Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 26s (2025)
https://www.jneonatalsurg.com

Study Of Combined Efficacy Of Upper Limb Proprioceptive Neuro Muscular Facilitation And Diaphragmatic Strengthening Exercise On Chest Expansion And Pulmonary Functionin Under Graduate Students With Rounded Shoulders

Miss. Pratiksha Uday Patil[1], Dr. Gloria Naik[*2]

[1]M. P. Th, Department of Community physiotherapy, D. Y. Patil College of Physiotherapy, Kolhapur

Email ID: pratikshapatil2976@gmail.com

[*2](M. P. Th), Assistant Professor, Department of Cardiopulmonary and Respiratory Physiotherapy, D.Y. Patil College of Physiotherapy, Kolhapur, Department of Community Physiotherapy

Corresponding Authors:

Dr. Gloria Naik,

Cite this paper as: Miss. Pratiksha Uday Patil, Dr. Gloria Naik, (2025) Study Of Combined Efficacy Of Upper Limb Proprioceptive Neuro Muscular Facilitation And Diaphragmatic Strengthening Exercise On Chest Expansion And Pulmonary Functionin Under Graduate Students With Rounded Shoulders. *Journal of Neonatal Surgery*, 14 (26s), 1226-1234.

ABSTRACT

Background: One of the most prevalent postural issues among young adults who are otherwise asymptomatic is Rounded shoulders. A high prevalence of forward shoulder posture has been linked to sedentary lifestyles, inadequate postural adjustments, slouching, and extended flexed postures. The scapula opens, the pectoralis major muscle tightens, and the neck protrudes forward in the phenomenon known as rounded shoulder posture, resulting in When viewed from the side, the upper torso tilts forward and the shoulder rolls forward. The prevalence of rounded shoulders is 84% among young adults (18 – 24 years of age) Ethical clearance was obtained from Institution Ethical Committee. Total 52 participants were included in this study according to the inclusive criteria. This quasi-experimental study was conducted at D.Y. Patil College of Physiotherapy over 1.5 years. 52 students with rounded shoulders were recruited using convenience sampling. Participants underwent upper limb proprioceptive eneuromuscular facilitation and diaphragmatic strengthening exercise sessions for 8week 3session per week, and their pre and post chest expansion and vital capacity was evaluated using measuring tape and digital spirometery scores measured.

Result: The paired t-test results indicate statistically significant improvements in various parameters post-intervention, as demonstrated by the p-values, all of which are <0.05. significantly difference found in chest expansion and vital capacity. And reduce the rounded shoulders.

Conclusion: The study concludes that upper limb proprioceptive neuromuscular facilitation and diaphragmatic strengthening techniques on chest expansion and pulmonary function effectively reduce rounded shoulder in undergraduate students. of tubers (10.20 and 10.30 per plant), were recorded in plots having tuber treatment *Terminila arjuna* bark extract and two foliar sprays of Enviro (botanical virucides)followed by tuber treatment and six sprays with *Tinospora cordifolia* (aerial stem extract) and uber treatment and six foliar spray with *Allium sativum* (garlic clove extract) during 2022-23 and 2023-24, respectively.

Keywords: *Rounded shoulder, Chest expansion, Proprioceptive Neuromuscular Facilitation, Students, pulmonary function.*

1. INTRODUCTION

Reduced physical activity and improper posture patterns in day-to- day living can cause muscular and skeletal tissues to shift shape.[1] Acromion protraction in front of the line of gravity, shoulder protraction downward rotation, and anterior tilt are the characteristics of rounded shoulder posture (RSP).[1] Additionally, prolonged usage of smartphones causes bad posture, including rounded shoulders, slouched posture, and forward neck position.[1] A complex system made up of the head, neck, and shoulders may experience one or more abnormal conditions as a result of changes in bodily processes brought on by rounded shoulders.[1] When the line of gravity (LOG) travels between the cervical spine's bodies, the acromion, the anterior region, and the external auditory meatus, it is considered normal posture Fig1.[2]

The internal moment generated by the different muscles and other soft tissue components surrounding a joint often balances the exterior moment created by gravity and ground reaction forces at that joint. [2] Postural malalignments, on the other hand, may necessitate higher internal pressures to counteract the external torque generated by gravity, which is exacerbated by the LOG. [2]

Failure of the head to align with the vertical axis of the body can lead to further malalignments in the body, namely, rounded shoulders and increased thoracic kyphosis, to compensate for the altered location of the LOG, leading to further impairments. [2] Combination of all these postural deviations is often known as “slouched posture” or “slumped posture.” fig 2. [2]

