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ASSOCIATION OF PECTORALIS MINOR TIGHTNESS WITH INSPIRATORY CAPACITY AND CHEST EXPANSION IN COLLEGE STUDENTS: A CORRELATIONAL STUDY

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ABSTRACT

Background: The pectoralis minor muscle significantly contributes to scapular positioning and upper thoracic mobility. Tightness in this muscle is commonly observed in individuals with poor posture, such as rounded shoulders and forward head posture, which may restrict thoracic cage movement and affect breathing efficiency. Among students, prolonged sitting, use of electronic devices, and poor ergonomics can contribute to postural imbalances and increased muscle tightness. Since effective thoracic expansion is crucial for optimal breathing, it is important to investigate whether pectoralis minor tightness affects lung function and chest wall mobility. Understanding this relationship can aid in developing integrated musculoskeletal and cardiopulmonary rehabilitation strategies.

Objective: The aim of this study was to determine the correlation between pectoralis minor tightness and inspiratory capacity, and to evaluate its relationship with thoracic expansion measured at the axilla, nipple, and xiphoid levels in healthy student participants.

Methods: Eighty-five healthy students participated in the study. Pectoralis minor tightness was assessed using a standardized length test. Inspiratory capacity was measured using an incentive volumetric spirometer, and thoracic expansion was measured at three anatomical levels using a measuring tape. Pearson's correlation test was used for analysis.

Results: There was a modest, non-significant link between pectoralis minor tightness and thoracic expansion, but a substantial moderate correlation with inspiratory capacity ($r = 0.309$, $p = 0.004$). At the axillary level, there was a weak and negative correlation between thoracic expansion and pectoralis minor tension ($r = –0.194$, $p = 0.075$).At the nipple level, there was a weak and statistically insignificant correlation between pectoralis minor tightness and thoracic expansion ($r = 0.006$, $p = 0.956$). Additionally, there was a slight and negative correlation ($r = –0.189$, $p = 0.084$) between thoracic extension at the xiphoid level and pectoralis minor tightness.

Conclusion: Pectoralis minor tightness moderately affects inspiratory capacity but not regional thoracic expansion.

Keywords: Pectoralis minor tightness, Thoracic expansion, Inspiratory capacity

INTRODUCTION

College students frequently experience pectoralis minor tightness, which is primarily the result of protracted poor postural habits, including prolonged sitting, excessive smartphone or laptop use, and slouching. The pectoralis minor muscle becomes shortened and compressed as a result of these repetitive activities during the course of time. An anterior shoulder posture is the consequence of the shoulders being pulled forward. In the absence of appropriate intervention, this altered posture can result in musculoskeletal imbalances, discomfort, and potential dysfunction in the shoulder girdle.(1)

A number common posture problems are a forward head position, rounded shoulders, or an anterior hip tilt. These problems are often caused by sitting for long periods of time or not having good ergonomic habits. which can be seen in college students. Forward head posture is a prevalent postural deviation that has a substantial effect on the respiratory mechanism as a result of muscular imbalances in the cervical, thoracic, and shoulder regions. Ultimately, these modifications can impede breathing efficacy, restrict chest expansion, and reduce thoracic mobility.(2)

During deep inspiration, the pectoralis minor muscle helps to elevate the upper ribs, which in turn contributes to an increase in inspiratory capacity and thoracic expansion. This is an important function of the pectoralis minor muscle. This muscle is usually connected with forward head position, which produces scapular protraction and inhibits upper rib mobility. Scapular protraction is caused by tightness in this muscle. This constraint has a strong impact on the expansion of the thoracic cavity at the axillary level, which may result in a reduction in lung volume. It is possible for pectoralis minor tightness to affect the mechanics of the chest wall, which can have a negative impact on total pulmonary function and breathing efficiency, even in persons who are otherwise healthy.(2)(3)

A slight tightness in the pectoralis might cause a change in posture and inhibit thoracic movement, which may result in worse breathing mechanics. In spite of the fact that it is clinically relevant, there has been a lack of research that has investigated its influence on thoracic expansion and inspiratory capacity. When it comes to devising tailored physiotherapy therapies to improve respiratory function and posture, having an extensive knowledge of these relationships is absolutely necessary. The aim of the study is to determine whether students' thoracic expansion and inspiratory capacity are correlated with tightness in the pectoralis minor.

METHODOLOGY

Study Design: It is a correlation study, which was conducted among 85 college-going students aged 18 to 25 years, comprising 33 males and 52 females.

Inclusion criteria:

- Age group 18 to 25 years old
- Those who have a pectoralis minor muscle tightness up to 2.5 cm.

