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

A Double Blinded Randomized Control Trail

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Abstract: This Trail focus on compare the effectiveness of thoracic mobility exercises 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. 57 participants randomly allocated each groups and allocation was concealed. Accessors and participants are blinded interventions were provided 3 times per week for nearly 2 weeks. BMI showed a significant association with pain intensity. Experimental group showed a significant improvement in pain intensity during sitting, forward bending, walking, and standing and in activities of daily living, thoracic-lumbar extension, extensor muscle strength than control group. Additionally both groups showed improvement in self-efficacy.

Key words **- Upper Back Pain (UBP), Undergraduates, Thoracic mobility exercises, Manual Release technique and Muscle strength.**

I. INTRODUCTION

Upper Back referring to region from T1 to T12 region of the spine and often referred as “Cinderella” region due to its less research focus (Exelby, 2011) (Heneghan et al., 2018). Pain in upper back region referred as Upper Back Pain (UBP) (Sergienko & Kalichman, 2015). UBP 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. Generally, Prevalence of acute or subacute and chronic UBP pain is ranging from 3.4%- 34.8% and 15.6%- 19.5% respectively among general population (Fouquet et al., 2015). According to evidence, wide range of causes for non-specific UBP which includes musculoskeletal causes as well as systemic origin (Maselli et al., 2022). UBP 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 lead to hunched position, while the muscles of the upper back and neck become weak (Lin et al., 2020).

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 UBP 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). Support braces, tape-assisted posture retraining, muscular stretches 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).

NEED OF THE STUDY.

Literature reveals that UBP is highly prevalent among adults who spent long hours in working or studying with prolonged poor sitting posture. 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 there is a high prevalence among UBP (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. Undergraduates and their academic performance considered as a significant factor in economic and social development of the country. 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 for UBP.

II. RESEARCH METHODOLOGY

2.1 Objectives:

Main objective of the study is to find out the effectiveness thoracic mobility exercise compared with manual release technique in minimizing UBP. In addition, evaluate the correlation between the sociodemographic factors and pain intensity of participants and evaluate the effectiveness of thoracic mobility exercise and manual release technique in improving UBP intensity, thoracic mobility, upper back muscle strength and self-efficacy of participants

2.2 study design:

A double blinded RCT which accessors and participants are blinded. Study was registered in National Library of Medicine's ClinicalTrials.gov platform (Protocol ID: NCT06340542, Link address: https://classic.clinicaltrials.gov/ct2/show/NCT06340542). Initially 72 undergraduates with UBP screened for eligibility 60 individuals selected who has pain more than 7 days as well as without any recent surgeries or accidents related to pain. After that, 30 participants were randomly allocated to each groups. Three of them withdraw the study. 57 participants (experimental n=28 and control = 29) completed the study. Participants were allocated to experimental and control group by using lottery method. Each participants received the treatment for 3 times per week for 2 weeks. Experimental group received exercise therapy (thoracic mobility exercise) and control group received manual therapy. 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 clearly informed about the withdrawal policy and confidentiality.

2.3 Study sample:

Undergraduates who are currently studying in state universities in Sri Lanka (between 20 – 26 years) and those who were currently having upper back pain for more than seven days was 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.

2.4 study site:

Study was conducted in clinical setup where rooms are air conditioned with ambient temperature 25 degree to 28 degree Celsius to increase the participant comfort. Assessment and treatment were maintained in a private manner to ensure the confidentially of participants.

2.5 Data collection tool:

Validated high reliability tools such as Visual Analogue Scale (VAS), Tape Measurement, Manual Muscle Testing – Oxford grading Scale, Pain Self-Efficacy Questionnaire (PSEQ) were used to measure pain intensity, thoracic-lumbar flexion and extension, extensor muscle strength and self-efficacy of the participants respectively.

2.6 Theoretical Framework

Independent variables which are used for analysis are age, gender, Body Mass Index (BMI), monthly income, pain duration, family size and previous treatment. Dependent variables are Pain intensity during present, sitting, forward bending, Standing, Walking, Sleeping, Transferring and ADL (VAS Scale), Muscle strength of Extensors (MMT scale), thoracic-lumbar flexion and extension, Self-Efficacy (PSEQ questionnaire)

III. RESULTS AND DISCUSSION

3.1 Descriptive Statics of Participants

Table 3.1: Descriptive Statics and association with pain intensity

Variable	Experimental Group			Control Group			Association with pain intensity (sig)
	Minimum	Maximum	Mean± Std.Deviation	Minimum	Maximum	Mean± Std.Deviation	
Age (years)	20	26	22.61 ± 1.892	20	24	22.14 ± 1.597	0.598
Gender	75.0% Male	25% Female		75.9% Male	24.1% Female		0.352
BMI (kg/m^2)	28.4	15.6	21.29± 3.144	28.7	14.73	20.7 ± 3.611	0.006*
Monthly Income (Rs)	100000/=	15000/=	47928.57± 22835.53	400000/=	15000/=	64896±70 111.821	0.791
Pain duration (months)	48	1	10.18±12.681	36	1	8.97 ± 10.016	0.247
Family Size (No of members	4 (53.6%)	7(0%)		4 (44.8%)	8(0%)		0.462

