Effects of therapeutic exercises combined with breathing exercises on pectoral muscles length and chest expansion among students with rounded shoulder

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***Abstract*- Background**

Proper posture is defined as a balanced musculoskeletal state in which no extra stresses put on muscles or soft tissues. Students are usually unaware of proper posture and appropriate ways to maintain it. Prolong working on laptops, desktops pain leads to discomfort affecting their work and activities of daily living. In forward shoulder posture (FSP), shoulder impingement can occur and lung function can be affected. The aim of this study is to find out the effects of therapeutic exercises combined with breathing exercises on pectoral muscles length and chest expansion among students with rounded shoulder.

Methods:

A randomized controlled trial study was conducted to find out the effects of therapeutic exercises combined with breathing exercises on pectoral muscles length and chest expansion among UTAR students. The intervention period was five weeks. A total of 45 participants were recruited and randomly assigned into three groups, Group A (n=15), Group B (n=15) and Group C (n=15). Group A performed stretching and breathing exercises, Group B performed strengthening and breathing exercises and Group C performed only breathing exercises. Stretching exercises targeted on both pectoralis major and minor muscles while strengthening exercise only involved prone scapular retraction. In this study, pectoralis major and minor muscle length as well as chest expansion were measured.

Results:

After five weeks of intervention exercises, result revealed that there were significant improvement with $p<0.05$ in pectoral length and chest expansion during post-test for all three groups. There were no significant differences in post-test for pectoral muscles length and chest expansion among three groups.

Conclusion:

The study showed all three groups improved significantly in pectoral muscles length and chest expansion. There were no significant differences in post-test for pectoral muscles length and chest expansion among three groups. All three groups were almost same effective in improving pectoral muscles length and chest expansion.

***Index Terms*-** Stretching, Strengthening, Breathing exercises, Pectoral muscle length, Chest expansion.

I. INTRODUCTION

Normal posture is when the line of gravity (LOG) passes through the external auditory meatus, the bodies of the cervical spine, and the acromion and anterior to the thoracic spine (Singla & Veqar, 2017). When the head not in the same line with the vertical axis of the body it may lead to rounded shoulder posture (RSP) and the thoracic kyphosis increases. The combination of increased kyphosis and altered line of gravity w known as slouched or slumped posture. This will increase workload on body ligaments and muscles in order to maintain an upright posture. RSP is characterized by protracted, internally rotated, anteriorly tilted, elevated, and abducted scapula along with winging of scapula. Tightness of the Pectoralis minor muscle is a contributing factor for RSP. (Wong et al, 2010). Forward shoulder posture can also occur due to repetitive overhead activities, backpack carriage, bad habit or posture, mouth breathing, computer and laptop use, and prolonged study hours (Singla & Veqar, 2017). The common risk factors that cause postural abnormalities were lack of knowledge on correct posture, sedentary lifestyle, occupational demands, joint stiffness, decreased fitness, muscle weakness, poor core stability, and poor ergonomic workstations (Rekha et al., 2018). Staying in the same position for prolonged periods can result in tightening of the agonist muscles and weakening of the antagonist muscles, thus abnormal posture adapted. Reduction in

physical activity, inappropriate posture habits in daily living and long-term use of smart phones lead to wrong posture such as forward neck posture, rounded shoulders and slouched posture. (Lee, Nam, & Sung, 2017). Change in the curvature of the neck bone causes upper-crossed syndrome due to an imbalance in muscular pattern, which subsequently leads to rounded shoulder posture (RSP) (Kim & Kim, 2016). Stretching of the pectoral muscles is used to correct abnormal postures and shoulder impingement syndrome. Retraction exercise that selectively strengthens the rhomboid, middle and lower trapezius muscles may be appropriate for patients with forward scapular posture as this exercise aimed to pull back the scapula from protraction position.

II. Research Methods

A randomized control trial was conducted in this study. Both females and males of UTAR students aged 18-25 with rounded shoulder posture were recruited. Total number of participants were 45. A screening test was done to confirm subjects have RSP where they are instructed to lie supine with their arms in a neutral position, the investigators palpated the acromion process and measured the vertical distance from the acromion process to the bed with a measuring tape. When the distance was more than 3 cm or more, the subject was selected for this study (Yoo, 2018). Subjects were assigned into three groups, Group A, Group B and Group C. Group A performed stretching exercise followed by breathing exercise, Group B performed strengthening exercise followed by breathing exercise and Group C performed breathing exercises only. Subjects were introduced, explained and demonstrated about the intervention exercises based on their groups.

