sivakumar currently pursuing Masters in Rehabilitation Science (funded by SAARC Developmental Fund) in Department of Rehabilitation Science at BHPI. I would like to conduct a thesis titled, **"Effectiveness of Thoracic mobility exercise versus manual release technique in minimizing mechanical upper back pain among undergraduates in Sri Lanka".** This is a Randomized Control trail with the purpose of finding the effectiveness of thoracic mobility exercise when compared with manual therapy in minimizing upper back pain.

This study includes pre and post-test assessment of pain intensity, muscle strength of upper back, Range of motion of thoracic pain and Disability level which need only bed and chair for assessment. Assessment will be long lasting only for 20 minutes. In addition, participants will be allocated to two intervention groups which need bed with closed space for the application of the manual therapy. Each treatment session will be long lasting for 30 minutes 3 times per week for nearly two weeks. According to the calculation, total sample size is 60 undergraduate students and Data collection period will be from 1st November 2023 to 31st January 2023.

I have obtained Ethical approval from my institute (Ref No: CRP-BHPI/IRB/10/2023/734) and here, I have attached a copy of ethical approval letter. Please consider my requesting letter for data collection and kindly grant me a permission and necessary facilities to conduct the research in medical faculty.

Thankyou

Yours Sincerely,

(S.Vithursha)

ANNEX V: IRB Approval Letter

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

BANGLADESH HEALTH PROFESSIONS INSTITUTE

Ref: CRP-BHPI/IRB/10/2023/734

Date: 09/10/2023

To
Ms. Vithursha Sivakumar
M.Sc. in Rehabilitation Science
Session: 2021-2022
Student ID: 181210147
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal "Effectiveness of Thoracic mobility exercise versus Manual release technique in minimizing mechanical upper back pain among undergraduates in Sri Lanka [thesis]" **by ethics committee.**

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

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

The purpose of the study is to find out the effectiveness thoracic mobility exercise compared with manual release technique in minimizing upper back Pain. The study involves pretest and posttest assessment using questionnaire and measuring tape to find out pain intensity, Muscle strength of upper back, Range of Motion and Disability level which will take 20 minutes as well as study involves application of Thoracic mobility exercise and manual therapy which will take 30 minutes for 3 times a week to find the effectiveness in the therapy.

There is no likelihood of any harm to the participants and / or participation in the study because both therapy will improve the upper back pain. Therefore it may benefit to the participants who will involve in the study. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 08.30 AM on 8th April, 2023 at BHPI (35th IRB Meeting) .

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This

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CRP-Chapain, Savar, Dhaka-1343, Bangladesh. Tel: +88 02 224445464-5, +88 02 224441404, Mobile: +88 01730059647
E-mail : principal-bhpi@crp-bangladesh.org, Web: bhpi.edu.bd

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

Ref: CRP-BHPI/IRB/10/2023/734

Date: 09/10/2023

Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

....