Previous treatment	No (71.4%)	Exercise (0%)	No (79.4%)	Consult a doctor (0%)	0.347

*significance

Demographic characteristics of participants is shown in the table 3.1. In overall participants, average age was approximately 22.37 years old (±1.75), indicating a relatively young cohort. 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%.Participants is nearly equal to BMI of 20.99 (±3.37) which is acceptable according to the south Asian BMI range which is between 18.5 – 24.9 kg/m2 (Ansari et al., 2021).

Table 3.1 indicated that only BMI exhibited a significant correlation with pain intensity, with a p-value of 0.006. It reveals that potential association between higher BMI and increased UBP severity, particularly among individuals categorized as overweight or obese. 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 conducted in 2013 reported that an elevated BMI is linked to back pain and other musculoskeletal pain syndromes, possibly due to chronic systemic inflammation (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 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.

3.2 Pain intensity

Pain intensity was measured in different levels such as during the assessment, sitting, standing, forward bending, Standing, Walking, Sleeping, Transferring and ADL. Pain intensity in VAS scale was categorized in to three categories such as mild, moderate and severe pain. According to a study, indicate that measurement of chronic and subacute musculoskeletal pain in VAS can be categorized as mild pain range $\leqslant$ 3.4, moderate pain in between 3.5 to 7.4 and severe pain $\geqslant$ 7.5(Boonstra et al., 2014).

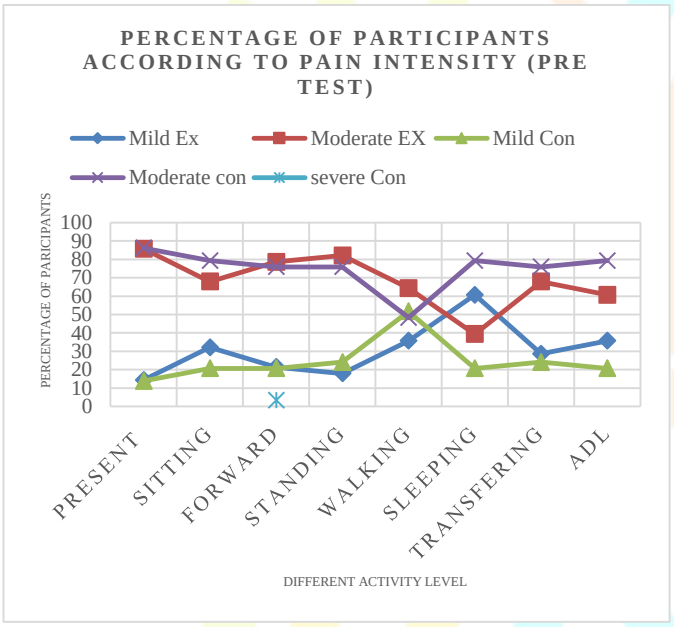

Figure 3.1: percentage of participants who belongs to mild, moderate and severe pain category in both control and experiment group in the Pretest.

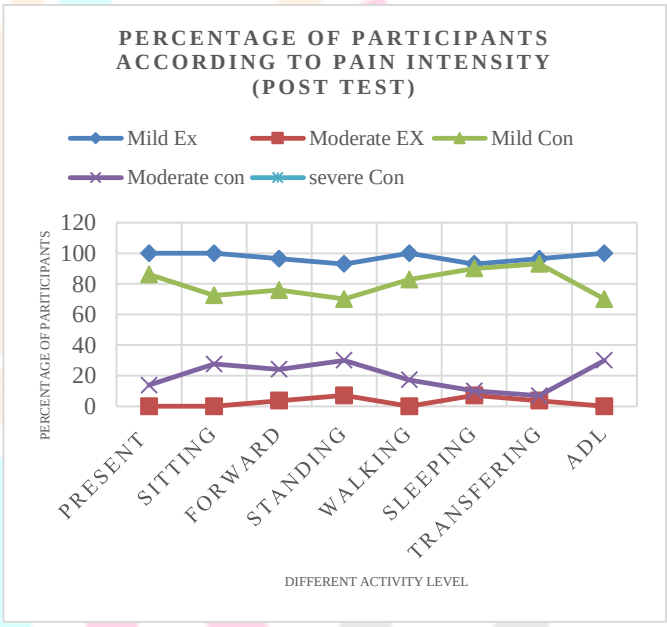

Figure 3.2 : percentage of participants who belongs to mild, moderate and severe pain category in both control and experiment group in the post test.