Group A: Stretching exercises with breathing exercises

Subjects were instructed to perform two stretching exercises targeted on pectoralis major and minor muscles, and after the stretching exercises subjects performed four different types of breathing exercises. Stretching exercises are performed 3 days per week, 1 session per day while breathing exercises are performed 2 days per week, total 4 breathing exercises per day. To stretch the pectoralis major muscle, subjects were instructed to stand at the corner of a wall with both arm touching the corner of the wall and abduct the shoulder horizontally to the ground. Subjects were instructed to walk one step closer to the corner and stop at the position where they started to feel the stretch. Subjects were informed to hold the stretch for 30 seconds and perform 3 repetitions. For pectoralis minor stretch, subjects were instructed to lie on the couch, in supine position, then abduct and extend their shoulders while raising their arms over their heads. They were informed to stop at the position where they felt the stretch and hold for 30 seconds and repeated 3 times.

Strengthening exercise with breathing exercises

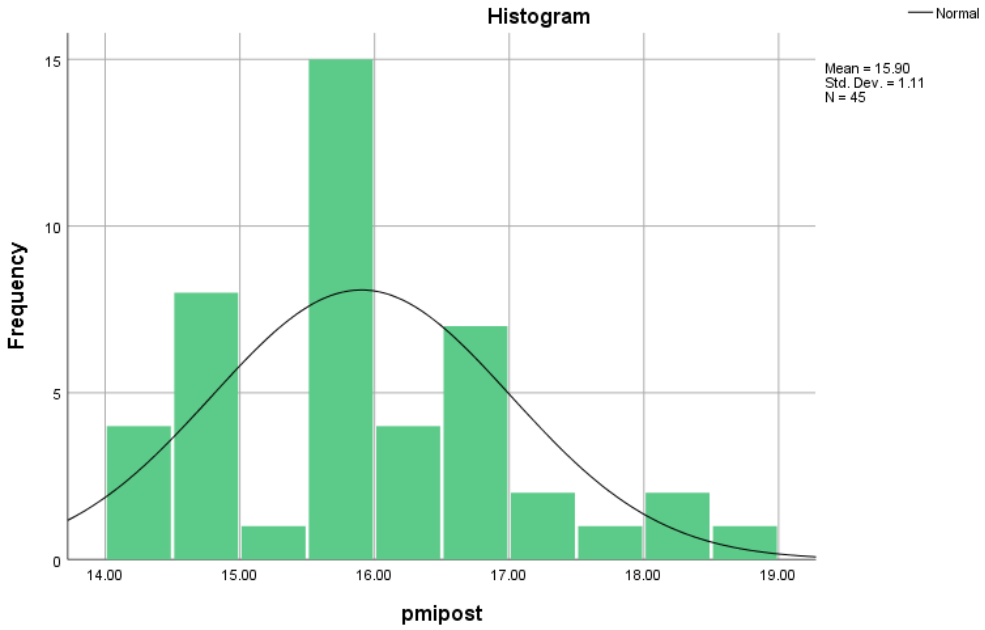
Subjects were instructed to perform 1 strengthening exercise which targeted on rhomboid and lower trapezius muscles, and after the strengthening exercise, subjects performed 4 different types of breathing exercises. Strengthening exercise was performed 3 days per week, 1 session per day while breathing exercises was performed 2 days per week, total 4 breathing exercises per day. Strengthening exercise was prone scapular retraction which selectively strengthen the rhomboid and lower trapezius muscles. Subjects were asked to be in prone position with their arms spreading horizontally, in 90 degrees. Then, subjects were informed to depress the shoulder first, then squeeze the scapula together while maintaining the depression. Researcher put 2 fingers between the subjects' scapula to give cues on how to squeeze the scapula together. Subjects were instructed to lift the dumbbells whose weights were 70% of the 1RM of each subject to endure moderate resistance. Subjects were informed to hold for 5 seconds each time and perform 10 repetitions of 2 sets. A two-minute rest was given between the sets.

