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ASSOCIATION BETWEEN PECTORALIS MINOR LENGTH AND FORWARD HEAD POSTURE AMONG HEALTHY YOUNG ADULTS

Physiotherapy

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ABSTRACT

Background: Posture is the alignment of body parts and is an important health indicator. It should be matched with a specific body position in the space that minimizes antigravity stress on body tissues. Forward Head Posture is considered to co-exist with hyperextension of lower cervical spine, rounding of upper back and elevation – protraction of shoulders. The prevalence in children and teenagers was 53.5%. The Pectoralis minor is triangular in shape and originates from the margins of the third to fifth ribs adjacent to the costochondral junction. The fibers consequently pass upward and laterally to insert into the medial border and superior surface of the coracoids process of the scapula. It is the only anterior scapulothoracic muscle. Any activity that causes the body to look down and forward for long periods of time can contribute to slumped shoulders. These positions disrupt how the muscles in the neck, back, and shoulders normally function. **Aim:** The aim of the study is to find out the association between pectoralis minor length & forward head posture among healthy young adults. **Materials And Methods:** A study was conducted among 70 young adults of Ahmedabad city, aged between18-24 years fulfilling the inclusion criteria. Subjects were selected by a convenient random sampling method and general assessment was taken. Cranio-vertebral angle (CVA), Cranio-horizontal angle(CHA), Pectoralis minor length(PML), Pectoralis minor index(PMI) was used as the outcome measure. Data were analysed using SPSS software. To analyze the data, descriptive statistics and analytical statistics were carried out. **Results And Discussion:** The total 70 subjects consisted of 31 males and 39 female participants. The mean age of the sample was found to be 21.97 ± 1.91. Results shows Correlation of PML with CHA and CVA was significant large negative Correlation, where r value is -0.535 and -0.528 respectively and the Correlation of PMI with CHA and CVA suggested significant medium positive correlation between two variables, where r value is 0.332 and 0.357 respectively. **Conclusions:** The result shows the significant association between pectoralis minor length and forward head posture among healthy young adults. Changes at cervical can lead the changes at shoulder, scapula and ribs level. So with increasing the forward head posture can lead to the shortening of pectoralis minor length.

KEYWORDS

Forward head posture, Pectoralis minor length, Craniovertebral Angle, Cranio-horizontal angle, Pectoralis minor index

INTRODUCTION

Posture is the alignment of body parts and is an important health indicator. It should be matched with a specific body position in the space that minimizes antigravity stress on body tissues [1]. Posture is the attitude assumed by the body either with support during muscular inactivity, or by means of coordinated actions of many muscle working to maintain stability or to form an essential basis which is being adapted constantly to the movement which is superimposed upon it.

Various occupations require people to assume static postures for long periods, which cause continuous contractions of the head and neck muscles. The head constitutes 6% of the total body weight, which is linked to the cervical spine and all other joints through the kinematic chain by various muscles. Inappropriate posture consists of incorrect interrelationships between each body segment. This causes muscle tension and shortening, making it difficult to achieve proper joint motion and can cause pain [2].

The Pattern Of Posture Is Good And Bed Posture.

GOOD POSTURE is said to be good when it fulfills the purpose for which it is used with maximum efficiency and minimum effort and POOR POSTURE is poor when it is inefficient, that is, when it fails to serve the purpose for which it was designed, or if unnecessary amount of muscular effort is used to maintain it.

Postural assessment is one of the important components of the clinical examination of patient with musculoskeletal disorder [3] Evaluating the upright standing posture in the sagital plane has been widely used as a diagnostic procedure for patient craniocervical pain[4]

The human body should have a relaxed posture of head and shoulder, which means the external auditory meatus is aligned in a straight line with acromian process of shoulder and chin tucked in. In an upright neutral posture of cervical spine, passive resistance to motion is minimal. Support of the cervical segment is provided by the muscular sleeve formed by the longus colli muscle anterior and the semispinalis cervicis & cervical multifidus muscle posteriorly.[5]

The importance of deep muscles for the maintenance of cervical posture is known, and region of local segmental instability results, if only the large superficial muscles of the neck (sternocleidomastoid & anterior scalene) are stimulated to produce movement. Deep cervical muscle activity is needed in synergy with superficial muscle activity to stabilize the cervical segment, especially in the functional midrange of cervical spine .[5]