Exclusion criteria:

- Individual present with…
- Respiratory condition
- Cardiovascular condition
- Neurological condition
- Fixed deformity of shoulder and upper quadrant

Procedure:

- Participants provided written informed consent in their native language for clarity and ethical compliance.
- Basic demographic data, were recorded systematically.
- A standardized assessment form was used to screen participants based on predetermined inclusion and exclusion criteria.
- The pectoralis minor length test was used to assess muscle tightness.
- A consistent and accurate Volumetric incentive spirometer [Voldyne® 4000] was used to test pulmonary capacity.
- Flexible measuring tape was used to quantify thoracic expansion at three levels: axillary, nipple, and xiphoid.

Pectoralis minor length test:

When doing the pectoralis minor length test, the patient lies supine on a flat, firm table, with their arms relaxed at their sides, their head supported without a pillow, and their respiration normal. It is possible to mark and palpate the acromion's posterior-inferior border. The vertical distance to the posterior acromion is measured using a measuring tape that is perpendicular to the table and is positioned directly beneath this spot on the table. To ensure dependability, the measurement is repeated, and the average is noted. A pectoralis minor that is shorter than 2.6 cm is said to be shortened, whilst one that is normal in length is said to be 2.6 cm or less.(4)

Outcome Measures:

Thoracic Expansion Measurement:

The patient is seated in an upright position. Three standardized levels are used for measurements: lower (Xiphoid level), mid (nipple level), and upper (axilla). Using a measuring tape that is secured but not tight, the chest circumference is first measured at the end of expiration for each level, and then at maximum inspiration. The difference between the two readings is used to determine thoracic expansion.(5)

Inspiratory Capacity Measurement:

A volumetric incentive spirometer, like the Voldyne® 4000, is used to measure inspiratory capacity (IC). The patient is sitting up straight, and the device has been cleaned, calibrated, and put together. The patient usually breathes out, then seals their lips around the mouthpiece, takes a slow, deep breath in to raise the piston, and holds their breath for 3–5 seconds before breathing out normally. The IC is the largest volume that was reached (in milliliters). The move is done three times, and the best of the three readings is used.(6)(7)

Statistical Analysis:

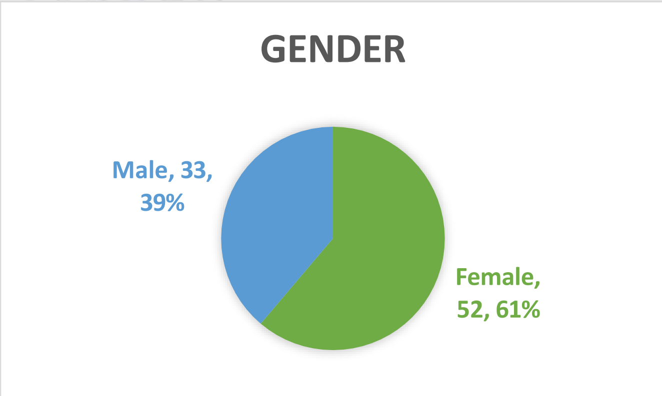
The sample size was calculated using GPower 3.1.9.2 with $\alpha = 0.05$, power = 0.80, and an effect size of 0.3, resulting in 85 participants. The study included 85 participants; therefore, normality testing was not required. Descriptive statistics were performed for age, height, and weight, and a frequency distribution was calculated for gender. Pearson's correlation test was applied to determine the relationship between pectoralis minor tightness and thoracic expansion at the axilla, nipple, and xiphoid levels, as well as between pectoralis minor tightness and inspiratory capacity.

RESULTS

Table 1 Descriptive statistics of Age, Height and weight

	Minimum	Maximum	Mean	Std. Deviation
Age	18.00	25.00	20.4588	1.47643
Height	137.00	188.00	162.1882	10.41233
Weight	31.00	99.00	55.3294	13.12793

Table 1 shows Descriptive statistics for 85 participants. These values reflect a relatively homogeneous group in terms of age, height, and weight.



Graph 1 : Frequency distribution of gender

Table 2 Pearson's correlation test between pectoralis minor length test and IC, thoracic expansion (Axilla, Nipple, Xiphoid)

Variables	r	P value
PMLength vs IC	0.309	0.004
PMLength vs AxillaTE	-0.194	0.075
PMLength vs NippleTE	0.006	0.956
PMLength vs XiphoidTE	-0.189	0.084
****. Correlation is significant at the 0.01 level**		

Pectoralis minor length and inspiratory capacity (IC): A positive, statistically significant correlation was found ($r = 0.309$, $p = 0.004$), indicating a moderate linear relationship. The correlation was significant at the 0.01 level (2-tailed).

Pectoralis minor length and axilla-level thoracic expansion: A negative correlation was observed ($r = -0.194$, $p = 0.075$), which was not statistically significant at the 0.05 level, suggesting a weak inverse relationship without meaningful association.

Pectoralis minor length and nipple-level thoracic expansion: A very weak positive correlation was noted ($r = 0.006$, $p = 0.956$), which was not statistically significant at the 0.05 level, indicating no meaningful association.