Group C: Breathing exercises

Subjects in this group were asked to perform only breathing exercises, which needed 20 minutes twice per week, consisted of total 4 breathing exercises and 5 minutes for each. The first exercise was Apical Expansion Exercise. Subjects were asked to sit in a comfortable position, hands placed over the clavicle and first rib and then breathe using the upper chest. Subjects were instructed to apple slight pressure on clavicle during inspiration and release the pressure during expiration. Second exercise was Lateral Coastal Exercise. Subjects in sitting position with hands place over the lateral margin of lower ribs and were asked to expand the lateral side of the chest wall. Subjects were instructed to apple slight pressure on lower ribs during inspiration and release the pressure during expiration. Third exercise was Diaphragmatic Breathing Exercise. Subjects were told to keep their hands on the anterior aspect of chest wall just below the xiphisternum. Both hands were move in and out during breathing. Only very slight pressure was applied when the hands moved in and out. The fourth exercise was Thoracic Expansion Exercise. Subjects were asked to breathe in while taking their shoulders in full flexion and breathe out while taking their hands down. Subjects were given one script including the instructions for all the 4 breathing exercises and be reminded all breathing exercises were in normal breathing (Matani & Mistry, 2017)

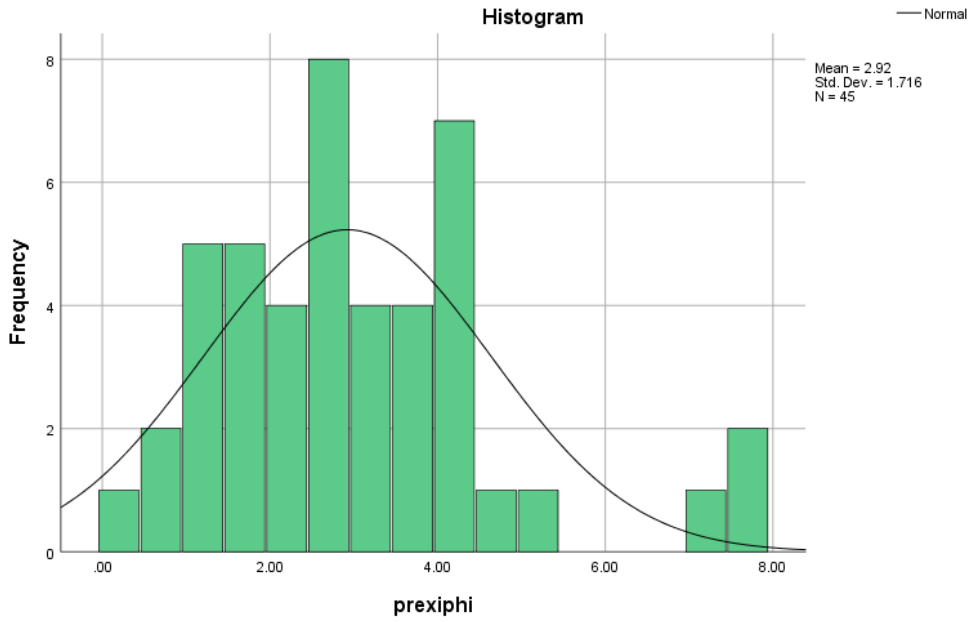
III. Result and Discussion

Histogram of Post-test for Pectoralis Minor length



Based on figure above, the histogram showed the post-test result for pectoralis minor length of all 45 participants. Table show that the post-test result for pectoralis minor length has significant value p<0.05, which accept the alternate hypothesis that the result was not normally distributed.

Histogram of Pre-test for Chest Expansion at Xiphisternum level



Based on figure above, the histogram showed the pre-test result for chest expansion at xiphisternum level of all 45 participants. Table 4.3 showed that the pre-test result for chest expansion at xiphisternum level has significant value p<0.05, which accept the alternate hypothesis that the result was not normally distributed.

Levene's Test of Equality of Error Variances

Variables	Levene statistic	df1	df2	Sig.
Pre.Pec.Major	0.60	2	42	0.55
Post.Pec.Major	1.307	2	42	0.28
Pre.Pec.Minor	0.29	2	42	0.75
Post.Pec.Minor	0.11	2	42	0.90
Pre.CE.Axillary	0.13	2	42	0.88
Post.CE.Axillary	3.73	2	42	0.03*
Pre.CE.Nipple	0.48	2	42	0.62
Post.CE.Nipple	1.57	2	42	0.22
Pre.CE.Xiphi	2.25	2	42	0.12
Post.CE.Xiphi	1.94	2	42	0.16

Note: df=degree of freedom; Sig.=significant p value
* indicates p<0.05

Tests of Between-Subjects Effects

Variables	F	df	Sig.
Pectoralis Major Length	1.09	2	0.35
Pectoralis Minor Length	2.05	2	0.14
Chest Expansion Axillary level	0.17	2	0.85
Chest Expansion Nipple level	0.39	2	0.68
Chest Expansion Xiphisternum level	1.12	2	0.34

Note: df=degree of freedom; Sig.=significance p value
* indicates p<0.05

There was no significant difference in the pectoralis major length, pectoralis minor length, chest expansion at axillary, nipple and xiphisternum levels for the 3 intervention groups (Group A, Group B and Group C).