Smartphone are becoming increasingly indispensable in everyday life and offer a substantial variety of mobile applications for information, communication, education and entertainment purposes. While mobile applications offer several ways to prevent and treat chronic diseases such as diabetes or alcoholism, there are also obvious adverse effects on physical and mental health caused by their overuse.[4] Recent investigations have shown that Smartphone users tend to report pain in the neck, shoulder and thumb and the severity of the symptoms as the total time spent using the smart phone increases. Prolonged use causes faulty posture such as forward neck posture, slouched posture or rounded shoulders.[5] Regarding mental health, recent studies showed that increased Smartphone use might be related to sleep disturbances and depression.[5]

Anatomy of spine [2]

These regions are:

1. The Cervical spine (C1-C2)
2. The Thoracic spine (T1-T12)
3. The Lumbar spine (L1-L5)
4. The Sacral spine (S1-S5)

The functional distinctions between the different regions of the spine are suggested by the difference in the size, shape, and structure of vertebrae and inter vertebral joints

1.1.1 Functional Components of the Spine

Functionally spinal column is divided into anterior and posterior pillars. The anterior pillar is made up of the vertebral bodies and intervertebral discs, hydraulic, weight– bearing, shock absorbing

potion of the spinal column. The size of the disc influences the amount of motion available between two vertebrae. The posterior pillar or vertebral arch is made up of the articular processes and facet joint, which provide the gliding mechanism movement. The orientation of the facets influences direction of motion. Posterior unit are the boney levers, the two transverse processes, and Spinous process to which the muscles attached and function cause and control motions and provide spinal stability.

Anatomy of cervical spine [9]

The cervical spine has the smallest vertebral bodies, as well as the largest spinal foramens through which the spinal nerve roots travel. The head, which houses the sensory organs and nerves for sight, smell, hearing and taste, is dependent on the cervical spine for both support and mobility.

The cervical spine is essential for several activities of daily living, including directing the sensory organs towards aspects of the environment that would be most pertinent in a stable and safe manner. The cervical spine is able to serve all these functions due to the geometric characteristics of its vertebral bodies, which can be divided into three distinct units:

1. The Atlas (C1):

The atlas (C1) is the first point of bony contact between the skull and the spine. It has largest vertebral foreman of all the cervical vertebrae. It does not have a spinous process, but rather, a posterior tubercle where the nuchal ligament is attached. The first cervical nerves exit over the posterior arch of the C1 vertebrae, on both sides of the posterior tubercle, under the posterior atlanto-occipital membrane. The occiput of the head are" cradled" by the concave atlas and the convex occiput allows for flexion, and to a greater, extension.

2. The Axis (C2):

The Axis (C2) resides under the atlas to form the atlanto-axial joint that is secured by the transverse ligament. The Odontoid process of the axis is the articulation point of the atlas above it. In addition to supporting the weight of the head, the atlanto - axial joint allows for a large of axial rotation.[2]

3. The Column (C3-C7):

The remaining segments of the cervical spine (C3-C7) share the same basic morphological characteristics of a flat superior surface flanked by processes and a concave inferior surface. However, C6 and C7 differ from the rest of the rest of the column in that their spinous processes are longer and the C6 spinous process is not usually divided into two. All parts vertebral segments are arranged on top of each other with inter-vertebral discs separating them. Intervertebral discs are cartilaginous pads that are subject to significant compressive loads and serve as shock-absorbers between 6 vertebrae. These viscoelastic discs also hold adjacent vertebrae together while allowing slight mobility. Each disc is made up of a thick outer layer, called the annuls fibrosis, that encloses a gel- like center, called the nucleus pulposus.

- **Pectoralis minor muscle: [10]**

The Pectoralis minor is triangular in shape and located under the pectoralis major, both from the anteriror wall of the axilla. It originates from the margins of the third to fifth ribs adjacent to the costochondral junction. The fibers consequently pass upward and laterally to insert into the medial border and superior surface of the coracoids process of the scapula. It is the only anterior scapulothoracic muscle.