If the head is not in line with the body's vertical axis (Fig 2), the body may become increasingly malaligned, resulting in rounded shoulders and greater thoracic kyphosis, to make up for the LOG's changed placement, which results in additional limitations. "Slouched posture" or "slumped posture" are terms frequently used to describe a combination of all three postural abnormalities.[2] Muscle imbalance caused by rounded shoulder may manifest as a shortening of the anterior shoulder muscles, including the serratus anterior, pectoralis minor and major, and upper trapezius, rhomboids, middle and lower trapezius, and lengthening of the posterior shoulder muscles.[2]This muscular imbalance increases the chance of developing neck, shoulder, and nonspecific arm pain by altering kinematics, scapular, and gleno-humeral orientation.[2]

For extended periods of time, students are compelled to sit in front of a laptop or desk in a static position with their neck, shoulders, and back fixated without enough support. [2] anterior muscles in the neck shortened and deep posterior muscles of the spine in the neck area and the lower posterior mucles of the scapula get stretched and weakened [2]

Beause the respiratory muscles weaken with round shoulder position, it is difficult for the lungs to expand normally, which can result in irregular breathing and a drop in lung activity, total lung capacity, gas partial pressure, etc. [3] The two phases of breathing are inhalation and exhalation. The rib and abdominal muscles alter the rib cage's volume inward during inhalation, while the inspiratory muscle expands the chest cavity's volume and create sa negative pressure, which permits air to enter the lungs.[3] Proper head posture is a crucial component in enhancing lung performance.[3]Although it is comparatively challenging to assess, the diaphragm's movement is one of the key components of the breathing pattern.[3] The non-invasive ultrasonic examination technique, which has gained popularity recently, offers the benefit of being able to visuallyassess diaphragm movement and quickly identify problems.[3]

A noticeable drop in respiratory values was observed as the degree of rounded shoulder increased, suggesting that it may have an impact on pulmonary function. [4] Pulmonary function may be impacted by rounded shoulders through a number of mechanisms, including an increase in energy expend it ure brought by Reduced ventilator capabilities may result from hypertonic respiratory muscles. Respiratory values may decrease and energy consumption may rise if respiratory muscles such the serratus anterior, pectoralis minor, and intercostal are shortened. [4]

Since the diaphragm and core muscles are involved in maintaining good alignment, diaphragmatic strengthening activities can aid with rounded shoulders by improving posture. Additionally, improved posture and breathing habits are encouraged by diaphragm strengthening. [4] Exercises that strengthen the diaphragm, particularly with weights, are a good method to enhance posture, core stability, and respiratory efficiency. The muscles around the diaphragm, such as the abdominal muscles, intercostal, and pelvic floor, are engaged when weights are introduced to diaphragmatic workouts. [5]

Prolonged sitting, which is frequently done for work or study, is a major factor in college students' round shoulders. [6] A lot of pupils sit for extended periods of time at desks or in lecture halls, frequently slouching. This can cause muscular imbalances and round shoulders [6].

Students frequently lean forward with their heads down, producing improper neck and shoulder alignment. [7] This condition is known as "techneck," and it has been exacerbated by the increased usage of smartphones, tablets, and laptops. This bad posture can eventually result in rounded shoulders [7].

Academic pressure frequently causes university students to adopt sedentary lifestyles where exercise is neglected. [8] Round shoulders are a result of the muscles supporting good posture, like the shoulders and upper back, being weakened by inactivity [8].

Because of the demands of their studies, social lives, and finances, university students frequently endure high levels of stress. [9] As a subconscious reaction to emotional strain, students may slump or hunch as a physical manifestation of this stress, which may ultimately lead to rounded shoulders [9].

A large number of students work or study in settings that are not ergonomically designed. When students lean forward to read or type for extended periods of time, poorly constructed seats, tables, or computer sets cause them to adopt bad posture, including rounded shoulders [10].

Enhancing Postural Alignment with PNF

By increasing the strength and flexibility of the muscles in charge of maintaining good posture, PNF treatments are frequently utilized to enhance postural alignment. PNF can stretch the anterior chest muscles (pectorals), which are often stiff in those with bad posture, and help activate the posterior shoulder muscles (rhomboids, trapezius) for rounded shoulders [11].

Tightchestmuscles(pectoralismajorandminor)andtheanteriordeltoidcanbetargetedwithPNFstretching techniques like contract-relax and hold-relax. [12] By contracting the target muscles, these methods help the antagonist muscles produce a stretch reaction, which increases flexibility and lessens rounded shoulder position [12].

