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Correlation of head and shoulder posture with non-specific neck pain: A cross-sectional study

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ABSTRACT

Non-specific neck pain (NSNP) is one of the most significant health problems especially with frequent use of media devices as computers and cell phones that may be associated with some faulty postures as forward head posture or rounded shoulders. The aim of this study was to investigate the relation of neck, head and shoulders angles: cranio-cervical angle (CVA), forward shoulder angle (FSA), coronal shoulder angle (CSA) and sagittal head tilt angle (SHT) with the non-specific neck pain. A total of 100 females with non-specific neck pain, whose ages were ranged between 18-25 years old. Numeric Pain Rating Scale (NPRS) and Digital Camera were used to assess neck pain, and neck different angles of cervical and shoulders, respectively. There was indicated a positive and significant correlation between NPRS and FSA ($P < 0.045$), while there were non-significant correlations between NPRS and other variables ($P > 0.05$). It was found that there was a significant positive correlation between forward shoulder angle and non-specific neck pain in the sample of female participants. However, no significant associations were observed between neck pain intensity and CCA, CSA, and SHT. Addressing and improving forward shoulder angles may be a potential strategy to reduce neck pain in individuals with non-specific neck pain.

KEYWORDS

Non-Specific Neck Pain; Forward Head Posture; Rounded Shoulders; Numerical Rating Scale; Cervical Angles

1. INTRODUCTION

Non-specific neck pain (NSNP) is one of the most significant health problems that occupy the fourth leading cause of musculoskeletal disorder worldwide (de Campos et al., 2018). It is estimated that about 70% of the population experiences neck pain throughout life, with a 15% to 50% incidence annually. The statistical prevalence of neck pain shows Asia at 10.14%, Australia at 10.13%, the Caribbean at 9.7%, central Asia at 9.8%, central Europe at 9.9%, east Asia at 11.8%, eastern Europe as 9.9%, Latin America s 10.12%, and southeast Asia as 7.6% (Khan et al., 2022).

The frequency of neck pain increases in adolescents and young adults due to using smart phones and computers for a long time that may cause some faulty postures as rounded shoulders (RSP) and forward head postures, these posture disorders can be the cause of neck pain (Ertekin & Günaydın, 2021).

The NSNP is described as pain in the posterior region of the neck from the superior nuchal line to the spine of the scapula and the side region down to the superior border of the clavicle and the suprasternal notch, without radiating to the upper limbs (Guzman et al., 2008).

Work-related musculoskeletal disorders (WRMSDs) of the shoulder, wrist, neck, and/or back have multiple causes. Among computer office workers, WRMSDs are often caused by chronic cumulative micro traumas, resulting in severe symptoms such as pain, numbness, and tingling sensation. These symptoms can lead to reduced worker productivity, difficulty in performing job tasks, and high treatment costs. Work-related physical factors, psychosocial factors, and lack of awareness are all important factors associated with WRMSDs (Battecha et al., 2019).

Factors such as overlong work hours, sedentary lifestyle, high workload and demands, and inappropriate designs of computer workstations contribute to the occurrence of neck pain among office employees, particularly those who work with computers (Paksaichol et al., 2012). Prolonged sitting at work or improper head posture during work may play a significant role in the development of neck pain. Although some studies show a significant difference in head posture between patients with neck pain and pain-free participants, the association between forward head posture (FHP) and neck pain remains controversial (Nejati et al., 2015).

Rounded shoulder posture (RSP) is defined as when the scapulae are abducted and the acromion process is anterior to the vertical postural line (Gu et al., 2024). RSP is the most prevalent clinical postural misalignment that is caused by the negatively impacted of sedentary workers who frequently move their upper limbs on the strength and function of the muscles of the upper extremities, as it causes the spine to flex and increases tension on the nerve roots and so, shoulder pain is commonly appeared among those people (Rottermund et al., 2015).

Forward head posture (FHP) is one of the most common cervical postural faults found in almost all populations (Mahmoud et al., 2019). It is characterized by increased flexion of the lower cervical spine and upper thoracic region, as well as increased extension of the upper cervical vertebrae. The FHP leads to an increase in gravity forces exerted on the head, potentially causing degenerative changes in the cervical spine. However, the relationship between FHP and neck pain is still debated (Lau et al., 2010; Shiravi et al., 2019). Flexed head and neck postures during seated work are associated with an increase in gravitational load moment and cervical extensor muscle activity, which may contribute to a higher prevalence of neck pain in individuals with this postural habit (Kim & Kim, 2016). Studies have shown that a smaller craniovertebral (CV) angle is correlated with neck pain severity and disability. A smaller CV angle and the presence of neck pain are related to structures that become more vulnerable to wear and tear (Lau et al., 2010).