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

According to the figures 3.1 and 3.2, there was a dramatically increase in percentage of participants belongs to mild pain intensity when compared to control group. According to the Mann-whitney U test, significant difference was observed in experimental group during different pain intensity level such as during present (p=0.003), sitting (p=0.006), standing (p=0.012), forward bending (p=0.012), walking (p=0.023) and ADL (p=0.043) between both groups. However, both groups showed improvement in different pain intensity level except standing (p=0.07) and walking (p=0.08) during Wilcoxon test (statistical analysis performed by assuming $\alpha = 0.05$).

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, cranio-vertebral 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. In this study context, 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.

3.3 Thoracic mobility

Table 3.2 Tape measurement of thoracic-lumbar flexion and extension in both groups

		Mean Std. Deviation		Comparison between the groups
		Pre Test	Post test	
Thoracic-lumbar flexion	Experimental	7.16 ±1.38	7.39 ± 1.29	0.386
	Control	7.05 ± 0.93	7.13 ± 0.92	
Thoracic-lumbar extension	Experimental	4.06 ± 0.32	4.33 ± 0.30	0.036*
	Control	4.13 ± 0.26	4.17 ± 0.25	

*significance

Independent sample T- test was used to compare between the groups, p value, which is obtained for thoracic-lumbar flexion and extension at baseline are 0.707 and 0.376 which indicates that both groups are similar in baseline. However, in post-test p value obtained for thoracic-lumbar extension is 0.036 which indicates there is a significant improvement in experimental group. Similarly, both group showed improvement in thoracic-lumbar flexion after the interventions and did not show improvement in thoracic-lumbar extension in control group (p=0.054) in paired sample t test.

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). A 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). Further, 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). 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. This situation improve the thoracic back pain.

3.3 Extensor muscle strength

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. In Experimental group, majority participants who belongs to grade 3 (42.9%) and 3+ (57.1%) were improved their muscle strength 3+ (53.6%) and 4 (39.3%) which was statistically significance (p=0.000) in Wicoxon test. In contrast, in control group there is no significant difference (p=0.065) (illustrated in figure 3.3 and 3.4).

According to the research, neural adaptation of muscle strength and muscle strength gains will occur from 2 weeks (GABRIEL et al., 2001; Mofatteh, 2021). 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.

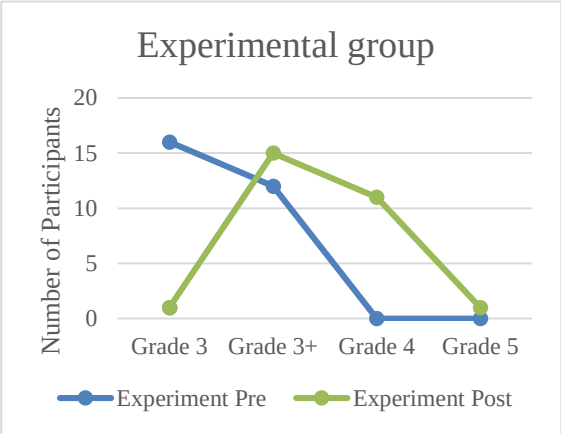

Figure 3.3 Muscle strength grading of participants during Pre and Post-test in experimental group

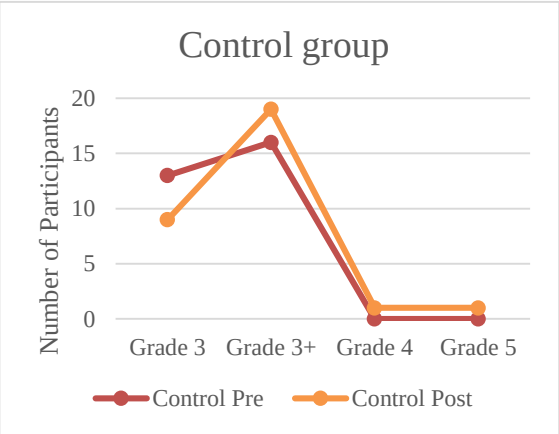

Figure 3.4 Muscle strength grading of participants during Pre and Post-test in experimental group

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;

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 $\geqslant$ 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. Both groups improved there self-efficacy after interventions with p value of 0.000 in Wilcoxon test. Beyond solely targeting pain reduction, interventions should aim to empower individuals to regain control over their lives and engage in meaningful activities despite pain.

IV CONCLUSION

The findings highlight the diverse demographic characteristics of the participants experiencing UBP, reflecting the heterogeneous nature of the condition. Importantly, the study identifies a significant correlation 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. 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 thoracic-lumbar extension and muscle strength of thoracic extensors, highlight the therapeutic potential of these interventions. 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.

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. 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.

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