The muscles of the upper back and shoulders can be effectively targeted by PNF patterns such as D1extension (shoulder flexion, abduction, external rotation) and D2 flexion (shoulder extension, adduction, internal rotation). [13] It is possible to offset the forward pull that results in rounded shoulders by strengthening these posterior muscles, which include the rhomboids, infraspinatus, and trapezius [13].

Muscle imbalances between the posterior upper back muscles (weak) and anterior chest muscles (tight) are frequently the cause of rounded shoulders. [14] Shoulder posture can be improved and balance restored with PNF techniques that combine strengthening and stretching (e.g., contract-relax for chest muscles and hold- relax for back muscles) [14].

Scapular stability, which is essential for preserving appropriate shoulder posture, canal so be targeted by PNF approaches. [15] By focusing on the scapular muscles, the D1 and D2 flexion/extension patterns can be modified to improve scapular control, which in turn improves posture and shoulder alignment [15].

PNF techniques in corporate functional motions in addition to strengthening individual muscles. [16] In addition to addressing problems like rounded shoulders that result from inefficient movement patterns, students can rest or more natural and efficient movement patterns by practicing PNF-based functional movement patterns. [16].

By restricting the space in the chest cavity, RSP can impede lung expansion and lower lung capacity, which can have a negative impact on pulmonary function. [17] Shallow breathing patterns, decreased oxygen intake, and higher respiratory effort can result from this restriction. [17] For example, people who have thoracic kyphosis, a disorder frequently linked to RSP, may see a30% reduction in lung capacity, which would impair Respiratory efficacy [17].

Effect on the parameter of pulmonary function effect: Forced Expiratory Volume in One Second Forced Expiratory Volume in One Second, or FEV1, is a vital sign of airway health. RSP can narrow the thoracic cavity, which is especially detrimental to the lower lungs [18].Reduced FEV1 readings result from air flow being restricted by the lungs' inability to fully expand. According to studies, those who have bad posture may show a decrease in FEV1 because their respiratory system mechanics are impaired. This is because forced expiratory flows are impacted by the forward head and rounded shoulders, which reduce diaphragm excursion [18].

TheentirevolumeofairthatcanbeexhaledfollowingadeepinhaleismeasuredbytheForcedVitalCapacity, or FVC [19]. RSP restricts the amount of air that may be breathed and expelled by reducing chest expansion.

A decreased FVC results from a restricted rib cage, which restricts the ability to inhale deeply and exhale properly[19].

Peak Expiratory Flow, or PEF, is a crucial sign of how well the big airways are working since it gauges the fastest possible exhalation [20]. PEF is decreased by the constricting effects of rounded shoulder position on chest expansion, which also prevent the respiratory muscles from operating at their best.

Because of their changed posture and decreased lung volume, people with RSP may exhibit diminished PEF, which impairs their their capacity to expel air at peak flow [20].

Patients with rounded shoulders may benefit from spirometry since it can be used to evaluate lung function and give information about how postural abnormalities, such as rounded shoulders, may impact respiratory mechanics [21]. Thoracic expansion is frequently restricted by rounded shoulders, which can impair the diaphragm's and other breathing muscles' effectiveness. Clinicians can track possible changes in lung volume and air flow in these patients by using spirometry, which aids in directing rehabilitation and corrective postural exercises [22].

Spirometry's Function in Patients with Rounded Shoulders:

The musculoskeletal and respiratory systems can be greatly impacted by rounded shoulder posture, which is defined by an anterior displacement of the shoulders and a prolonged scapular position [23]. Round shoulders cause the chest to sag, which restricts the thoracic cage's ability to expand, decreasing lung volume and compromising appropriate diaphragm function. This may lead to a decrease in tidal volume, a reduction in vital capacity and a general impairment in pulmonary function A popular non-invasive method for assessing a patient's lung capacities and air flow is spirometry [23]. Spirometry is useful for evaluating lung function and identifying any pulmonary ventilation limitations in people with round shoulders. Spirometry measures metrics such theFEV1/FVC ratio, Forced Vital Capacity (FVC), and Forced Expiratory Volume (FEV1). [23]

Expansion of Chest and Rounded Shoulders:

The movement of the rib cage during inhalation and exhalation is referred to as chest expansion, and it is mostly caused by diaphragm contraction and rib cage mobility [24]. A healthy person's chest should expand between 2.5 and 5 cm, however this might be limited by a number of things, including bad posture [24]. Chest expansion can be severely hampered by rounded shoulder posture, which is typified by forward shoulder

dislocation and extended scapulae. The rib cage's capacity to fully extend is restricted by this postural anomaly, which therefore impacts lung function and overall respiratory efficiency. [24] Effects of Rounded Shoulders on Lung Function and Thoracic Mobility Rounded shoulders may cause the thoracic cage to move less freely, which may limit the growth of the lungs [25]. This restriction results from shorter chest muscles like the pectorals and changed spinal alignment (increased kyphosis), which prevent the rib cage from moving and elevating normally during breathing [25]. Limiting chest expansion lowers the amount of air that can enter the lungs, resulting in shallow breathing and a drop in lung volumes like tidal volume (TV) and forced vital capacity (FVC). Overall respiratory inefficiency may arise from this [25].

