An association of Pulmonary Function Test with Pectoralis Minor Tightness and Forward Head Posture in Healthy College Going Students- Correlational Study

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Abstract

Background: In forward head posture posture, the respiratory mechanism is most commonly affected due to muscular imbalance in the thoracic, cervical & shoulder regions which will hamper breathing capacities. The literature is mostly available with pectoralis major muscle tightness and weakness of scapular muscles but very few articles are available for pectoralis minor tightness and its effect on breathing capacities. So, the study aims to determine the effect of pectoralis minor muscle tightness and forward head posture on pulmonary function test in healthy individuals aged 17 to 25 years.

Methods: A total of 120 subjects were included in the study based on inclusion & exclusion criteria. Before data collection, Pre-evaluation of the subject was done by using Flexi-ruler for kyphotic & lordotic curve, Pectoralis minor tightness test by measure tape in both upper limb and Inter-scapular distance. The procedure includes a pulmonary function test in which measurements include FEV1, FVC, MVV, FEV1/FVC & MVV*40/FEV1 by using a computerised spirometer for diagnostic spirometry.

Results: The statistical analysis was done by using Pearson's correlation coefficient which shows a poor but positive correlation between Inter-scapular distance, Flexi curve angle, and all pulmonary function test measurements(r=0.315, 0.251, 0.047, 0.301 & 0.047 between interscapular and pulmonary function test& r=-0.085, 0.075, 0.004, -0.050 & 0.018).While poor & negative correlation between left and right pectoralis minor tightness & all measures of pulmonary function(r=-0.059, -0.106, 0.048, 0.004 & 0.353 between left pectorals tightness & PFT while for right pectorals tightness & PFT, r=-0.22, -0.015, -0.035, -0.037 & -0.047).

Conclusion: Pulmonary function parameters show poor correlation which means the respiratory mechanism is not being impaired due to tightness of pectoralis minor muscle & forward head posture of healthy individuals aged 18 to 25.

Keywords: *Forward head posture, pulmonary function test, pectoralis minor muscle tightness*

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Introduction

The ideal posture is the position in which minimal stress is required to maintain the position and any alteration in this position can increase the stress to the joints and changes the line of gravity, and it is known

as "faulty posture"[1] Deviation from this optimal ideal standing posture changes the LOG, BOS, COG, will cause excessive strain on internal forces that are passive structure and will increase the muscle activity on that particular joints or structure. [2] If this posture is adapted continuously in daily life then slowly the body will adapt it causing the shortening or lengthening of the muscles or ligaments[2]. There are so many posture deviations but among them forward head posture is taken into consideration because it is the most common posture seen in adult, and it is adapted while using Smartphone, carrying a heavy backload, using computers having slouched posture, so it is taken to study the effects on healthy individuals. [1,3] In this posture, the head is positioned more anteriorly due to which LOG shifts anteriorly, so it will increase the flexion movement; due to increases in cervical lordosis also there will be the occurrence of protraction movements which will produce an extension of the upper cervical spine and flexion of the lower cervical spine[2,3]. There will be more adaptive lengthening of upper posterior back muscles, and adaptive shortening of anterior shoulder muscles more severe will leads to kyphosis. Due to medial rotation and shortening the muscle involved in moving the scapula downward and anteriorly (forward) and outward are serratus anterior, pectoralis minor, pectoralis major, subclavius muscle[4]. If there is the adaptive shortening of pectoralis minor it will alter the scapular position by altering scapular kinematics by increasing internal rotation, downward rotation, the anterior tilt of the scapula causing the protracted shoulder and shortening of this muscle will hamper the lung volumes[5]. Chronic shortening will affect normal scapular kinematics in individuals with shoulder impingement and not allow the scapula to fully upwardly rotated, externally rotated, posterior tip, or elevated ultimately reduce the lung capacity due to a decrease in thoracic cavity expansion and decreasing activation of the accessory muscle of inspiration[6]. In Forward Head Posture, there is the weakening of the upper thoracic muscle and shortening of anterior chest muscle as this creates the musculature imbalances and due to it, there is the weakness of accessory respiratory muscles which further decreases lung capacities[7]. As pectoralis minor is an accessory Inspiratory muscle so a person with pectoralis minor tightness and forward head posture can go for a pulmonary function test for checking all parameters which are directly related to breathing problems[8]. So the main aim of this study is to correlate that pectoralis minor tightness in FHP affects the lung capacities in the normal individual having bad posture, using Smartphone's working for long hours and to improve breathing problems and posture and to reduce the breathing difficulty in this age group[9] as this study is conducted because there are fewer articles available on pulmonary function test and pectoralis minor tightness with forward head & rounded shoulder.

