



Original Article

Comparison of the Average Forward Head Angle of Male and Female Students in Three Educational Levels

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ABSTRACT

Background: Forward head posture is a major postural deformity in the head and neck area. Considering the importance and secondary consequences of this deformity, current study aims at investigating this deformity among boys and girls of different educational levels of Tehran universities.

Methods: This is a cross-sectional descriptive and field study (causal-comparative). A total of 1017 students, 511 girls (age: 23.74±3.91, height: 162.42±7.14, weight: 57.33±8.87) and 506 boys (age: 23.82±3.57, height: 174.70±7.97, weight: 69.19±12.18) were selected. Their forward head angle was measured 3 times by a specific goniometer and the subjects' final angle was considered as the average of three measurements. Data were analyzed using SPSS V.22 software and the two-way ANOVA, Tukey and one-way ANOVA tests.

Results: The results of one-way ANOVA analysis showed a significant difference in the head angle of the students at different educational levels ($P < 0.05$). The results of Tukey post-hoc test showed a significant difference between post-graduate and undergraduate female students and doctoral female students ($P < 0.05$). Also, there was a significant difference only between male undergraduate students and male doctoral students ($P < 0.05$). The results of two-way ANOVA showed that gender and educational level factors had a significant effect on head angle ($P < 0.05$), but neither factor had an interaction effect on head angle ($P > 0.05$).

Conclusion: According to the results of this study, educational level and gender were the major factors in the development of forward head posture, so considering these two variables could be effective in prevention, control, and correction of related deformities.

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Introduction

Natural physical structure and optimal body posture is an indicator of health [1]. One of the determinants of optimal body posture is the balance in the musculoskeletal system since the body structures are protected against the prevalence of progressive injury and deformities [1]. As a result, the muscles would have the highest efficiency, and vital organs such as the heart and lung would function well [2]. Most prevalence studies in 1994 to 2013

reported a high proportion (62 to 86%) of body postural deformities among individuals in different statistical communities [3-8]. Based on a number of these reports, forward head posture is one of the most common spinal deformities in the studied communities [5, 8-10]. Studies on the prevalence of this deformity among students of Mashhad, Tehran, Khorramabad, Lorestan, Semnan, and Shiraz between 2003-2012 showed that the lowest and highest prevalence of forward head posture deformity compared to other spinal deformities were observed in adolescents of Lorestan province (4.73%) and students of Islamic Azad University of Khorramabad (58%), respectively [3, 11-13].

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Most studies on forward head posture have found it as a malalignment of the head and trunk, leading to pain and musculoskeletal deformities [14]. Bending of the lower neck (C3-C7) and opening upper vertebrae (C1, C2) have been found to maintain horizontal vision with the activation of the upper neck extensors [15, 16]. As such, auricle of ear and acromion process are not aligned in this deformity. According to Rene Keilat, the body is subordinate to the head, and therefore the whole body aligns itself with the head, which is well justified by the consequences reported for this deformity [17]. These consequences include the following: reduced range of motion in neck [16]; fatigue and pain in neck and shoulder muscles [16]; reduced range of motion of upper shoulder rotation [16]; defect in balance control [18]; over 30% reduction in lung vital capacity [16]; cranial nerve compression [8]; limitations in the range of motion of the glenohumeral joint [8]; hyperkyphotic posture [19]; and temporomandibular disorder and subsequent swallowing problems [19]. In addition, reports indicate a higher prevalence of forward head posture in individuals with various disorders such as headache [20], temporomandibular disorders [21], migraines [22], respiratory problems [23, 24], and neck pain [25] compared with healthy individuals. Forward head posture causes changes in the scapular kinematics and muscular activity of the shoulder area that can eventually lead to shoulder problems [26]. Forward head posture may lead to muscle disorders, not only in the neck but also in the thoracic spine and shoulder girdle [27].