The primary action of this muscle included the stabilization, depression, Protraction, internal elevated scapula rotation and downward rotation of the scapula. pectoralis minor role in respiration elevates the ribs for deep inspiration when the pectoral girdle is fixed or stabilized ,position of good alignment, the pectoralis minor acts assessory muscle of inspiration..

The pectoralis minor muscle creates a passage between the ribs for the transit of the brachial plexus and both the subclavian artery and vein. If the muscle is shortened/tight this abnormal tension: negatively affecting the Scapulohumeral Rhythm; can also cause thoracic outlet syndrome.

Scapula, normally called as shoulder blade, it rests at a position on the posterior thorax approximately 2 inches from the midline, between the second and seven through. The scapula is internally rotated from vertical and is upwardly rotated 10° to 20° from vertical.

Fig 1.1: Pectoralis minor muscle

The position of scapula is very important for muscle balance, there is a significant relationship between the contraction abilities of the muscles in the shoulder region, and the position of scapula and shoulder protraction is developed due to the poor posture creates disadvantage for muscle function.

- **Forward Head Posture(FHP) :[11]**

FHP is considered to co-exist with hyperextension of lower cervical spine, rounding of upper back and elevation – protraction of shoulders. Forward head posture is the anterior positing of the cervical spine, this posture called as “Text neck, scholar neck, wearies neck, ilunch, reading neck (9)

In FHP, head shifts anteriorly from the line of gravity, scapula may rotate medialy, a thoracic kyphosis may develop and overall vertebral may be shortened Because of this structural changes, typically, muscle overused in a certain direction will become tighter and shorter – an effect Known as 'adaptive shortening.’

A study showed prevalence of FHP to be 85.5% and a significant association was seen between FHP and gender. A study on heroin users showed that 36.7% had moderate FHP while 20.0% had severe FHP. The prevalence in children and teenagers was 53.5%.

A forward head posture is one in which the head is positioned anteriorly and the normal anterior cervical convexity is increased with the apex of the lordotic cervical curve at a considerable distance from the LoG in comparison with optimal posture. The constant assumption of a forward head posture causes abnormal compression on the posterior zygapophyseal joints and posterior portions of the intervertebral discs and narrowing of the intervertebral foramina in the lordotic areas of the cervical region.

The cervical extensor muscles may become ischemic because of the constant isometric contraction required to counteract the larger than normal external flexion moment and maintain the head in its forward position. The posterior aspect of the zygapophyseal joint capsules may become adaptively shortened, and the narrowed intervertebral foramen may cause nerve root compression.

Whenever the person is sitting or standing, which is probably between 16–18 hours a day, cervicocranial neck extensor musculature must isometrically work every second of every minute of every one of these hours, every day of every year of every decade. This use/overuse/ misuse/ abuse of the extensor musculature of the neck will likely result in neck pain.

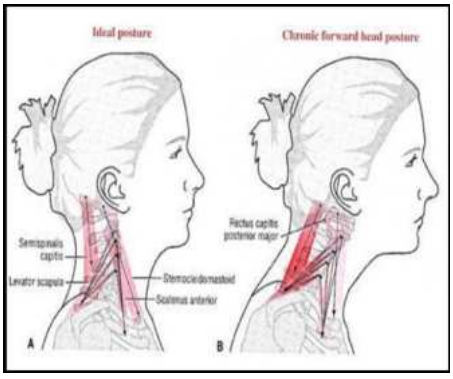


Fig 1. 2: Forward Head Neck Posture

The forward head posture (FHP) has been shown to, be a general posture displacement, and the typical estimate is about 66% of the patient population. In general, these abnormal postures are associated with the development and persistence of many disorders, including cervicogenic headache and migraine, myofascial pain syndrome, abnormal shoulder blade movement, and temporomandibular joint disorder [3].

- **Rounded Shoulder:- [12]**

Rounded shoulders, sometimes Known as "mom posture", are part of overall bad posture, and they can get worse if left untreated. Rounded shoulders are an excessive thoracic kyphosis referring to an uneven forward rounding or curvature of the middle and upper back. Rounded shoulders shift out of proper alignment with the spine, causing posture-related problems, like shoulder/neck/back discomfort, tightness, stiffness, and pain.