Methods and Materials

1. Subjects: Healthy non-smoker subjects were recruited for this cross-sectional study from the S S Agrawal group of colleges in India. According to G Power analysis with 0.5 power and 95% confidence interval & 0.05 significance level, a total of 120 samples were selected based on inclusion and exclusion criteria. Inclusion criteria include the healthy person who was between 17 to 25 years old, those have a pectoralis minor muscle tightness up to 2.5 cm, having a Flexi curve angle between 20^0 to 40^0, the interscapular distance between 3 to 4 inch. Individuals were excluded if they presented with a history of smoking, any respiratory, cardiovascular, or neuromuscular disease, and had fixed deformities of the shoulder and upper quadrant.

2. Pre-evaluation of participants: Before the pre-evaluation of participants informed consent was given to all and included those who were willingly participated in the study. The pre-evaluation of

subjects includes interscapular distance, Flexi curve angle, and pectoralis minor muscle tightness test.

3. Pulmonary Function test measurements: To measure lung function under the American Thoracic Society (ATS) guidelines, a computerized spirometer with a standard mouthpiece was used. All participants underwent pulmonary function testing with forced expiratory volume(FEV1), Forced vital capacity, FEV1/FVC, Maximal voluntary ventilation(MVV), MVV*40/FEV1 in the sitting position.Theparticipants were familiar with the test protocols before the start of the test and were permitted to do several trials before the test. A mouthpiece with no teeth grip was used when conducting spirometry, and the subject held the mouthpiece securely with the nose closed by the nose clip.A minimum of three trials with the best (highest) test result retained for analysis was completed by all subjects. Between each trial, a minimum 3-minute rest was provided. The same instructions were given to all the subjects when conducting the tests to prevent bias.

4. Statistical Analysis: The statistical analysis was done by using SPSS 20(IBM, NY). Using the Kolmogorov-Smirnov test, normality was tested and determined. For relationship, the correlation coefficient was calculated by using Karl Pearson's correlation coefficient to determine the association of pulmonary function test with (i)pectoralis minor tightness, (ii)Interscapualr distance, and (iii) Flexi-curve angle

Results

3247766992. Sociodemographic characteristics:

Table 1 shows demographic data of 120 participants in which 18 were male & 102 were female participants and in the age group, 17 to 19-year-old the participants were 70, in 20 to 22-year-old category the participants were 42 and in 22 to 25 year old it was 8 participants included in the study.

3247766992. Relationship between lung function and pectoralis minor tightness: (Table 2 & 3)

Pectoralis minor tightness on both the side was negatively but poorly correlated with FEV1 & FVC which indicated there was a decrease in the capacity of lung function with an increase in tightness but as it was very poor so obvious affection couldn't be seen in the participants.While the left side of pectoralis minor tightness was poorly but positively correlated with FEV1/FVC, MVV & MVV*40/FEV1 which indicate if tightness increases there will be decreases in Table 2 where r=-0.22 & -0.059 for FEV1 for tightness on right & left side of pectoralis minor muscle. All most all lung function test was negatively correlated with pectoralis minor tightness that suggesting with an increase in tightness, pulmonary function outcome measures will be declined & it may hamper the respiratory function of healthy individuals(r= -0.015, 0.048 for FVC, r=-0.047, 0.086 for MVV*40/FEV1 and MVV r=-0.037 & 0.004 on right & left side of pectoralis muscle) but here the correlation is poorly related with muscle tightness so it will no more hampering respiration. In the age group 23-25-year-old individuals having a good relationship with pectoralis tightness as r= 0.224 for FVC, -0.535 for FEV1/FVC, -0.785 for MVV & -0.709 for MVV*40/FEV1 on right side of pectoralis minor tightness)that suggesting as age is increased, participants may have problems in lung functions mainly MVV, FEV1/FVC ratio & MVV*40/FEV1 if they have a more tightness of pectoralis minor muscle on right side of shoulder region seen in Table 3.