Chest Expansion Measurement's Clinical Significance in Patients with Rounded Shoulders: One crucial clinical technique for evaluating thoracic mobility in people with rounded shoulders is measuring chest expansion [26]. Usually, the measurement is carried out by comparing the chest circumference at particular anatomical locations during maximum inspiration and expiration, such as the xiphoid process or the fourth intercostal space [26]. In patients with round shoulders, less chest expansion is as sign of less thoracic mobility, which is important for spotting any respiratory function limitations. Additionally, it aids physicians in tracking progress after physical rehabilitation treatments or postural adjustments meant to enhance thoracic expansion and shoulder posture [26].

Measurement of Chest Expansion as a Prognostic and Diagnostic Instrument In patients with rounded shoulders, chest expansion measurement can beused as apredictive and diagnostic tool [27]. Chest expansion diagnostic tests are useful in identifying people with postural abnormalities, such as rounded shoulders, that limit lung function [27]. Furthermore, the efficacy of treatments intended to address rounded shoulders can be assessed by chest expansion. Increased chest expansion, for instance, should be the outcome of physical therapy or postural correction exercises intended to enhance shoulder alignment and thoracic mobility. [27] Healthcare professionals can monitor a patient's development and assess if treatment ap

2. MATERIAL AND METHODOLOGY

Quasi-Experimental, prospective interventional study conducted at D. Y. Patil Education society (Deemed to be university), Kolhapur using 52 sample size for a duration of 6 months. Materials: Digital Spirometry, measuring tape. Study subjects were selected fulfilling exclusion and inclusion criteria Inclusion criteria: Agegroup18to25years of age., all gender with rounded shoulders, willing to participate in study. Exclusion criteria: History of trauma, injury, surgery or fracture, history of smoking, history of cardiac or pulmonary condition.

3. PROCEDURE

The study protocol was presented for approval before the Institutional Ethical Committee and Protocol Committee of D. Y. Patil Education Society, deemed to be University, Kolhapur, and D.Y. Patil College of Physiotherapy, Kolhapur**.** After obtaining approval, the participants were approached, and the purpose of the study was explained to them. Written consent was obtained from those willing to participate.

Students with rounded shoulders from D. Y. Patil University, Kolhapur were assessed using the table-to- acromion distance measurement. Those who met the inclusion and exclusion criteria were invited to participate in the study. The nature of the study was explained to the students, and those who agreed to participate were included. Written consent was obtained from all participants. Demographic information, including name, age, gender, height, weight, and academic year/semester, was recorded on a data collection sheet. Chest expansion was measured using a tape measure at three levels: Upper thoracic expansion at the fourth costal level along the mid-clavicular line Middle thoracic expansion Lower thoracic expansion at the xiphoid process. Digital spirometry was used to measure vital capacity and pulmonary ventilation, specifically assessing forced vital capacity(FVC), forced expiratory volume in one second(FEV1), and peak expiratory flow rate (PEF).

Participants were briefed on upper extremity PNF exercises, specifically the D2 flexion pattern (shoulder flexion, abduction, external rotation; forearm supination; wrist radial deviation; and finger extension) performed during exhalation, and the D2 extension pattern (shoulder extension, adduction, internal rotation; forearm pronation; wrist ulnar deviation; and finger flexion) performed during inhalation. Participants lay in a supine position with a weight cuff placed on the abdomen to provide resistance against diaphragmatic movement. They were instructed to lift the weight using an inspiratory effort (abdominal expansion).

The exercise program consisted of 30-40 minutes of training, three sessions per week for eight weeks. After eight weeks, a post-test assessment was conducted using the same parameters as the pre-test. The study findings were interpreted based on a comparison of pre-test and post-test outcome measures. The study was concluded after conducting a statistical analysis of the outcome measures.

4. RESULTS

The paired t-test results indicate statistically significant improvements in various parameters post- intervention, as demonstrated by the p-values, all of which are<0.05. significantly difference found in chest expansion and vital capacity.

And reduce the rounded shoulders.