- **Overall Unhealthy Posture Contributes To The Following:**
- The head constantly being in a forward or backward position
- Headaches
- Body aches and pains
- Muscle fatigue
- Chronic back soreness
- Bent knees when standing or walking
- Body movement dysfunction
- Joint problems
- Potbelly
- Rounded shoulders

- **Body Responses To Rounded Shoulders Include:**
- Chronic musculoskeletal aches and pains
- Breathing problems
- Limited body function
- Impaired mobility performance
- Increased mental and musculoskeletal stress

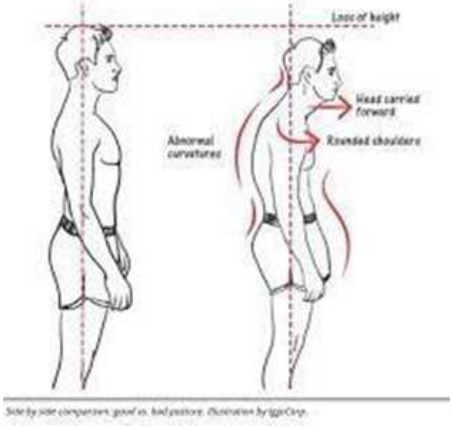


Fig 1.3: Postural changes in Forward head neck posture

- **Causes**

Rounded shoulders are typically caused by unhealthy posture, but can also be caused by muscle imbalances from, for example, overfocusing on building chest strength but neglecting the core and upper back. Other causes include:

- Standing and sitting for long periods
- Stress
- Lack of physical activity
- Environmental factors
- Too much exercise, sports, and physical activities

- **Musculoskeletal Imbalance**

Postural imbalances anywhere in the body can cause rounded shoulders.

Any activity that causes the body to look down and forward for long periods of time can contribute to slumped shoulders. These positions disrupt how the muscles in the neck, back, and shoulders normally function. It is this muscle that control the way the body maintains its posture throughout the day.

Daily Tasks That May Contribute To Rounded Shoulders Include.
- Using a smart phone or tablet
- Using a computer or laptop
- Sitting for long periods
- Driving a vehicle
- Bending over repeatedly
- Carrying heavy objects all day

For example, when an individual tilts their head forward to look at their phone, the upper back has to round forward to hold the head. Constantly tilting can begin to generate an unhealthy muscle memory causing the neck and shoulder muscles to remain in a semi-flexed position that starts to become the norm.

Another example is when the arms are held out and in front for prolonged periods, like driving, typing, and cooking, the chest muscles get shortened. As time goes on, this causes the shoulder blades to move forward on the ribcage, making the upper back and shoulder area hunch awkwardly and unhealthily.

- **Stress**

When the brain perceives a threat, the body physically prepares to take action through the fight or flight response.

Common Reactions Include:
- Jaw tensing
- Tightening the abdominal muscles
- Holding one's breath
- Rounding the shoulders

Stressors Can Include:
- Job worries
- Money issues
- Relationship problems
- Family responsibilities
- All can cause changes in the body that result in rounded shoulders.

- **Environmental Factors**

1. Respiratory conditions like asthma, COPD, and allergies can affect the body's breathing and the ability of the diaphragm to contract and relax correctly.
2. Ribcage restrictions caused by chronic breathing problems can result in the thoracic/middle back tightening up, causing excessive shoulder rounding.

- **Exercise And Physical Activities**
- Exercise and physical activities can contribute to rounded shoulders because of the long periods of spinal flexion. These can include:
- Bike riding, martial arts, and swimming.
- Knitting requires the arms to be out in front.
- Gardening requires kneeling and being hunched over.

The risks of rounded shoulders include the negative impact they can have on health and appearance. By inadvertently training the body to be hunched forward over time, the muscles interpret this slumped position as the body natural state. This can be very

harmful for the body if left untreated increased stress on the shoulder joint can cause pain around the neck and upper back

- **Operational Defination :**

The physical appearance of the head, cervical spine and shoulders is a

crucial element of human posture (Griegel-Morris et al. 1992; Raine and Twomey 1997). Both the craniohorizontal angle and craniovertebral angle are used to determine the head–neck position on the sagittal plane. The craniohorizontal angle describes the inclination of the head from the horizontal axis with respect to the position of the upper cervical spine. The craniovertebral angle describes the inclination of the head with respect to the lower cervical spine (C7), which identifies the head and neck position.