Clinically, it is not clear what poor posture means. Clinical theory suggests that FHP and RSP result in decreasing the flexibility of the movement group muscles including pectoralis major and minor as well as latissimus dorsi, as well as decreased range of motion at the glenohumeral joint. Additionally, the stabilization group, which includes the serratus anterior, posterior deltoid, infraspinatus/teres minor and lower trapezius, is suggested to be weaker when FHP and RSP are present (Gu et al., 2024). So, this study aims to investigate the relation between cervical shoulder angles and non- specific neck pain.

2. METHODS

2.1. Participants

One hundred female participants were recruited in this study from the students of Umm-Al Qura University. The aim and the procedures of the study were explained to each participant and an informed consent was obtained prior to study. The study was approved by the Biomedical Research Ethics Committee No. (HAPO-02-K-012-2024-01-1951). All participants were included if they were female, had non-specific neck pain at least for 3 months ago, their ages ranged from 18-25 years old. For exclusion criteria, any subject had a specific neck pain as (tumor, rheumatoid arthritis, ankylosing spondylitis, fracture, dislocation, myelopathy, radiculopathy, neck pain originating from whiplash accident), history of any spinal surgery or deformities as scoliosis, any pain or pathology in their TMJ joint, hemorrhagic blood diseases, long term use of corticosteroids or receiving any treatment for their pain or muscle relaxant currently.

2.2. Instruments and Outcome Measures

2.2.1. Numerical Rating Scale (NRS)

Numerical Rating Scale have shown high correlations with other pain-assessment tools in several studies. Much evidence supports its validity and reliability as measures of pain intensity. In a Numerical Rating Scale (NRS), patients were asked to mark the number between 0 and 10 that fits best to their pain intensity, where zero represents “no pain at all” and 10 represents “the worst pain they have ever experienced like in (Al-Hadidi et al., 2019; Ferreira-Valente et al., 2011).

2.2.2. Digital Camera

A canon 600D digital camera, Lens EF-S 18-55mm was employed in the study to measure the cervical shoulder angles to document the participants' postures and identify the presence of any bad postures. Digital Imaging for Postural Assessment (DIPA) method has a reported excellent intra-rater reliability and inter-rater reliability in measuring cervical angles (Singla et al., 2017; Lu et al., 2022). and the software (Surgeimap) was used to analyze digital photos to measure the neck, head, and shoulders angles. This software had been used previously in cervical angles analysis (Lafage et al., 2015; Aafreen et al., 2023).

2.3. Procedures

2.3.1. Measurement of angles

- Cranio-cervical angles: Adhesive markers were placed at the two anatomical points (Targus, C7 spinous process) and horizontal line through C7 Vertebra.
- Forward shoulder angle: Adhesive markers were placed at the two anatomical points (between the acromial and the C7 spinous process) and horizontal plane and a line joining the surface landmarks of the acromial angle and the C7 spinous process.
- Coronal shoulder: Adhesive markers were placed at the two anatomical points (between the left and right coracoid process) and horizontal line.
- Sagittal head tilt: Adhesive markers were placed at the two anatomical points (canthus of the eye and the tragus of the ear) and horizontal line of tragus of the ear.

The NRS was first taken from the participants then adhesive markers were placed at the five anatomical points (Targus, C7 spinous process, right acromial, left and right coracoid process). The camera was mounted on a tripod stand, fixed at a standardized distance of 100cm from the subject’s lateral foot and anterior foot, and height adjusted according to the level of the subject chest, Two photos were taken for each participant, one from the anterior view and the other from the lateral view (right side), When the photo was taken from the side the participant was instructed to flex and extend the head three times and then rest it in a comfortable position to restore resting head posture. After that, the two photos were then analyzed using a Surgi map program (Yip et al., 2008; Shinde & Shah, 2022; Aafreen et al., 2023). In the following, we present and describe the angles that were measured.

Cranio-cervical angle

- Angles line: angle found at the intersection of a line drawn from the tragus of the ear through the spinous process of C7 Vertebra and a horizontal line through C7 Vertebra (Figure 1).
- Average: The normal Craniovertebral angle ranges between 48-50 degrees.
- Measure: Forward head position (Sheth et al., 2018).

