

**Comparison of Craniovertebral Angle of Students based on Gender and Field of Study Differences****Reza Rajabi, Ph.D.<sup>1</sup>, Homan Minoonejad, Ph.D.<sup>2</sup>, Mohammad Karimizadeh Ardakani, M.Sc.<sup>3</sup>, Zahra Darzi Sheikh, M.Sc.<sup>4</sup>, Ensieh Omidvar, M.Sc.<sup>5</sup>**

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**Abstract**

**Background:** Since neck bears head's weight, its abnormal position not only makes an inharmonious appearance but also can cause musculoskeletal disorders. The aim of this study was to compare the craniovertebral (CV) angle of students based on their gender and field of study.

**Methods:** In this descriptive study, 1017 students (511 female and 506 male students) of Tehran Universities in different academic fields (Humanities, Basic Sciences, Engineering, and Medicine) were investigated. After recording age, weight and height of students, their CV angle was measured using Head Posture Spinal Curvature Instrument (HPSCI) and recorded in the data collection form. Based on the gender and field of study of students, CV angles were compared using two-way ANOVA and data were analyzed through SPSS18. Statistical significant level was considered at  $P=0.05$ .

**Results:** Mean CV angle of female students was higher than that of males in all academic fields. The highest degree of CV angle was observed in the male engineering students ( $46.85^\circ$ ), and female medical students ( $48.65^\circ$ ) and the lowest was seen in the male basic sciences students ( $47.41^\circ$ ) and female humanities students ( $50.54^\circ$ ). According to the obtained results, CV angle has significant relationship with both gender and field of study ( $P=0.001$ ).

**Conclusion:** Since no norm has been determined for the mean CV angle of the students at this age range, therefore, the degree of forward head posture of them cannot be definitely described. However, due to the growing tendency among students to pursue study, it is essential to inform them about the correct body posture to prevent subsequent musculoskeletal disorders.

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## Introduction

Due to repetitive movements and maintaining posture for a long time, all joints and supporting structures of the body face destructive forces with aging. Among them, cervical spine that is more involved in the daily routine activities and repetitive movements of head and neck, is more affected by the forces (1). Deviation from the normal head posture, increases stress on the musculoskeletal system of neck, shoulder girdle, arm, and trunk. This diversion is associated with neck and trunk pain and also temporomandibular joint dysfunction. Yet, this abnormality can occur without any symptoms (2).

The most common deviation in the head and neck that changes the posture of head and upper quadrant part of body, is forward head posture (FHP) with approximately 66% prevalence in various studies (3,4). In forward head posture, head and neck are deflected forward in relation to the vertical reference line and subsequently, the center of head gravity moves forward, flexion torque increases, and the length and the activity of head and neck muscles change (5). The most common causes of FHP are wrong habits and improper body position during daily routine activities (5,6). For example, forward movement of head while sitting at a desk, working with computer, and studying, imposes additional load on the antigravity muscles of the neck; therefore, these muscles are stretched and it can cause fatigue and neck pain (7,8). Harris et al (2000) in their

ergonomic study on schoolchildren reported that mean hour of computer use was 2-3 hours per day and 9-16 hours per week, which caused pain among 60% of the computer users during their work. Computer users need to increase their neck flexion to see the bottom part of the computer screen and raise their shoulders while typing. Therefore, they have to increase their head flexion to comply with inappropriate ergonomic conditions and compensate the conditions (9).

In today's world, due to technological advances and reduction of physical activity, movement deficiency has been spread in human populations especially among students. In Banaeifar et al (2008) study on students of Azad University, South Tehran branch, the prevalence of forward head posture was higher compared to the other abnormalities and it was significantly different in four faculties (humanities, management, technology, and teacher training); that is, the prevalence of this abnormality in technical faculty (14.9%) was higher compared to the other faculties (10). Few studies have been performed on measuring CV angle based on gender differences. Keyvanlu et al (2010) in their study on assessment of the CV angle and its relationship with gender and weight on 300 students, used radiography to determine the angles between C1-C2 and C2-C7. They reported that forward head posture in females is more severe than males (3). In this regard, Ruiov et al (2014) have studied the head and shoulders angle in 257 adolescents (aged 15-17 years) and its

association with pain in the upper quadrant of body. They have reported that 68% of the students had forward head posture and the angle was higher in females than males (11).