As the forward head angle increases, the likelihood of muscle imbalance and deviation from optimal form increase; subsequently, the natural length and tension of the muscles and muscle recruitment patterns is altered. This angle can increase as a result of repetitive movement patterns and maintaining sedentary position to the point that the individual suffers from forward head disorder [28-31].

On the other hand, studies have found that the amount of forward head angle and the prevalence of forward head posture depend on gender [32]. A study of the relationship among some ergonomic features of school desks & benches and anthropometry indices of male students from Kermanshah plus prevalence of spinal column and upper skeletal organ abnormalities [32]. The high prevalence of spinal deformities, especially forward head posture, has been reported among university students [33]. It should be noted that with the entry of students into higher education levels, the amount of time spent on computers and study usually increases in such students, and this increase in time leads to repetitive movement patterns and maintaining sedentary position, which can make the person more susceptible to developing the deformity [31]. Studies have shown that corrective programs on forward head posture reduced neck pain in people with neck pain [34, 35].

According to the above-mentioned cases, prevention of this deformity enhances the health index, and brings significant economic benefits to the society due to higher productivity and lower medical costs, especially that the research population is composed of the students

who contribute to the advancement of the country in the future. Inappropriate postural habits of studying [11] and computer work [19] and carrying a backpack of inappropriate weight [36, 37] are among the risk factors associated with forward head posture. Therefore, students are more likely to develop this deformity because they spend more time studying and working on computers in higher educational levels. Carrying heavy backpacks, because of heavy books and laptops, for a long time is a double factor for exacerbating the mean forward head posture angle. Since the occupational future of students requires a sound physique, special attention to physical health and posture of students can be a top priority for planners and decision makers [5]. Therefore, the current research aims at investigating the prevalence of forward head posture in students at different educational levels in Tehran universities with an emphasis on gender. The findings of this study can help design preventive and corrective exercise programs for forward head posture deformity optimally tailored to their needs.

Methods

Participants

The present cross-sectional research was conducted via descriptive and causal-comparative method. Six universities from Tehran including University of Tehran, Allameh Tabataba'i University, Iran University of Science and Technology, Shahid Beheshti University, Tarbiat Modarres University, and Kharazmi University with similar fields of study and educational levels were purposively sampled. The departments included humanities, basic sciences, and technical and medical sciences at undergraduate, postgraduate and doctoral levels. A total of 1017 students (511 female and 506 male) were selected randomly and signed written informed consent for ethical considerations.

Exclusion criteria were the following: 1) serious neck and thoracic injury; 2) upper body and shoulder injuries; 3) static hyperkyphosis and scoliosis; 4) professional athletic and championship background; 5) neurological, musculoskeletal, and cardiopulmonary diseases at the time of study or in the past that limited their movement. Group allocation and the participant flow chart are presented in Figure 1.

Test Procedures

In this study, 9 evaluators were employed to measure the studied variables, due to the number of universities studied and the gender of the samples. Therefore, firstly, for the purpose of uniformizing the research method and for reducing the measurement error by the evaluators, the principal investigator and the research authority provided special training the method of working with the measuring instrument as well as determining the respective anatomical points for measuring the forward head posture angle during two sessions. At the end of the session, the reliability of the measurement was calculated by the evaluators (each evaluator with three measurements) on a specific sample, and its Intraclass Correlation Coefficient (ICC) was reported at 0.81.

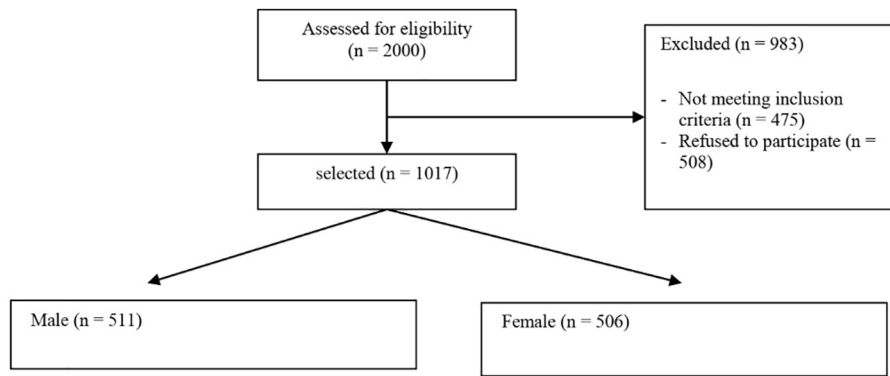


Figure 1: Participant flow diagram.