Member Secretary,
Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

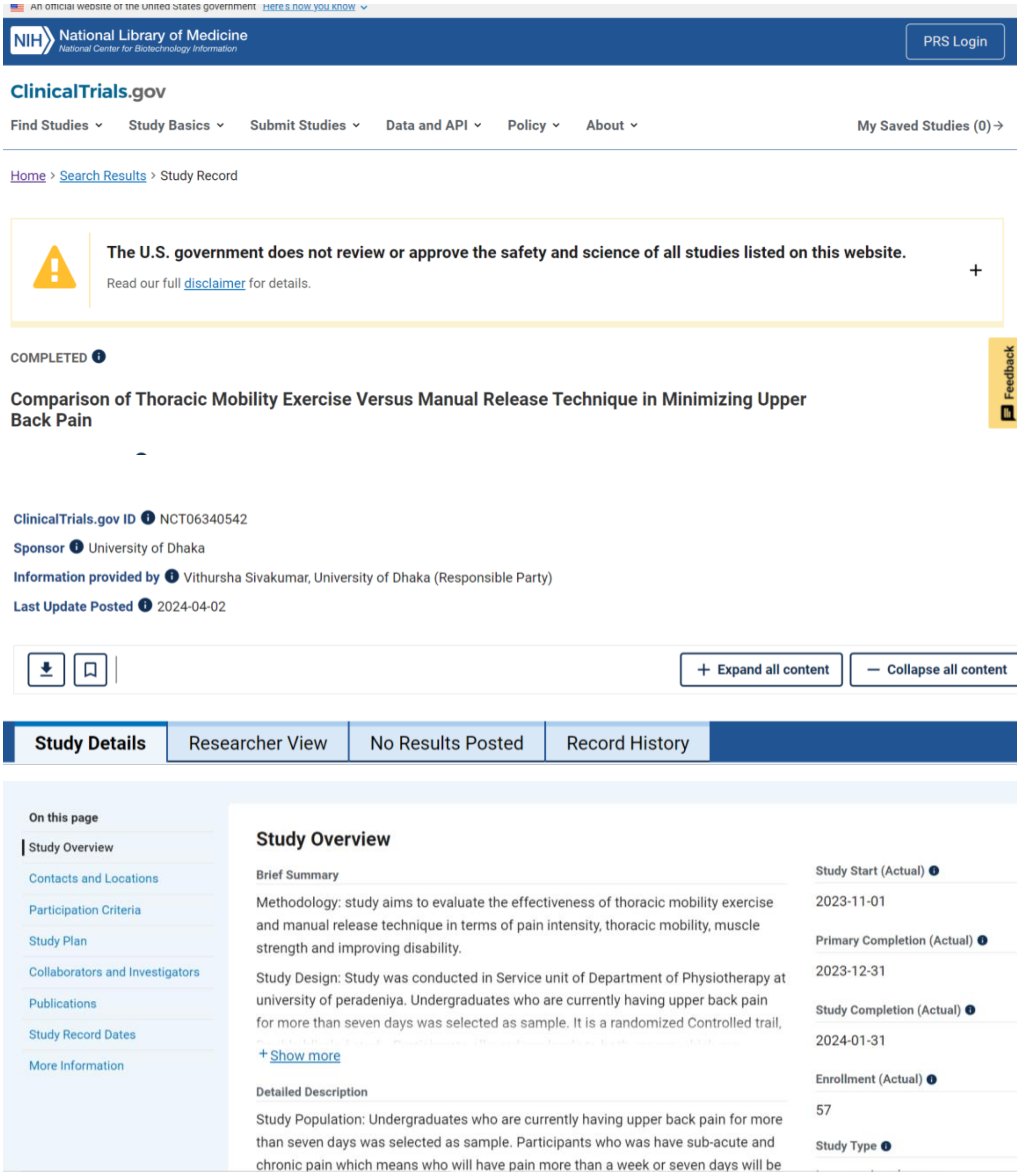
সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ। ফোন: +৮৮ ০২ ২২৪৪৪৫৪৬৪-৫, +৮৮ ০২ ২২৪৪৪১৪০৪, মোবাইল: +৮৮ ০১৭৩০ ০৫৯৬৪
CRP-Chapain, Savar, Dhaka-1343, Bangladesh. Tel: +88 02 224445464-5, +88 02 224441404, Mobile: +88 01730059647
E-mail : principal-bhpi@crp-bangladesh.org, Web: bhpi.edu.bd

ANNEX VI: Clinical Trail Registration

Proposal submission:

https://classic.clinicaltrials.gov/ProvidedDocs/42/NCT06340542/Prot_SAP_ICF_000.pdf

Trail Registry link: https://clinicaltrials.gov/study/NCT06340542



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Feedback

COMPLETED

Comparison of Thoracic Mobility Exercise Versus Manual Release Technique in Minimizing Upper Back Pain

ClinicalTrials.gov ID NCT06340542

Sponsor University of Dhaka

Information provided by Vithursha Sivakumar, University of Dhaka (Responsible Party)

Last Update Posted 2024-04-02

+ Expand all content | — Collapse all content

Study Details | Researcher View | No Results Posted | Record History

On this page
- Study Overview
- Contacts and Locations
- Participation Criteria
- Study Plan
- Collaborators and Investigators
- Publications
- Study Record Dates
- More Information

Study Overview

Brief Summary

Methodology: study aims to evaluate the effectiveness of thoracic mobility exercise and manual release technique in terms of pain intensity, thoracic mobility, muscle strength and improving disability.

Study Design: Study was conducted in Service unit of Department of Physiotherapy at university of peradeniya. Undergraduates who are currently having upper back pain for more than seven days was selected as sample. It is a randomized Controlled trail,

+Show more

Detailed Description

Study Population: Undergraduates who are currently having upper back pain for more than seven days was selected as sample. Participants who was have sub-acute and chronic pain which means who will have pain more than a week or seven days will be

Study Start (Actual)
2023-11-01

Primary Completion (Actual)
2023-12-31

Study Completion (Actual)
2024-01-31

Enrollment (Actual)
57

Study Type