It is believed that this abnormality is due to incorrect sitting positions, unsuitable positions in studying, and using computers in non-standard ergonomic conditions. This abnormality is called "Reading Neck" because it is mainly observed among students and educated people (5). On the other hand, since students need a healthy body for their professional future, special attention to their physical health and postural structure, can be a top priority for the planners and chief executives of universities (10).

In most studies performed about forward head posture and its causes, incorrect head and neck positions have been examined (3, 7-10, 14,15). To our knowledge and considering previous studies (3,11), no study has been performed on head posture of students in a large population and based on gender differences. In addition, the relationship between craniovertebral angle and academic fields of the students is not clear. However, the necessity of working with computer and laptop, and sitting at desk for a long time in one hand and lack of knowledge about the correct posture of body during these activities in another hand, can cause musculoskeletal disorders in students' population. Therefore, the aim of this study was to investigate the CV angle of students (male and female) in

different academic fields (Humanities, Basic Sciences, Engineering, and Medicine).

## Methods

In this descriptive-comparative study, all students (male and female) of a number of universities in Tehran/ Iran (Tehran University, Allameh Tabatabai University, University of Science and Technology, Shahid Beheshti University, and Kharazmi University) were included. Finally, 1017 students (511 female and 506 male) of different academic fields (Humanities, Basic sciences, Engineering, and Medicine) were selected. The mean age ( $23.82\pm 3.57$ ,  $23.74\pm 3.91$  years), weight ( $69.19\pm 12.18$ ,  $57.33\pm 8.87$  kg), and height ( $174.70\pm 7.97$ ,  $162.42\pm 7.14$  cm) were determined for males and females, respectively. In this study, the faculties were selected purposefully but the students were selected randomly.

First, participants signed the consent form and then filled out a data collection form. All students were involved in daily activities and studying. They were physically healthy and had no symptom of disease, no history of bone fracture, surgery, joint diseases and injuries in the cervical and thoracic spine and shoulder girdle, malalignment of musculoskeletal system and pelvic crossed syndrome. The participants were selected using collected data from the forms. Then a full description of the test was offered to all participants.

### Measurement of the Forward Head Posture

Forward head posture was measured using head posture spinal curvature instrument (HPSCI, Wilmarth, 2002). For this purpose, participants were asked to stand in a comfortable position and perform the neck flexion and extension exercises for 3 times to ameliorate abnormal muscle condition. Then, they were asked to put their head and neck in a normal position and forward head posture was measured (Figure 1). At this stage, the examiner stood to the left side of the participant, fixed the stationary arm of the goniometer in a position perpendicular to the ground, the axis of the goniometer in the side parallel to the spinous process of C7, and the moveable arm of the goniometer on the anterior ear cartilage (Tragus). The angle between the moveable arm and the horizontal line passing through C7 was recorded as the craniovertebral (CV) angle. The examiner regarded the number closer to the hand of goniometer as the CV angle and if the hand of goniometer was placed between two numbers, the smaller one would be recorded. The measurement was repeated for three times for each. A two-minute rest between each test was given to the participant. At the end, the average of three measures was recorded as the CV angle for each participant. The smaller CV angle shows greater forward head posture (16).



**Figure1.** Measurement of CV angle

To analyze the collected data, descriptive and inferential statistical methods were used. The normality of data was analyzed using Kolmogorov-Smirnov test. Statistical analysis of the obtained data was performed using two-way ANOVA, and the CV angle in the students of different academic fields was checked using Scheffe post hoc tests via SPSS18 ( $P=0.05$ ).

### Results

Male and female subjects had respectively mean age of  $23.82 \pm 3.57$  and  $23.47 \pm 3.91$  years, mean weight of  $69.19 \pm 12.18$  and  $57.33 \pm 8.87$  kg and mean height of  $174.70 \pm 7.97$  and  $162.42 \pm 7.14$  cm.