In this study, the angle obtained from the intersection of two transient vertical lines of the seven cervical vertebrae and the line crossing of the tragus of ear and the seven cervical vertebrae was considered as the forward head posture angle [13]. The larger angle means more forward head deformity [7]. In this study, the forward head posture angle was measured by a specific goniometer called Head Posture Spinal Curvature Instrument (HPSCI) (Figure 2). The measurement procedure was that the subject stands in a comfortable position and performs the flexion and extension movements of the neck three times, and then keeps the head in a natural and comfortable position for measurement [7]. At this stage, the evaluator is placed beside the subject, and adjusts the goniometer's fixed arm perpendicular to the ground, positioning the goniometer axis parallel to the C7 Spinous process and the goniometer's movable arm on the anterior cartilage of the ear. The angle between the movable arm and the perpendicular line passing through the C7 vertebrae was recorded as the forward head posture angle. Evaluators were asked to consider the number closest to the point as the forward head posture angle and to record the smaller number if the point was placed between two numbers. A total of three measurements were made for each individual and a 2-minute break was allowed in test intervals. At the end of the measurement, three measurements were recorded as the amount of forward head posture angle.

Statistical Analysis

In data analysis, descriptive statistics were used for data description, and in inferential statistics, Kolmogorov-Smirnov test was run to ensure normal distribution of data. One-way ANOVA and Tukey's post hoc tests were used to examine the forward head posture in the inferential

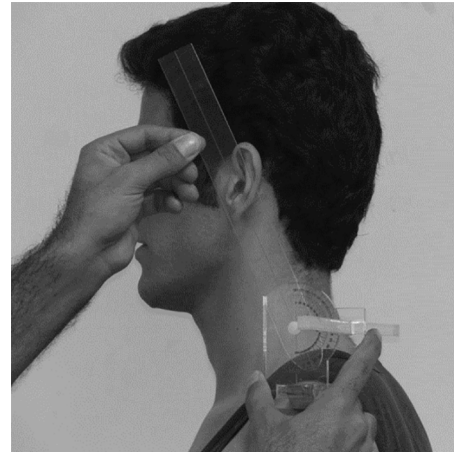


Figure 2: Forward head Angle measurement method with special goniometer.

statistics. Two-way ANOVA demonstrated the interaction effect (gender and educational level) on forward head posture. Data analysis was performed by SPSS software (version 23) at the significance level of $P < 0.05$.

Results

The number and demographic characteristics of the subjects, including age, height, weight, field of study, educational level and gender are summarized in Tables 1 and 2.

The research findings indicated that the highest and the lowest forward head posture angle for male and female students were for doctoral and undergraduate levels, respectively. One-way ANOVA test showed a significant difference between the mean forward head posture angle of the different educational levels in both sexes. Through

Table 1: Participant's demographic characteristics*

Variable	Female Group (N=511)	Male Group (N=506)
Age (y)	23.74±3.91	23.82±3.57
Height (cm)	162.42±7.14	174.70±7.97
Weight (kg)	57.33±8.87	69.19±12.18

*Values are presented as mean±standard deviation

Table 2: Number of participants based on academic grade and field study

Gender	Education levels				Field study				
	Bachelor	Master	PHD	Total	Humanities	Science	Engineering	Medical	Total
Female	193	169	149	511	124	127	134	126	511
Male	176	178	152	506	130	125	131	120	506

Table 3: The results of one-way ANOVA

Gender	Academic grade	mean±SD	Sig*
Female	Bachelor	36.67±0.65	0.003*
	Master	39.70±0.66	
	PHD	41.67±0.33	
Male	Bachelor	40.98±0.66	0.001*
	Master	42.23±0.33	
	PHD	43.40±0.66	

*Significant difference between academic grade ($P<0.5$).