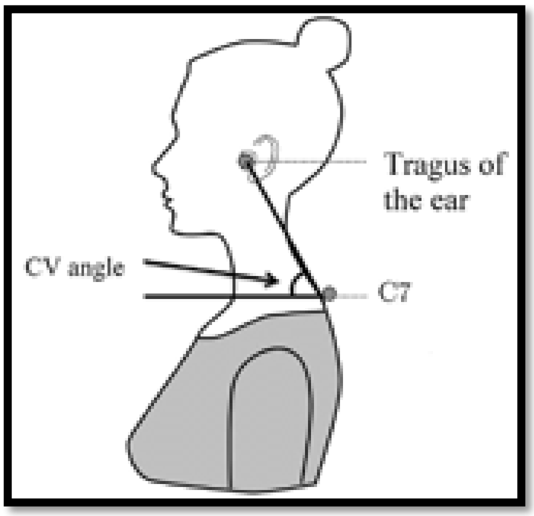

Figure 1. Measurement of cranio-cervical angle

Forward shoulder angle

- Angles line: between the horizontal plane and a line joining the surface landmarks of the acromial angle and the C7 spinous process (Figure 2).
- Average: of young adults as 113 degrees and 101 degrees for females and males respectively.
- Measure: Rounded shoulder (Raine & Twomey, 1994).

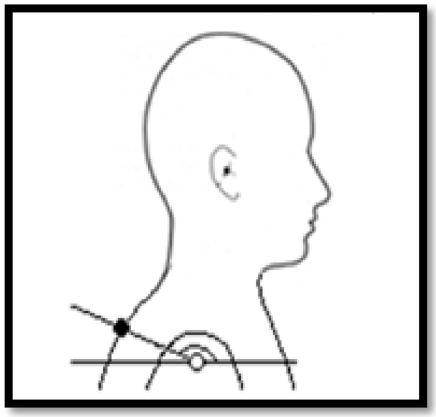

Figure 2. Measurement of forward shoulder angle

Coronal shoulder angle

- Angles line: a line was drawn between the left and right coracoid process markers, and the angle of this line to the horizontal was calculated in degrees (Figure 3).
- Average: A value of 180” described the shoulders as even, a lesser value described a higher right shoulder, and a greater value described a lower right shoulder.
- Measure: Determined whether the left and right shoulder in same level or not (Raine & Twomey, 1997).

Figure 3. Measurement of Coronal shoulder angle

Sagittal head tilt

- Angles line: This angle, which is formed between a line from the canthus of the eye and the tragus of the ear and the horizontal
- (Figure 4).
- Average: 171.4” and 172.8”, respectively.

- Measure: Measure of posture of the upper cervical spine (Raine & Twomey, 1994).

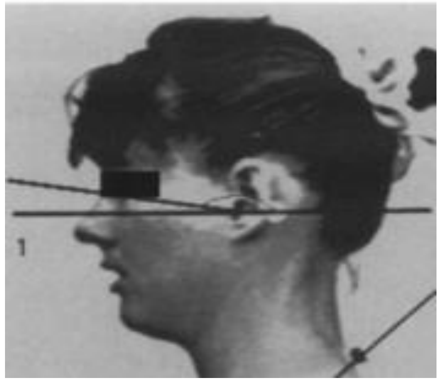

Figure 4. Measurement of sagittal head tilt

2.4. Statistical analysis

Descriptive statistics (mean & ±SD) were used for all participants to study all variables, it was used to calculate the means and standard deviations of characteristics of the subjects; age in years, weight in kg, body mass index, pain intensity and angles (cranio-cervical angle, Forward shoulder angle, Coronal shoulder angle and Sagittal head tilt). Pearson correlation was used to find the relation between variables, level of significance was set as 0.05 and all statistical calculations were done using computer program SPSS release 25 for Microsoft Windows.

3. RESULTS

The mean and standard deviation values of various parameters were calculated as: age [20.247±1.306], weight [56.61 ±15.89], height [158.33±5.836], BMI [22.349 ±5.54], CVA [48.337±5.807], CSA [180.525±1.80], FSA [125.509 ±14.17], SHT [169.18±4.548], and NPRS [5.48±1.72] (Table 1).

Table 1. Descriptive statistics for participants' age, weight, height, and other measured parameters

	Number	Minimum	Maximum	Mean	Std.Deviation
Age	100	18.00	23.00	20.2475	1.30695
Weight	100	35.00	122.00	56.6139	15.89841
Height	100	144.00	172.00	158.3366	5.83657
BMI	100	14.80	44.27	22.3490	5.54336
CVA	100	34.30	62.30	48.3370	5.80734
CSA	100	175.90	186.40	180.5250	1.80182
FSA	100	92.60	151.60	125.5090	14.17496
SHT	100	150.90	180.00	169.1800	4.54884
NPRS	100	2.00	9.00	5.4800	1.72023

The results indicated a positive and significant correlation between NPRS and FSA ($P < 0.045$), while correlations between NPRS and other variables were non-significant ($P > 0.05$) (Table 2).