Descriptive statistics representing gender of the study participants:

Gender	No. of Participants	Percentage
Male	19	36.54%
Female	33	63.43%
Total	**52**	**100.00%**

Table-1-Descriptive statistics (%)ofgender

Table- shows that gender of participants in percentage. Among 52 participants considered for the study, were females and remaining were males respectively. The percentage distribution, showing that males are accounted for36.54% of the total, while females comprised 63.43%.

Variable	Mean	S.D.
Age	21.56	1.26
HEIGHT (CM)	164.04	7.80
WEIGHT(KG)	58.17	6.09
BMI (Kg/m^2)	21.58	0.70

Table2: Mean, SD of age, height, weight and BMI

The mean age of the participants was21.56years, with a standard deviation (SD) of 1. 26 years, indicating that most participants were close in age. The mean height was164.04cm, with a standard deviation of 7.80 cm, suggesting some variation in participants' heights. The mean weight was 58.17 kg, with a standard deviation of 6.09 kg, indicating moderate variability in body weight among participants. The mean body mass index (BMI) was21.58 kg/m², with a standard deviation of 0.70 kg/m², suggesting that most participants had a BMI within a relatively narrow range.

Variable		TimePoint	Mean	S.D.	P-value
TADTEST		**PRE(cm)**	3.91	0.50	1.93E-21*
		POST (cm)	3.06	0.38	
CHESTMEASUREMENT	**Upper**	**PRE(cm)**	1.38	0.49	1.73E-11*
		POST (cm)	2.07	0.41	
	Middle	**PRE(cm)**	1.94	0.54	5.15E-19*
		POST (cm)	2.82	0.50	
	Lower	**PRE(cm)**	2.82	0.68	6.27E-23*
		POST (cm)	3.75	0.72	
		PRE	1.43	0.28	

DIGITALSPIROMETRY	**FVC(L)**	**POST**	2.07	0.42	2.00E-17*

(*indicates p-value 0.05) is significant)

Table3: pre and post measurements of TAD, Chest measurements, digital spirometer

This table presents pre-and post-test comparisons for different variables using mean values, standard deviations (SD), and p-values**.** The paired t-test was used to assess changes after the intervention.

Table-to-Acromion Distance (TAD)Test: Pre-test mean TAD: 3.91 cm ± 0.50 Post-test mean TAD: 3.06 cm ± 0.38

P-value=1.93E-21→Indicates a statistically significant reduction in TAD, suggesting an improvement in shoulder posture.

Chest Measurement (Expansion at Different Levels):

Upper Chest Expansion:

Pre-test:1.38cm(SD=0.49)

Post-test: 2.07cm(SD=0.41)

P-value=1.73E-11→Significant increase in upper chest expansion.

Middle Chest Expansion:

Pre-test:1.94cm±0.54

Post-test:2.82cm±0.50

P-value=5.15E-19→Significant improvement in middle chest expansion.

Lower Chest Expansion:

Pre-test:2.82cm±0.68

Post-test:3.75cm±0.72

P-value=6.27E-23→Significantincreaseinlowerchestexpansion.

Digital Spirometry (Lung FunctionTests):

Forced Vital Capacity (FVC):

Pre-test:1.43L± 0.28

Post-test:2.07 L±0.42

P-value=2.00E-17→Significant improvement in FVC, indicating better lung capacity.

Forced Expiratory Volumein1Second(FEV1):

Pre-test:1.42L(SD=0.28)

Post-test:2.06 L(SD=0.42)