Table 4: The results of Tukey post hoc

Gender	Group		Sig*
Female	Bachelor	Master	0.094
	PHD	Bachelor	0.0001*
		Master	0.001*
Male	Bachelor	Master	0.090
	PHD	Bachelor	0.001*
		Master	0.146

Table 5: Result of two-way ANOVA for determining the effect of gender, academic grade, and interaction effect of the two on forward head angle

Source	F	Mean square	df	Sum of square	Sig*
Gender effect	4.789	22.846	1	22.846	0.029*
Academic grade effect	10.443	49.812	2	99.624	0.0001*
(Gender* academic grade)	0.879	4.915	2	8.390	0.415

*Significant difference of independent variable on forward head angle ($P<0.05$).

Tukey's post hoc test, it was found that the difference between doctoral female students and undergraduate female students and between doctoral female students and postgraduate female students is significant, but in male students, only there is a significant difference between the doctoral male students and postgraduate male students (Table 3 and 4).

In addition, the results of two-way ANOVA showed that gender and educational level had a significant effect on forward head posture angle separately, but neither factor had an interaction effect on this angle (Table 5) and descriptive statistics showed greater mean forward head posture angle in boys than in girls.

Discussion

Determining the prevalence of musculoskeletal disorders is the first step in preventing, diagnosing, and treating such disorders. The current research aimed at investigating the prevalence of forward head posture in students at different educational levels in Tehran with an emphasis on gender. Examination of the head position on the sagittal plane showed a significant difference between the mean forward head posture angle of the male and female students at different educational levels, which is in agreement with the findings by Yousefi. Overall, it can be concluded that increasing forward head posture angle in male and female and male students after undergraduate and in postgraduate level may be due to educational background, longer study time, extended laptop work, carrying heavy backpacks (with books and laptop), and reduced physical activity due to heavier educational demands. There have been several well-founded reports concerning increasing forward head posture, because of maintaining static and inappropriate position during study [11], working with computer [38], inappropriate

backpack weight [36, 37], and low physical activity [2, 13, 39], which are in line with the findings of present research. In addition to the above, students, the heavier load of PhD exam materials for graduate students as compared with undergraduate students has exacerbated the forward head posture for them.

Forward head angle was worse in boys than girls at all educational levels. These findings are in line with the findings by Sene, Bahrami and Farhadi, and Daneshmandi, Pourhoseini and Sardar [11]. Sene compared the prevalence of postural abnormalities by the New York Standardized Test and checkered Board in upper limbs of 11-15-year-old male and female students (921 boys and 967 girls) and reported the prevalence of forward head posture with poor grades in girls and boys as 4.2 and 6.1 percent, respectively [12]. Bahrami and Farhadi also reported this deformity by a Checkered Board on 450 girls and 400 boys with the ages of 11 to 15 years as 2.22 and 7.25 percent, respectively [3].

A possible reason for higher prevalence of this deformity among boys is that they are typically taller, as previous studies have shown that there is a significant relationship between height and forward head posture angle so that forward head posture angle increases with elevated mean height (Mehrdad, 2013 #10). In addition, there was a significant relationship between desk and bench ergonomics and the anthropometric characteristics of the subjects with the mean forward head posture angle. Given that desk and bench ergonomics is the same for boys and girls in universities in the country, it is likely that desk and bench ergonomics is more disproportionate for boys than for girls [13].

Conclusion

In general, considering the findings of this study and

comparing it with other studies, it is suggested that the implementation of preventive and corrective programs for postgraduate students with more emphasis on doctoral level and female students be prioritized.

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Conflict of Interest: None declared.

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