Table 2. Correlations between measured angles and NPRS

		NPRS
CVA	Pearson Corrolation	0.075
	Sig.(2-tailed)	0.458
	Number	100
CSA	Pearson Corrolation	-0.109-
	Sig.(2-tailed)	0.280
	Number	100
FSA	Pearson Corrolation	0.201*
	Sig.(2-tailed)	0.045
	Number	100
SHT	Pearson Corrolation	-0.053-
	Sig.(2-tailed)	0.600
	Number	100

*Note: * significant*

The highest pain score recorded was 9/10, with average angles of craniocervical (50.4875°), coronal shoulder (179.98°), forward shoulder (133.3°), and sagittal head tilt (169.90°). Conversely, the lowest pain score was 2/10, with average angles of craniocervical (49.467°), coronal shoulder (179.78°), forward shoulder (116.15°), and sagittal head tilt (166.13°) (Table 3).

Table 3. Average measures for all variables

NPRS	Avreage of CVA	Avreage of CSA	Avreage of FSA	Avreage of SHT	Avreage of NPRS
2-2	49.467	179.78	116.15	166.133	2
8-9	50.487	179.987	133.3	169.90	8

Normal angle ranges: Craniocervical angle (48°-50°), Coronal shoulder angle (180°), Forward shoulder angle (101°-113°), and Sagittal head tilt (171.4°-172.4°). An increase in angles corresponded with an increase in Numerical Pain Rating Scale scores, although CCA, CSA, and SHT did not exhibit statistical significance. This trend suggests a potential association between increased angles and higher NPRS scores, indicative of mechanical neck pain rather than pathological (non-defined) neck pain, which is common in this age group and may be attributed to poor posture, such as prolonged sitting. These findings suggest a potential link between mechanical neck pain and FSA, highlighting the importance of posture in FSA management strategies.

4. DISCUSSION

It is well known that the prevalence of broad use of computers and/or smartphones increases the risk of neck posture issues. "Forward head posture" and "rounded shoulder posture" that are the most frequent posture problems observed in this environment (Ertekin & Günaydın, 2021) The present study was conducted in the Physiotherapy Laboratory at Umm al-Qura University, Faculty of Applied Medical Sciences, Medical Rehabilitation Sciences, from August 2023 to May 2024 to investigate the correlation between head and shoulder posture and non-specific neck pain (NSNP) in a sample of female participants.

About CCA It is assumed that the muscles of the movement are shortened as compared to an individual without forward head and rounded shoulder posture (FHRSP). It is also assumed that the muscles of the stabilization groups are lengthened and weaker as compared to an individual without FHRSP. One of the clinical assumptions associated with FHRSP is that select muscles are prone to weakness because of their increased passive length (Janda, 1983; Kebaetse et al., 1999; Gbiri & Shittu, 2014). These muscles include but are not limited to the serratus anterior, posterior deltoid, infraspinatus/teres minor complex, and lower trapezius. It is thought that because of altered length tension relationship, these lengthened muscles would be at a mechanical disadvantage and therefore weaker (Wang & Cochrane, 2001; Kapreli et al., 2008).

Respiration is an activity influenced by complex biomechanical factors and the stability of the cervical and thoracic regions of the spine is of great importance to smooth respiratory functions (Lee & Chu, 2014). However, FHP causes the shortening and weakening of the sternocleidomastoid (SCM), scalene muscles, trapezius, and Erector Spinae (ES) muscles (Ordway et al., 1999) and therefore, reduces the endurance and proprioception of these muscles (Lee & Chu, 2014).

FSA has even been suggested that a change in shoulder and head posture can adversely affect the functioning of the shoulder complex in subjects without shoulder complaints (Robertson, 1984). FHRSP would lead to shortening of the pectoral muscles and elongating of the scapular retractors. The shortened pectoral muscles might then exhibit increased strength, and, more importantly, the elongated scapular retractors might become relatively weaker (Singla et al., 2017).

The coronal shoulder angle, also known as the anterior shoulder alignment, is a crucial measurement that evaluates the alignment of the shoulders. To be specific, it measures the angle between a horizontal line and the line connecting the coracoid processes - the bony projections on the front of the shoulder blades. Ideally, a normal shoulder alignment should measure around 180 degrees, where both shoulders are level and the line connecting the coracoid processes is parallel to the horizontal line. However, it's important to note that slight deviations from this value may occur due to individual variations in anatomy (Rani et al., 2023).