- **Craniovertebral Angle:** CVA is the between the line from external auditory meatus to the seventh cervical vertebra and a horizontal line at the level of the seventh cervical vertebra.[15] Normal angle :>= 49degree [9]
- **Cranio Horizontal Angle:** CHA is formed by a horizontal line and adjoining tragus of the ear and the external canthus of the eye [15] Normal angle: >=13.9degree

Pectoralis minor length (PMM) length can be measured in standing, sitting and supine position. 4 Specific position during PMM measurement can influence the relation with other objective findings during examination of shoulder. 7 Clinical tests used to measure the PMM tightness include pectoralis minor index and PMM length test and have intra-rater reliability.3-7 There is only one study related to the frequency of PMM tightness with values 14.4% among asymptomatic individuals. 6 This study aimed to determine the frequency of PMM tightness among individuals with asymptomatic shoulder.

- **Pectoralis Minor Length**: were made in supine position. Where the linear distance from the treatment table to the posterior aspect of the acromion.[14] Normal distance :> 2.6 cm
- **Pectoralis Minor Index:** PMI is measured from the edge of the 4th rib to the infer-medial aspect of coracoid process with measuring PMI is calculated by dividing the resting muscle length measurement by the subject height and multiplying by 10.

Need Of Study

- Forward head neck posture is very common in young adults because their sitting posture and prolonged smart phone usage.
- Forward head posture associated with pectoralis minor length is one of the common postural mal-alignments found in today's youth. This postural mal-alignment is one of the major causes of musculoskeletal condition in the body. If these postural changes are detected early, the musculoskeletal condition can be treated as well as further progression can be prevented. Hence, the purpose of the study is to find out the association between pectoralis minor length and forward head posture among healthy young adults.

Aim Of The Study

- The aim of the study is to find out the association between pectoralis minor length & forward head posture among healthy young adults.

Objective Of The Study

- To find out the forward head posture among healthy young adult the help of craniovertebral and crania horizontal angle.
- To find out the pectoralis minor length the help of pectoralis minor index & pectoralis minor length.
- To find the association between pectoralis minor length & forward head posture among healthy young adults.

Study Design And Study Setting:

- **Study Setting**: Ahmedabad and Gandhinagar city (Gujarat).
- **Study Design**: Observational study.
- **Study Population**: Healthy young adult 18 to 24 years age.
- **Sampling Method**: Convenience-random sampling
- **Sample Size:** 70.
- **Study duration:** 1 year
- **Selection Criteria**:

1. Inclusion Criteria:

Healthy young adults Age 18-24 years
Gender: males and females

2. Exclusion Criteria:

Pathological shoulder fractures Rheumatoid arthritis
History of cervical trauma Previous neck & shoulder surgery Not willing to participate.

Methodology:

- The project proposal was submitted and approved by Venus College of Physiotherapy.
- The subjects who were willing to participate in the study were selected from Ahmedabad and Gandinagar city.
- The individuals were selected by convenient sampling.
- All selected individuals were rectified by inclusion and exclusion criteria and 70 subjects were selected according to selection criteria for the study.
- The written consent was taken from all the selected subjects and was explained about confidentiality of personal data, and withdrawal at any time during and after the study.
- General assessment was done with required demographic data.
- The subjects were explained about the study and procedure of taking craniovertebral and crania horizontal angle and pectoralis minor length.
- The data was collected.
- The association between forward head neck and pectoralis minor length was assessed by using the collected data.

- **Procedure For Assessment Of Forward Head Posture**

Participants will be made to sit on a stool with their knees bent to 90 degrees and feet flat on the ground. They will be instructed to focus at a particular eye level. The starting position will be standardized by placing the subject in an upright position. A mobile phone will be mounted on a stand and placed one meter away from the subject laterally. Bright color markers will be placed on the C7 spinous process, tragus of the ear, and canthus of the eye.

The examiner will locate the C7 spinous process by asking the subject to move the cervical spine into flexion and extension. The C7 spinous process will become more prominent, while the C6 spinous process will be absent in palpation when the cervical spine is in extension.