Pectoralis minor length and xiphoid-level thoracic expansion: A weak negative correlation was observed ($r = -0.189$, $p = 0.084$), which was not statistically significant at the 0.05 level, suggesting no meaningful association.

DISCUSSION

This study correlated pectoralis minor tightness to inspiratory capacity and thoracic expansion at three anatomical levels: axilla, nipple, and xiphoid process. Pearson's correlation analysis on 85 participants found one significant association and several non-significant changes, which help us comprehend musculoskeletal implications on respiratory mechanics.

Pectoralis Minor Tightness and Inspiratory Capacity

The considerable negative connection between pectoralis minor tightness and inspiratory capacity ($r = 0.309$, $p = 0.004$) was significant. This positive link between pectoralis minor length and inspiratory capacity means that greater tightness reduces IC since muscle stiffness is inversely related to length.

Biomechanically, the pectoralis minor inserts on the coracoid process from the anterior 3rd–5th ribs. When tight, this muscle tilts and rotates the scapula anteriorly and downward, minimizing posterior tilting during inspiration [15]. This scapular position limits costal elevation and rib cage expansion, limiting lung inflation.The moderate inverse relationship between pectoralis minor tightness and IC in our investigation is consistent with the literature. [16] [17] show that upper thoracic position and scapular mechanics affect respiratory performance. Pectoralis minor tightness reduce anterior-posterior thoracic expansion and inspiratory volume. Tightness may constrain the thorax mechanically and reduce muscle contribution to respiratory effort, lowering inspiratory capacity.

Pectoralis Minor Tightness and Thoracic Expansion at Axilla Level

Pectoralis minor tightness was negatively correlated with axillary thoracic expansion ($r = -0.194$, $p = 0.075$), suggesting that tightness may impair upper thoracic mobility. Scapular posture and upper rib elevation affect the axilla level, which is mostly the upper ribs (1–3) and the superior thoracic cage. During inhalation, pectoralis minor contraction increases anterior tilt and decreases upward rotation, which are necessary for proper rib elevation [18]. During deep breathing or exertion, a tight muscle may hinder the first few ribs' upward and outward mobility during inspiration. The correlation did not achieve statistical significance, but it supports earlier evidence indicating pectoralis minor tightness can indirectly limit thoracic excursion by influencing scapular and rib cage mechanics [25][22].

Relationship Between Pectoralis Minor Tightness and Thoracic Expansion at Nipple Level

The tightness of the pectoralis minor muscle did not have an effect on the growth of the thorax at the nipple level ($r = 0.006$, $p = 0.956$). The results show that there is no link between these factors. Anatomically, this separation makes sense. The nipple line (usually ribs 4–6), diaphragmatic movement, and lower rib motion are more important in the mid-thoracic area than muscles in the upper thoracic area like the pectoralis minor [24][23]. The pectoralis minor has less mechanical effect further down the thoracic cage and doesn't change the mid-rib movement.In this pose, diaphragmatic descent, abdominal flexibility, and mid-thoracic spine motion also have a big impact on chest wall expansion. The absence of association between these parameters and pectoralis minor function supports the anatomical specificity of musculoskeletal influences on respiration.

Pectoralis Minor Tightness and Thoracic Expansion at Xiphoid Level

The connection between pectoralis minor tension and xiphoid thoracic expansion was weak and negative (r = –0.189, p = 0.084). Ribs 7–10 undergoing "bucket-handle" motion during inspiration are at the xiphoid level. Diaphragmatic contraction and abdomen wall compliance generate this movement [23]. Thus, higher chest wall muscles like the pectoralis minor should have little effect on this region. [25]. This could clarify the mild negative tendency found in our study.

Clinical significance

Musculoskeletal tightness—particularly in structures such as the pectoralis minor—can exert effects on respiratory and chest wall functions, Consequently, a comprehensive assessment that offers a more accurate understanding of the functional respiratory consequences of such tightness, and may better inform targeted physiotherapeutic interventions.

CONCLUSION

This study found a significant correlation between pectoralis minor tightness and inspiratory capacity, indicating that increased tightness may reduce lung volume by restricting chest wall mobility. However, no significant correlations were found between pectoralis minor tightness and thoracic expansion at the axilla, nipple, or xiphoid levels. These findings suggest that while pectoralis minor tightness can influence global respiratory function, its effect on segmental thoracic expansion is minimal. This highlights the importance of addressing muscle tightness when evaluating respiratory function, particularly in individuals with postural or breathing limitations.

Future recommendations:

Use objective tools like spirometry or ultrasound for better measurement accuracy.

Conduct studies on clinical populations with respiratory or postural impairments.

Perform longitudinal or interventional studies to assess causal relationships.

Conflict of interest: NONE

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