There is evidence of a connection between sagittal head and neck posture, the results of the systematic review and meta-analysis detailed in the article. The review found a statistically significant difference in CVA between patients who reported having neck pain and those who did not. Furthermore, there existed an inverse relationship between CVA and assessments of neck discomfort severity and impairment. Although the review did discover a link between CVA and neck pain. As a result, it's unclear how these particular postural adjustments and neck pain are related and more study may be needed (Yuen et al., 2021).

At current study one hundred female participants with NSNP, aged between 18 and 25 years old, were included in the study. The Numeric Pain Rating Scale (NPRS) was used to assess neck pain intensity, while various angles related to cervical and shoulder posture were measured using Surgeimap software and a digital camera. The findings of the study revealed a significant positive correlation between neck pain intensity, as measured by the NPRS, and the forward shoulder angle FSA ($p < 0.045$). This indicates that individuals with a more pronounced forward shoulder posture may experience higher levels of neck pain. However, no significant correlations were observed between neck pain intensity and other variables, including the cranio-cervical angle CCA, coronal shoulder angle CSA, and sagittal head tilt SHT ($p > 0.05$).

The positive and significant correlation between NPRS and FSA of the current study agrees with the results of a study that was done by Ertekin & Günaydın (2021). It had been reported that there was a correlation between neck pain, rounded shoulder posture, upper trapezius stiffness, cervical angle, and shoulder angle. The study examined the rounded shoulder using a Lateral Acromion-Testing Table and measured cervical angle and shoulder angle using the smartphone-based photogrammetric program 'Dr. Goniometer'. They use shear-wave elastography to evaluate the stiffness of the upper trapezius. As a result, they stated that whereas a positive relationship was observed between the upper trapezius muscle stiffness and shoulder angle, there was an increase in muscle stiffness and consequently, neck pain.

Another study agrees with the result of this current study that was done by Yuen et al. (2021). It had been reported that the RSP of the piano players was higher than that of the non-piano players; there was a significant difference in the score for the RSP of the piano players and the non-piano players. The results showed that the piano players had a higher RSP compared to the non-piano players. The players' age ranged from 18 to 25 years old. The study used the photogrammetry method to make measurements from the taken photographs, known as the photographic posture analysis method (PPAM).

On the other hand, the current study found substantial heterogeneity with the study done by Mahmoud et al. (2019) in which there were variations in terms of sample population demographic data, instrument used to measure posture, reporting of posture and neck pain related parameters, etc. Consequently, due to the lack of consistency in parameters and control groups, as well as the variation in instrument types, it was not possible to draw definitive conclusions about the relationship between FHP and neck pain across different age groups.

Another study disagrees with the current study that done by Kim & Kim (2014) a total of 126 college students (95 males, 31 females) participated in this study. They assessed the Rounded Shoulder Posture (RSP) by using vernier calipers to measure the distance between the acromion process of the shoulder joint. The results of the study found no significant correlation in rounded shoulder posture in the standing and sitting posture positions.

5. LIMITATIONS

The number of participants was limited, which may have impeded the generalizability of the findings. Additionally, participants experienced heightened psychophysiological tension during the procedure period, which could have introduced bias and impacted their responses. Furthermore, there were constraints in terms of tightness and a short timeframe, which limited the ability to gather an optimal number of samples.

6. CONCLUSIONS

From the results of the present study, it can be concluded that there was a significant positive correlation between NPRS scores and FSA, indicating that higher pain scores were associated with increased forward shoulder angles. However, no significant associations were observed between neck pain intensity and cranio-cervical angle, coronal shoulder angle, and sagittal head tilt. These findings highlight the importance of considering posture, specifically forward shoulder angles, in the assessment and management of neck pain. Addressing and improving forward shoulder angles may be a potential strategy in reducing pain and improving the well-being of individuals experiencing neck pain, particularly in the context of mechanical neck pain associated with poor posture.

7. RECOMMENDATIONS

In light of the research findings, the following specific recommendations are provided for future researches:

- Increase sample size: The utilization of a larger sample population can significantly enhance the reliability and generalizability of the results obtained.
- Inclusion of older age samples: to provide a more information of the phenomena under study. Incorporating older adults into research cohorts offers insights into various aspects of human development, health, and behavior.
- Investigations on samples comprising male participants: By doing the research on male populations, we can enhance our understanding of gender-related differences.
- Investigations into pathological neck pain conditions including disc prolapse and cervical spondylosis: To measure the relationship of neck pain caused by diseases to the head and shoulder angles.
- Explore measurement of angles in the lumbar or thoracolumbar region.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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