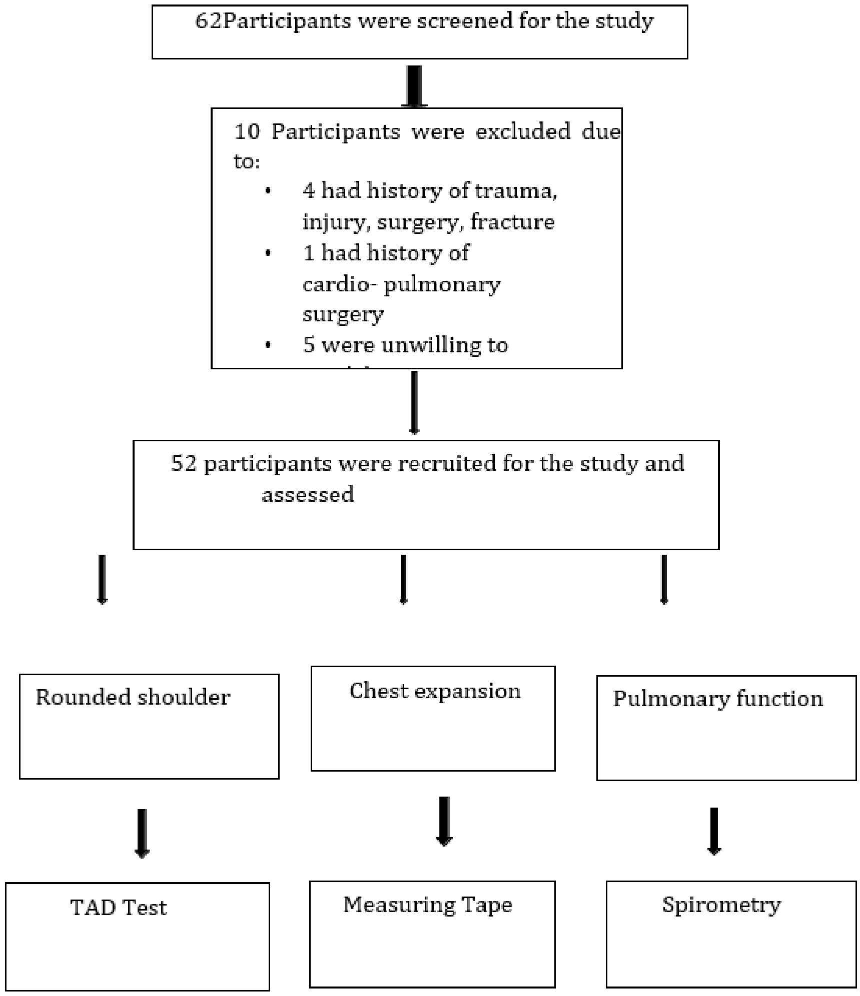
P-value=5.38E-18→Significant increase, reflecting improved airway function.

Peak Expiratory Flow(PEF):

Pre-test:2.80L/s±1.16

Post-test:4.22L/s± 0.93

P-value=5.36E-16*→Significant enhancement in peak air flow capacity.



5. DISCUSSION

One of The most prevalent postural issues among young adults who are otherwise asymptomatic is for ward shoulder position. A high prevalence of forward shoulder posture has been linked to sedentary lifestyles, inadequate postural adjustments, slouching, and extended flexed postures. Pupils are compelled to spend extended periods of time sitting motionless at desks or in front of laptops, with their necks, shoulders, and backs fixated without enough support.

The prevalence of rounded shoulders is 84% among young adults (18– 24 years of age [28] There has been studies which states that rounded shoulders is inversely proportional to chest expansion. Decreased chest expansion lead to decrease in the vital capacity and total lung volume. [29]

This study aims the Efficacy of upper limb proprioceptive neuromuscular facilitation and diaphragmatic strengthening exercise on chest expansion and pulmonary function in undergraduate students with rounded shoulders A total 52 subjects were recruited in the study age group of 18 to 25 years. A frequent postural deviation brought on by persistently bad posture and muscle imbalances is rounded shoulders. This disorder reduces respiratory efficiency by limiting thoracic movement and lung expansion. Research indicates that rounded shoulders and a forward head posture affect lung capacity and diaphragm movement, which may cause breathing problems [1,2]. Proprioceptive neuromuscular facilitation (PNF)and diaphragmatic strengthening exercises are commonly utilized to improve posture and respiratory function in order to counteract these effects. This study looks at how these treatments help people with rounded shoulders exp and their chests and enhance their pulmonary function. The Function of Proprioceptive Neuromuscular Facilitation (PNF) in Chest Expansion PNF is a method that enhances neuromuscular synchronization, muscle activation, and flexibility. Enhancing joint mobility and postural stability, it consists of periods of stretching and contraction. PNF stretching improves scapular posture in people with rounded shoulders by strengthening weak upper Back muscles and releasing tight pectoral muscles. Increased thoracic mobility and more effective breathing patterns are made possible by these advancements, which aid in rib cage expansion [3,4]. Exercises to Strengthen the Diaphragm and How They Affect Pulmonary Function. The goals of diaphragmatic breathing exercises are to improve lung function, encourage deep in halation, and strengthen the diaphragm. By decreasing the need for accessory respiratory muscles, this method improves pulmonary efficiency and oxygen exchange [5]. These exercises enhance Forced Vital Capacity(FVC) and Forced ExpiratoryVolumein1second(FEV1) in those with postural abnormalities and restore proper breathing mechanics. By improving thoracic expansion and muscular coordination, they enhance respiratory function when paired with PNF [3].