This information describes the process of measuring the craniovertebral and crania horizontal angles in an evaluation of head and neck posture.

Figure3.2: Measurement of Cranio Horizontal angle

Figur 3.3: Measurement of Cranio vertebral angle

The angle between the line connecting the C7 vertebrate and the tragus of the ear and the vertical line extending from the C7 was measured. The line connecting the external canthus angles of the eyes were also measured. Photographs were taken and later analyzed using the smartphone app "ON PROTRACTOR" to determine the degree of the craniovertebral and crania horizontal angles.

2. Pectoralis Minor Index:

PM length measurement procedure: For the anthropometric measurement of the PM length, we had adapted the protocol of Borstad et al. [16], as previously described by Cools et al. [10]. The instructions were to palpate two anatomical reference points which in line represent the PML

1. The inferomedial aspect of the coracoid process
2. The caudal edge of the fourth rib at the sternum.

The distance between these two bony reference points was measured with a vernier caliper and a flexible tape. To neutralize variations of muscle length resulting from respiration, subjects were asked to exhale before the measurement and to inhale only after the measurement. The subjects were in a supine position, with the elbows extended alongside the body with the palm placed on the examining table to minimize postural influences of the thoracic spine and to optimize muscle relaxation of the surrounding musculature as described by Cools

Then, the Pectoralis Minor Index was calculated using formula PMI = [PM length (cm)/subject's height (cm)] × 100, as described by Borstad et al. [23].

Figure 7.: Pectoralis muscle length for PMI

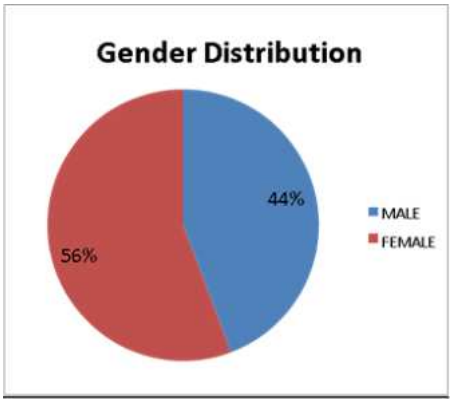
3. Pectoralis minor length:

The subject lies supine with their arms by their side and palms facing down, where the linear distance from the treatment table to the posterior aspect of the acromion.

Figure 8.: Pectoralis muscle length for PML

RESULT

ADULTS. The study comprised 70 subjects from Gandhinagar and Ahmedabad city after the selection criteria were met.. Data was analyzed using statistical software SPSS 22 version. Before applying statistical tests, data was screened for normal distribution. All outcome measures were analyzed using appropriate statistical test. Level of significance kept at 5%.



Graph 1: Gender Distribution Of The Subjects

The graph 1 shows gender wise (male and female) distribution of subjects participated in the study.

A total of 70 (N=70) subjects had participated in the study on voluntary basis including which there were 39 females and 31 male participants. In this study, firstly data analysed by Wilcoxon Signed Rank Test. According to that data was normally distributed. So for correlation Karl Pearson's correlation coefficient test was used.

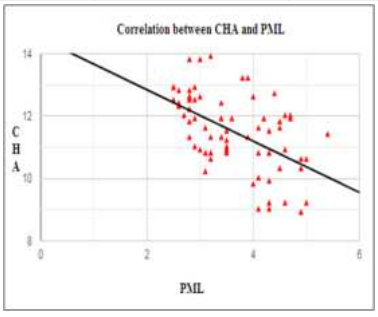
Table 1: Mean And Standard Deviation Of Age And Outcome Measure

OUTCOME	MEAN	STANDARD DEVIATION
Age	21.97	1.91
Cranio Vertebral angle	45.91	1.68
Cranio Horizontal Angle	11.50	1.20
Pectoralis Minor Length	3.63	0.78
Pectoralis Minor Index	7.74	1.29

Table 1 shows mean and Standard Deviation of Age and Outcome Measures of subjects participated in study.