Mean CV angles of male and female subjects were respectively  $49.01 \pm 5.63$  and  $50.54 \pm 4.79$  in humanities,  $47.41 \pm 5.07$  and  $51.50 \pm 4.70$  in basic sciences,  $(46.85 \pm 4.96$  and  $49.40 \pm 4.34)$  in engineering and  $48.30 \pm 5.21$  and  $48.65 \pm 4.47)$  in medicine students. Based on the

results of Levene's test, F-statistic was higher than 0.05; therefore, it can be said that error variances of the two groups are equal and there is no difference between the variances. Table 1 shows the total effects and separated effects of each independent variable on the dependent variable. The results show that mean CV angles between male and

female students ( $P=0.001$ ) and among different academic fields ( $P=0.001$ ) were significantly different. The interaction between gender and academic fields and the total effect of independent variables on dependent variable (CV angle) was statistically significant ( $P=0.001$ ).

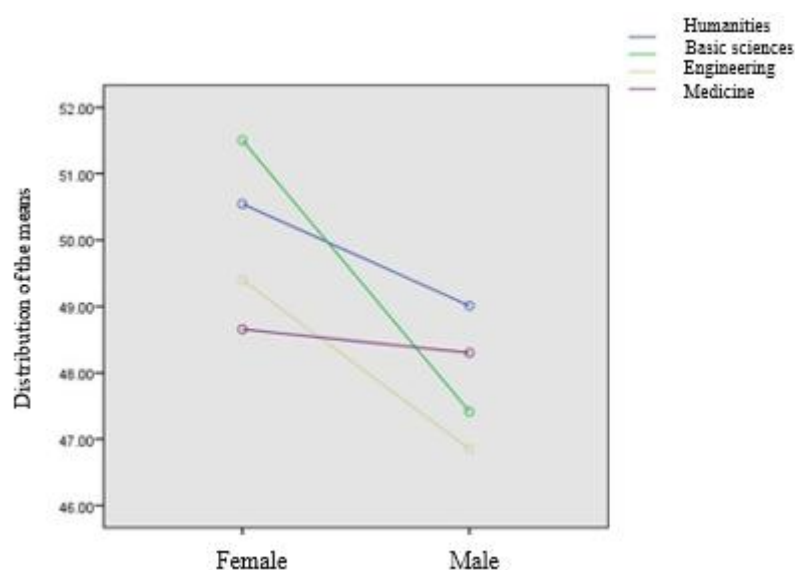
**Table 1.** The direct and interactive effect of independent variables (gender, academic field) on the dependent variable (craniovertebral angle)

Variables	Df	F	Sig
Gender	1	46.87	0.001*
Field of Study	3	6.42	0.001*
Gender ×Field of Study	3	6.35	0.001*

\* Significant at the level of  $P<0.05$

The results of Scheffe post hoc test showed no significant difference in mean CV angle between humanities and sciences, medical sciences and basic sciences, and medical sciences and engineering ( $P>0.05$ ); but the difference between humanities and basic sciences, humanities and engineering, and basic sciences and engineering in mean CV angle was significant ( $P<0.05$ ).

As shown in Figure 2, mean CV angle in female basic sciences students was higher than in male students of this field, which means that the severity of forward head posture in male basic sciences students was more than females in this field.



**Figure 2.** Distribution of mean CV angle of male and female students based on the academic fields

## Discussion

The results showed that the severity of forward head posture in male students was higher than females in all academic fields. Among male students, the most severe forward head posture was reported in engineering students (46.85%) and the lowest, in humanities students (49.01%) and among females, the highest severity of forward head posture was reported in medical students (48.65%) and the lowest, in humanities students (51.5%). Since CV angle is an angle between a horizontal line passing through C7 and a line extending from the tragus of the ear to C7, the smaller the angle, more severe forward head posture (12). According to the previous studies, physical problems including vertebral disorders are common among students, but they are not aware of their problem. The study of Mahdavinejad on the abnormalities of upper extremities in male students of Shahid Chamran University also showed that