3247766993. Relationship between lung function and the flexi-curve angle: (Table 2 & 3)

Flexi-curve angle was positively correlated with all parameters except FEV1 & MVV as it was negatively correlated with them in which r= -0.085 & -0.050. So it means if the angle increases in cervical there will be a decrease in the FEV1 & MVV

which indicates that less effort will be generated for maximal voluntary ventilation but it's too minimally affected so it won't be affecting lung function Table 2. In all age groups, the r-value will be around 0.2 or 0.3 indicating a poor correlation between Flexi curve angle & lung function testing parameters.

3247766994. Relationship between lung function and Interscapular distance: (Table 2 & 3)

Among all outcome measures, Interscapular distance was highly correlated with FEV1 & MVV where r = 0.315 & 0.301 which shows a distance between two superior angles of scapula increases there will be a decrease in the FEV1 & MVV that suggesting forced expiratory capacity will be affected & less effort will be generated in the muscles of respiration due to weakness of upper posterior back muscles in Table 2. Compare to another age group, FEV1 in 20-22-year-old participants were adequately correlated with interscapular distance as r value are 0.44 while other age groups were poorly where r = 0.19 for 17 to 19 year old & 0.237 for 23 to 25-year-old subjects but positively correlated with distance. but FVC was equally but adequately correlated in the age of 20-22 & 23-25 years (r= 0.451 for 20 to 22-year-old & 0.434 for 23 to 25 year old)which shows these groups have a significant association with interscapular distance while the ratio between FEV1/FVC was highly correlated in the age group 23-25 years old healthy individuals in Table 3 as the r was - 0712. In the age group 23-25, MVV has correlated adequately but a negative relationship with Interscapular distance as r= -0.465 while MVV*40/ FEV1 was highly related with Interscapular distance which means if Interscapular distance increases, MVV & MVV*40/FEV1 will be reduced due to muscular imbalance between extensor group of muscles and flexor group of muscles of the upper back region & respiratory effort will be less due to this cause.

Table 1: Sociodemographic characteristics

Variables	N(%)	Mean	Standard Deviation
Age	120(100)	19.56	1.704
17-19	70(58.34%)		
20-22	42(35%)		
23-25	8(6.66%)		
Height	120(100%)	53.58	12.81
Weight	120(100%)	160.65	9.10
BMI	120(100%)	20.66	4.54
Gender	120	1.115	0.359
Male	18(15%)		
Female	102(85%)		

Table 2 shows Pearson's correlation coefficient in the 120 healthy individuals

Variables	FEV1		FVC		FEV1/FVC		MVV		MVV*/FEV1	
	r	P value	r	P value	r	P value	r	P value	r	P-value
Intrascapular distance	0.315	0.00	0.251	0.006	0.047	0.613	0.301	0.001	0.047	0.614
Right side pectoralis minor tightness	-0.22	0.772	-0.015	0.871	-0.035	0.706	-0.037	0.735	-0.047	0.609
Left side pectoralis minor tightness	-0.059	0.521	-0.106	0.249	0.048	0.599	0.004	0.970	0.086	0.353
Flexi-curve angle	-0.085	0.354	0.075	0.416	0.004	0.965	-0.050	0.585	0.018	0.842

Table 3 shows Pearson's correlation coefficient with categories of age group between 17 to 25 year-old

	FEV1			FVC			FEV1/FVC			MVV			MVV*40/FEV1		
Age Group	17-19	20-22	23-25	17-19	20-22	23-25	17-19	20-22	23-25	17-19	20-22	23-25	17-19	20-22	23-25
Intrascapular distance	0.198	0.444	0.237	0.097	0.451	0.434	0.087	-0.089	-0.712	0.261	0.387	-0.465	0.097	-0.039	-0.616
Right side pectoralis minor tightness	-0.060	-0.103	0.004	-0.045	-0.117	0.224	-0.053	0.234	-0.535	-0.021	-0.024	-0.785	0.056	-0.013	-0.709
Left side pectoralis minor tightness	0.020	-0.061	0.130	0.040	-0.076	0.142	-0.097	0.179	-0.197	-0.031	0.009	-0.127	-0.058	-0.006	-0.236
Flexi-curve angle	-0.172	0.044	0.209	-0.208	0.002	0.063	0.119	-0.105	0.019	0.075	-0.102	0.247	0.215	-0.209	-0.004