Table 2: Correlation Between Pml And Cha

Variables	r-value	P value
PML & CHA	-0.535	0.000

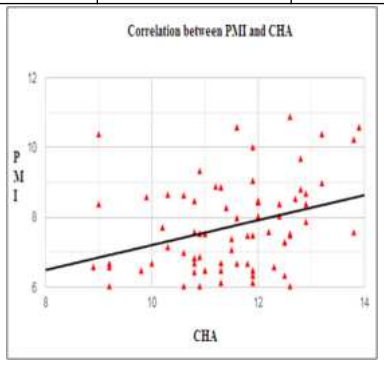


Graph 2: Correlation Between Pml And Cha

Table 2 and Graph 2 shows Correlation between CHA and PML suggested significant large negative Correlation between two variables, where r value is -0.535 and p value is 0.000. It indicates the increase in CHA with reduction of PML and reduction in CHA associated with increase in PML.

Table 3: Correlation Between Pmi And Cha

Variables	r-value	P value
PMI & CHA	0.332	0.004

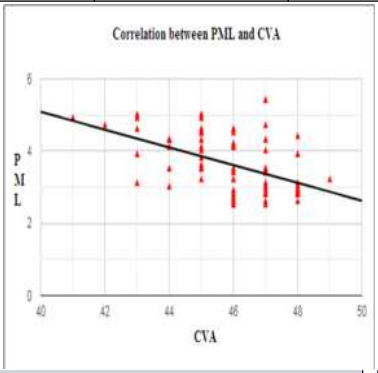


Graph 3: Correlation Between Pmi And Cha

Table 3 and Graph 3 shows Correlation between CHA and PMI suggested significant medium positive correlation between two variables, where r value is 0.332 and p value is 0.04 suggested that the increase in CHA with increase of PMI and reduction in CHA associated with reduction in PMI.

Table 4: Correlation Between Pml And Cva

Variables	r-value	P value
PML & CVA	-0.528	0.000

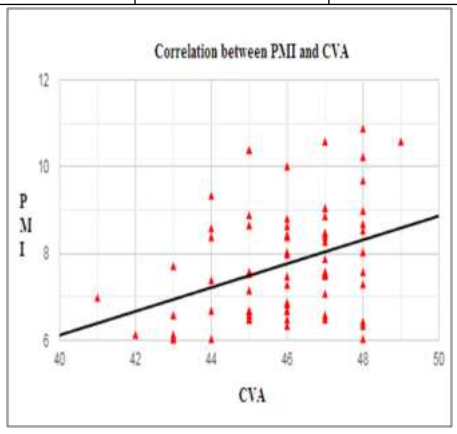


Graph 4: Correlation Between Pml And Cva

Graph 4 shows Correlation between CVA and PML indicates significant large negative Correlation between two variables, where r value and p value are -0.528 and 0.000 respectively. It suggested that the increase in CVA with reduction of PML and reduction in CHA associated with increase in PML.

Table 5: Correlation Between Pmi And Cva

Variables	r-value	P value
PMI & CVA	0.357	0.002



Graph 5: Correlation Between Pmi And Cva

Graph 5 and Table 5 shows Correlation between CVA and PMI indicates significant medium positive correlation, where r value and p value are 0.357 and 0.002 respectively, suggested that the increase in CVA with increase of PMI and reduction in CHA associated with reduction in PMI.

DISCUSSION

The present study conducted to find out the association between pectoralis minor length and forward head posture among healthy young adults. 70 subjects aged between 18-24 years with mean age 21.97 ± 1.91 are participated in study after inclusion criteria were met.

Results have been indicated that forward head rounded shoulder posture (FHRSP) causes a decrease in flexibility of the pectoralis major/minor complex; it means reduced length of the muscle. Here, the Correlation of PML with CHA and CVA suggested significant large negative Correlation between two variables, where r value is -0.535 and -0.528 respectively and the Correlation of PMI with CHA and CVA suggested significant medium positive correlation between two variables, where r value is 0.332 and 0.357 respectively.

FHP is one in which the head is positioned interiorly and the normal anterior cervical convexity that is cervical lordosis is increased in comparison with optimal posture. FHP can be linked to, among other factors, repetitive overhead activities, backpack carriage, bad habit, mouth breathing, computer and laptop use, and prolonged study hours. Sahrmann has stated that the shoulders tilt anteioly because of shortness of pectoralis minor and that the lateral border of the spine (posterior aspect of the acromion) should be no more than 2.54 (2.6) cm from the treatment table when the subject is in supine. A distance greater than this would suggest a muscle imbalance had occurred and the muscle had shortened.