Pre-test and Post-test of Pectoralis Minor Length

Pectoralis minor length	Group A	Group B	Group C	Sig.
Pre-test	15.60	15.16	14.72	0.11
Post-test	16.34	15.66	15.71	0.18
Mean differences	0.74	0.50	0.99	
Sig.	<0.01*	<0.01*	<0.01*	

Note: *indicates p<0.05

Pre-test and Post-test of Pectoralis Major Length

Pectoralis major length	Group A	Group B	Group C	Sig.
Pre-test	13.13	12.81	12.62	0.46
Post-test	13.66	13.21	12.96	0.26
Mean differences	0.53	0.40	0.34	
Sig.	<0.01*	<0.01*	<0.01*	

Note: *indicates p<0.05

For all 3 groups, there were significant improvement in pectoralis minor length with p value<0.05. The mean difference for Group C was the highest (0.99) followed by Group A (0.74) and Group B (0.50). The p value for pectoralis major length pre-test and post-test were 0.11 and 0.18, which were >0.05, indicated the results were not statistically significant.

Comparison of Post-test of Pectoralis Major Length among 3 groups

Variables	Group	Group	Mean Differences	Sig.
Pectoralis Major Length	A	B	0.45	0.89
		C	0.71	0.31
	B	A	-0.45	0.89
		C	0.26	1.00
	C	A	-0.71	0.31
		B	-0.26	1.00

Note: *indicates p<0.05

IV. Discussion

Chest expansion is improved because the respiratory muscles being lengthen by the breathing exercises performed. This supported the present study, breathing exercises alone improved the pectoral muscle length. This showed consistency with the study done by (Rai et al 2016), who also proved that stretching of the respiratory accessory muscles as well as breathing exercises alone can improve chest expansion at all 3 levels.Shortening of Pectoralis minor muscle can cause reduction in pulmonary function thus when this shortened muscle being stretched, pulmonary function can be improved. This supported the current study, where Group A (stretching group) significantly improved the chest expansion at all 3 levels among students with rounded shoulder. Moreover, the findings of this study showed that Group A was the most effective group in improving the chest expansion at the axillary level, while Group C was the most effective group in improving chest expansion at nipple and xiphisternum levels. This showed consistency with the articles done by (Morais et al., 2016) and (Matani & Mistry, 2017), which suggested that pectoral stretching improved chest expansion. Present study showed that pectoral stretching combined with breathing exercises significantly improved chest expansion among students with rounded shoulder. Limited chest expansion may affect lung capacity and result in difficulty in breathing in severe cases. (Cukier et al., 2016) suggested that respiratory muscles stretching should involve the scalene, sternocleidomastoid, trapezius, pectoralis major and minor. The present study agreed that stretching of respiratory muscles which involved pectoralis major and minor can improve lung capacity .The current study also showed that prone scapular retraction exercise combined with breathing exercise improved chest expansion with significance p value>0.05. Moreover, when in scapular retraction position, the anterior chest muscles being stretched. This lengthen the stretched muscles, and aid in increase in chest expansion, as less resistance put on chest wall. The present study also showed improvement in chest expansion in Group C (breathing group), the result was consistent with this study. In addition, results of current study for chest expansion were compatible with (Matani & Mistry, 2017) a study, which proved that breathing exercises alone improved chest expansion.

V. Conclusion

After five weeks of intervention, all three intervention groups showed significant improvement in pectoral muscles length and chest expansion at three levels. However, there was no significant difference of pectoral muscles length and chest expansion among three groups. Clinically, the stretching group with breathing exercises showed significant improvement in chest expansion and strengthening group with breathing exercises showed significant improvement in pectoral muscles length when compared with other groups. Further studies should be done to explore the long term effects of the intervention used in this study. The effectiveness of the intervention exercises on other population should be studied such as rounded shoulder associated with shoulder pathologies. Also, the effectiveness of therapeutic exercises combined with breathing exercises in clinical practice for RSP need further exploration.

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