Impact on the Expansion of the Chest The results of the study show that following the intervention, there was a significant increase in chest expansion at all three thoracic levels:

Increased upper chest: From 1.38 cm to 2.07 cm Increased middle chest: From1.94cmto2.82cm Increased lower chest: From 2.82 cm to 3.75 cm. These improvements indicate that specific work outs successfully increase thoracic mobility, encouraging more thorough and effective breathing. This improved chest expansion is a result of improved postural alignment and increased flexibility in the intercostal and auxiliary respiratory muscles [4]. Impact on Respiratory Function Digital spirometry evaluations of pulmonary function showed notable improvements: FVC, or forced vital capacity, rose from1.43Lto2.07L. FEV1, or forced expiratory volume in one second, rose from 1.42 L to 2.06 L. From2.80L/sto4.22L/s, the peak expiratory flow (PEF) significantly increased.

These results show increased respiratory efficiency and lung compliance. The combination of diaphragmatic strengthening and PNF improved airway function and tidal volume, which improved breathing control and efficacy [5]. The observed improvement in pulmonary function and chest expansion were caused by a number of factors: Baseline Postural Deviations: Because of their originally limited thoracic mobility, participants with more Severe rounded shoulders showed larger gains. Muscle Flexibility and Adaptation: Individual differences in muscle tone, flexibility, and prior exercise levels affect how effective PNF is [2,3].

Exercise Protocol Adherence: Regular exercisers exhibited significantly greater advantages than those who practiced typically [4]. Respiratory Muscle Strength: Breathing efficiency increased more in those with stronger diaphragm function. Lung Capacity and Airway Resistance: The extent of spirometric improvements varied depending on an individual's pulmonary compliance [1,5]. Implications for Clinical and Functional. The findings highlight thow crucial breathing exercises and posture correction are for enhancing respiratory health. In addition to people with postural disorders, athletes and others who lead sedentary lives also benefit from improved pulmonary function and chest mobility [2].

6. CONCLUSION

In conclusion This study shows that diaphragmatic strengthening exercises and upper limb PNF improve respiratory function and postural alignment in undergraduate students with round shoulders. These exercises can be useful in treating the musculoskeletal and pulmonary problems linked to bad posture, as seen by the notable improvements in spirometry values and chest measures. The synergistic benefits of upper limb PNF and diaphragmatic strengthening exercises for improving posture, chest expansion, and lung function are highlighted in this study. These techniques have proven effective for individuals with rounded shoulders, as demonstrated by the statistically significant improvements in TAD, chest expansion, and pulmonary function parameters. Therefore, incorporating PNF and diaphragmatic breathing techniques into rehabilitation practices is an effective approach for improving posture and respiration. This research underscores the significance of upper limb PNF and diaphragmatic breathing exercises for enhancing chest expansion and pulmonary function in those with rounded shoulders. The substantial differences noted before and after in chest expansion and spirometric values underscore the effectiveness of these measures in improving respiratory mechanics and postural stability. These findings align with existing literature on the role of neuromuscular facilitation and respiratory training in optimizing thoracic mobility and pulmonary health.

REFERENCES

[1] Lee,Do- Youn &Nam, Chan & Sung,Youn & Kim, Kyoung & Lee, Hae. (2017). Changes in rounded shoulder posture and forward head posture according to exercise methods. Journal of Physical Therapy Science. 29. 1824-1827. 10.1589/jpts.29.1824.

[2] Singla D,Veqar Z. Association Between Forward Head, Rounded Shoulders, and Increased Thoracic Kyphosis: A Review of the Literature. J Chiropr Med. 2017 Sep;16(3):220-229. doi: 10.1016/j.jcm.2017.03.004. Epub 2017 Sep 28. PMID: 29097952; PMCID: PMC5659804.

[3] OhS, LeeJ, KimS, LeeD, Hong JH, Yu JH, Kim JS, Kim S.2022.Correlation between lung capacity, resporatory gas analysis and diaphragm movement distance according to forward head posture and round shoulder posture. The Journal of Natural Healing. https://doi.org/10.12972/jnh.20220011

[4] Lee, J.H., & Lee, J. H. (2015). "The effects of diaphragmatic breathing on posture and muscle activity in the upper extremity. "*Journal of Physical Therapy Science*, 27(9), 3077-3080.DOI:10.1589/jpts.27.3077.

[5] Singh D, Sharma R, Verma P. Musculoskeletal pain and postural deviations among university students: A cross-sectional study. *J Educ Sci*. 2021;55(4):377-381.

[6] Kuyper MA, Greenfield P, Dubois K. The impact of technology on the development of poor posture in young adults. *J Postural Studies*. 2023;12(1):89-94.