Our study results revealed that students with decreased CVA values having a more incidence of FHP and are subjected to increased incidence of the pain. This is supported by study conducted by Lopez et al. [30] to compare standing head posture measurements between patients with non-traumatic neck pain (NP) and pain-free individuals. NP patients were found to have a significantly smaller angle resulting in a more forward head posture than pain free participants.

It has been assumed that forward head rounded shoulder posture (FHRSP) causes a decrease in flexibility of the pectoralis major/minor complex, as well as the latissmus dorsi muscles.

Greipp [28] performed a study in which he was able to predict, with 93% accuracy, teamwide incidence of swimmer's shoulder for the winter season based on a correlation between lack of flexibility and pain. Here, shoulder horizontal abduction tests were performed using a flexibility test that was validated in a preliminary study. This test involved the individual supine with arm in horizontal abduction FHRSP does have the clinical appearance of the pectoralis complex and latissmus dorsi muscles being in a shortened resting position, this did not seem to directly indicate any decrease in muscle length on passive muscle testing in our study. This is contrary to previous findings, where forward flexion was significantly increased in swimmers as compared to non-swimmers. In this study, swimmers were shown to have on increased incidence of FHRSP. However, this difference could be attributed to the fact that Division I collegiate swimmers are overhead athletes. This distinction includes the fact that they train and use their shoulder in positions of extreme flexion and abduction to a greater extent and with greater frequency then normal individuals.

Borstad [26] examined the relationship between posture, pectoralis minor length and movement alterations. Significant differences were demonstrated for several postural variables, including thoracic spine kyphosis, forward head posture and scapular rotation between individuals with short pectoralis minor muscles as compared to those with long pectoralis minor muscles.

Studies have also looked at how range of motion at the shoulder joint is linked to shoulder dysfunction. Other scholars have hypothesized that forward shoulder posture would be associated with a decrease in external rotation due to tightness of pectoralis major and minor, as well as latissmus dorsi muscles. Bang and Deyle analyzed an exercise group and an exercise plus manual therapy group to compare the effect of these intervention programs on shoulder pain. Specific manual therapy techniques, including pectoralis minor stretching and soft tissue mobilization, were given when indicated, based on the examination of each patient. Wang et al tested the 3-dimensional kinematics of a group of individuals with forward shoulder posture before and after a 6-week home exercise program. The exercise program included a self-stretch for the pectoralis minor as 1 of 6 exercises.

Muscle imbalances resulting from prolonged positioning or repetitive movements in a specific and static position can affect upper body posture. Biomechanical studies have shown that the deep flexor muscles of the neck, upper back extensors, and shoulder adductors become weakened and strained compared to their antagonists. This leads to an imbalance in the upper quarter of the body, resulting in forward head posture, abnormal scapular protraction, increased thoracic kyphosis, and neck flexion, which can eventually lead to painful shoulders and shortening of anterior shoulder muscles, such as the pectoralis major and minor.

According to Kendall [2], this abnormality can result from the shortening of the pectoralis minor muscle and weakness of the middle trapezius muscle. Additionally, in anterior shoulder dysfunction, the humerus bone is influenced by its connection to the glenoid cavity, causing the arm to move forward and rotate internally. This condition can result in weakness and strain of the shoulder's external rotator muscles and shortening of the internal rotator muscles of the shoulder.

Kim et al. (2008) [26] defined a different posture angle and a forward head distance to describe the head–neck posture, this result is similar to that in the present study, indicating that the subjects were more likely to adjust their head posture forward while they were carrying their backpacks The smaller craniohorizontal angle that indicates a more forward head position showed the subjects tend to walk with their heads oriented forward when they are carrying 10% and 15% BW backpack..

CONCLUSION

The result of the present study shows the significant association between pectoralis minor length and forward head posture among healthy young adults. Changes at cervical can lead the changes at shoulder, scapula and ribs level. So with increasing the forward head posture can lead to the shortening of pectoralis minor length.

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