Discussion

Due toprolonged cycles of extreme stress and the contraction of neck muscles to correct an unstable head position, forward head posture induces intense stiffness in the neck flexors[9].The length–tension relationship of the force in the respiratory muscles associated with the neck flexors is also altered by forward head posture[10].So, the purpose of our research was to find a relationship between forward head posture, pectoralis minor pulmonary tightness. The ratio of FEV1 / FVC and ISD, Flexi curve, and left pectoral minor tightness between FVC and ISD ratio of MVV*40 / FEV1 and ISD, Flexi curve, and left pectoral minor tightness between FVC and ISD ratio of MVV*40 / FEV1 and ISD, Flexi curve, were substantial positive weak correlation of MVV

and ISD.This correlation of ISD, Flexi-curve, Left pectoralis minor on FEV1, FVC, MVV, FEV1 / FVC ratio, MVV*40 / FEV1 seems significant because it indicates that there will be a decrease in FVC, FEV1, MVV, FEV1 / FVC, MVV*40 / FEV1 in the forward head posture with a rise in ISD, Flexi curve and Left pectoralis minor tightness. When Kim et al [11] compared the pulmonary functions of a forward head posture group and a control (healthy) group, the FVC in the forward head posture group was 81.95 percent, while the FVC in the control group was 93.54 percent, indicating that the FVC in the forward head posture group was slightly lower than the control group.The Forward Head Posture is also included in this study as it causes the shortening and weakening of accessory respiratory muscles such as serratus anterior, pectoralis major, pectoralis minor muscle, as they help them during the inspiration phase of breathing. Pectoralis minor is the muscle that helps the anterior muscle of the serratus draw the scapula to the chest and helps to check the gap from the acromion to the treatment table during deep inspiration, as stated in the introduction. Deepika Singla, and Zubia Veqar et al [12]studies, there is the alteration in scapular position and abnormal alignment occur in the cervical and thoracic spine due to the adaption of the Forward Shoulder In this posture there is anterior tilting, downwardly rotated, protracted scapula due to this there is the decrease in respiratory muscle activity as this muscle goes in tightening or weakness decrease in accessory muscle also increase in the forward angulations of scapulae there will be increases in slope of the upper thoracic spine with this there will be increased anterior-posterior diameter of the chest with the increase in kyphotic posture also reduced glenohumeral joint motion by reducing scapular posterior tilt. As the association finds that Forward Head Posture contributes to Forward Shoulder Posture and increases in thoracic kyphosis, this study was performed to estimate the decrease in pulmonary values such as FVC, FEV1, MVV, FEV1 / FVC ratio in the typical person with small pectoral tightness as this posture is now widely adapted by adults when using cell phones, carrying heavy backpacks, having weak posture when attending long lectures. V K VIJAYAN et al, studies[13] have shown that the positive association between MVV and FEV1 indicates that as MVV decreases the indirect proportion of the degree of respiratory muscle weakness in malnourished patients and the determination of MVV may also be helpful in the assessment of chronic pulmonary diseases and the relationship between malnutrition and chronic pulmonary diseases is increasingly being identified. Forward Head Posture is an abnormal posture, and during expiration, it may increase the internal pressure of the trunk and increase the dynamic mechanisms. The flexibility of the musculature of the cervical and thoracic spine is also important because it smoothes the respiratory function due to imbalances as discussed, there will be a decrease in endurance and proprioception of these muscles in FHP, there will be increases in muscle tension around the thoracic spine and limiting the upper range of motion of the thoracic. For this cause, in a normal person with FHP, lung capacity is measured, leading to small pectoralis minor tightness and affecting the lung capacity or not.The association between pulmonary function and forward head posture, pectoralis minor tightness and flexicurve angle for thoracic kyphotic posture is very weak in the present study, however. Almost all variables except FEV1 & FVC were moderate to strongly correlated in the age group of 23 to 25, but was negatively correlated with the right side pectoralis minor tightness, suggesting that as age increases, muscle tightness will decrease lung functional capacity. However, in the age group 17 to 19, the flexi curve angle is poorly but negatively associated with FVC, indicating that as the forward head posture increases, the FVC value decreases. Only Interscapular distance and MVV, FEV1, FVC, FEV1/FVC, MVV*40/FEV1

showed a positive poor correlation in our research, suggesting that the weakening of posterior scapular muscles affects PFT parameters and that there is no difference in PFT parameters between right and left pectoralis minor tightness.

Conclusion

Intra scapular Distance shows an association between MVV, FVC, FEV_1 which has poor correlation but in other variables like Flexi curve and Right and Left Pectoralis tightness are not correlated significantly with PFT values in a normal healthy individual. So there is no association between Pulmonary Function test and person with pectoralis minor tightness and forward head posture.

Ethical Clearance: Yes

Conflict of Interest: None

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