[7] Patel M, Mathias M, Edwards J. Postural problems in university students: are view of the factors contributing to musculoskeletal issues. *J Musculoskeletal Health*. 2022;40(2):127-133.

[8] LiuY, Zhang L, Wang J. The effect of stress on posture in college students: A clinical observation. *J Psychosom Res*. 2020;126:93-98.

[9] Allen SM, TagueCA, McGraw KD. Ergonomic interventions for reducing musculoskeletal discomfort and improving posture in university students. *Appl Ergonomics*. 2022;94:103394.

[10] Cakmakci O, Eker L, Eker D, Kucukdeveci A. The effectiveness of proprioceptive neuromuscular facilitation on improving posture and quality of life in individuals with postural impairments. *JBodywMov Ther*. 2023; 27(1): 64-70.

[11] Lee S, Lee W, Kim S, et al. Effectiveness of PNF stretching techniques on improving range of motion and posture in patients with rounded shoulders:A randomized controlled trial. *JPhysTherSci*.2021;33(2): 111-117.

[12] Kim J, Oh J, Yang S, et al. PNF techniques for improving muscle strength and shoulder function in individuals with forward headposture and rounded shoulders. *PhysTherRehabil*.2022;10(3):245-250.

[13] Zhang W, LiF, ZhangH.Correction of muscle imbalances in the upperlimb using PNF patterns in individuals with rounded shoulders. *J Sport Rehabil*. 2023;32(1): 18-23.

[14] Okada T, NaitoT, SatoK, etal. Scapular stability training using PNF patterns for improving posture in individuals with rounded shoulders: A clinical trial. *J Orthop Sports Phys Ther*. 2022;52(11): 823-829.

[15] Tsuchiya H, KatoT,SakamotoT.PNF-based functional movement training for correcting rounded shoulders in young adults: An interventional study. *Rehabil Phys Act*. 2021;25(1): 50-56.

[16] Singla D, Veqar Z. Association Between Forward Head, Rounded Shoulders, and Increased Thoracic Kyphosis: A Review of the Literature. J Chiropr Med. 2017;16(3):220-230.

[17] Gupta, R., Singh, R., & Aggarwal, A. (2022). *Postural deviations and their effects on pulmonary function in individuals with rounded shoulder posture*. International Journal of Physiotherapy,28(4),45-50.

[18] Sharma, R., &Kumar, S. (2021). *Impact of rounded shoulder posture on FEV1, FVC, and PEF in healthy adults*. Journal of Clinical Physiology, 14(2), 98-105.

[19] Hagg, G. (2020). *The relationship between postural alignment and respiratory function: A systematic review*. Journal of Musculoskeletal and Neuronal Interactions, 24(3), 123-134.

[20] RyuS, ChoSH, LeeYJ, et al. Spirometry in postural abnormalities: impact of rounded shoulder posture. J Thorac Dis. 2017;9(3): E244-9

[21] Taveggia G, Guariglia S, PilliL, etal. The effects of rounded shoulders on lung mechanics: a clinical evaluation using spirometry.

[22] Kim SJ, Han DH, Lee SM, et al**.** Respiratory function in individuals with postural abnormalities: across-sectional study. *J Korean Phys Ther Sci*. 2016;3(4):265-272.

[23] Jones CW, Harrison SL, Dunning J, et al. Measurement of chest expansion and its relationship to postural abnormalities in adults. *ClinRehabil*. 2017;31(5):684-692.

[24] Burtin C, Moullec G, Deschamps P,etal.Chest expansion and its relationship with respiratory capacity in patients with postural abnormalities. *Am J Respir Crit Care Med*. 2018;197(4):533-538.

[25] KimJK, LeeY, Kim DH, etal.Chest expansion as a measure of thoracic mobility and its role in the assessment of rounded shoulder posture. *J Phys Ther Sci*. 2019;31(12):960-966.

[26] Rochester CL, Edwards JD. The effects of posture on respiratory function and the role of chest expansion measurements in clinical practice. *J Rehabil Res Dev*. 2012;49(7):987-994.

[27] Tavana kermani M, Ebrahimi AtriA, Khoshraftar YazdiN. The effect to feight week

[28] Corrective exercise on the functional kyphosis curvature in the teenager girl. The Scientific Journal of RehablitationMedicine.2017Mar 21;6(1):161-8

[29] Janvhi Singh, Sheenam Popli, et al., Correlation of Rounded Shoulder with Cardio

[30] Respiratory Fitness and Psychosocial Health Status Among Adolescents-An Observational Study. Journa 5. Mohammad Sufyan , Assesment of sedentary lifestyle, obesity and cardiovascular disease.