32% of the students had forward head posture abnormality (13). Pascarelli (2001) also examined the prevalence of forward head posture among 400 computer users. The results showed that the prevalence of this posture among computer users was 71% (14). Since there has been no comprehensive study on the CV angle of students in a large population, the amount of forward head posture cannot be definitely discussed. Also, due to the use of different methods of measuring CV angle, comparison is difficult. However, according to the mean CV angle reported in similar populations, the results of the present study can be interpreted. In Yip et al (2008) study on 62 participants (22 males, 40 females), mean CV angle in healthy group was 55° and in the group with pain was 49° (14). Also, in Motiallah et al (2012) study on 60 participants (30 males, 30 females), the difference between mean CV angle in the control group (41.94°) and in the group with

pain ( $36.22^\circ$ ) was significant (7). Thigpen et al (2010) and Seydi (2014) have considered CV angle higher than  $46^\circ$  as the criterion for initiation of forward head posture (2,15). However, in the mentioned study, CV angle had been considered as the angle between the line extending from the tragus of the ear to C7 and the vertical line.

One of the factors affecting body's natural position is performing a certain activity for a long term. Studies have shown that repetitive actions, makes the body to take the specific position of that activity (17). Using unsuitable backpacks, psychosocial factors such as depression or stress, lack of ergonomic equipments and maintaining an inappropriate posture for long hours when watching TV and working with computer, have been reported as the possible reasons for increasing the degree of forward head posture (11). In recent years, use of laptop compared to computer, especially among students, has been increased. According to Jacobs (2013) study, the number of students who had laptop has increased from about 66% in 2006 to 88% in 2009, while the number of students who had computer has decreased from 71% to 44% in the same period (18).

The present study showed a significant difference between the CV angle of male and female students ( $P=0.001$ ). The results also showed a significant difference between CV angle and different academic fields ( $P=0.001$ ). The results of this study are consistent with the study of Brink (2009) but inconsistent with the studies of

Keyvānlu (2010) and Ruiiov (2014). In Keyvānlu et al (2010) study, females had more severe forward head posture than males. They reported that the only possible reason for this difference was angular measurement methods used for linear measurement (3). In Ruiiov et al (2014) study, too, CV angle in females ( $46.55^\circ$ ) was higher than males ( $48.43^\circ$ ), and 53% of females had pain in the upper quadrant part of their body. They believed that technological advances in human society, followed by increasing hours that students spend to use computers and internet, and play computer games, are main reasons for prevalence of forward head posture among students. The increase in head flexion among girls is due to psychological factors such as stress, as well as the feminine characteristics (11). It seems that this difference is due to the difference in musculoskeletal system of females compared to males in this age range. In the prospective study of Brink et al (2009) performed on the relationship between body posture and pain in upper quadrant parts of the body in high school students, the pain rate was two times higher in boys compared to the girls and it has been attributed to the fact that boys spend more hours per day/week on computer compared to the girls in the same age range (19). This finding that there is a significant relationship between the hours a person spends for working with computer and neck pain is consistent with the results of the present study.

As mentioned previously, post hoc test showed a significant relationship between CV angle and

academic field; so that, there was a significant difference between CV angle of students of humanities and basic sciences, engineering and humanities, and also between basic sciences and engineering; but no significant difference between the students of humanities and engineering, medicine and engineering, and also medicine and basic sciences. In female students, the highest CV angle was observed in medical students and the lowest in basic sciences students. On the other hand, among male students, the highest CV angle was observed in engineering and the lowest one in humanities students. In whole, it can be concluded that the nature of field of study in regard to requiring more use of computer and also difference of males and females in regard to their interest in field of study are responsible for these differences. To maintain in a certain position or to repeat a certain activity for a long time cause some changes in the soft tissues of body organs and consequently increases the pressure on them. At the beginning, a wrong body position might be accompanied with a

feeling of comfort, but in long-term, it leads to the formation of bad habit. As a result, this causes the muscle imbalances in the neck which ultimately increases the degree of forward head posture (20).

## **Conclusion**

Due to the lack of a comprehensive study on a large sample size, mean CV angle obtained in the present study can be used as a norm for this age group.

Since incorrect body posture makes the body out of balance and to compensate this imbalance, the structures of the same parts will be harmed, teaching the principles of correct body posture at work, maintaining body alignment and movement therapy for prevention and treatment of musculoskeletal pain and associated complications in students are emphasized.

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