Research Paper

Prevalence and Factors Associated With Postural Abnormalities in Male Students of Tehran Universities: A Cross-sectional Study

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ABSTRACT

Purpose: Postural abnormalities, such as forward head posture (FHP), posterior kyphosis, and lumbar lordosis, can lead to discomfort and health problems. This cross-sectional study was conducted to investigate the prevalence of these abnormalities and their association with age, body mass index (BMI), and physical activity among male students of Tehran universities.

Methods: A cross-sectional study was conducted on 400 students of Tehran University of Medical Science to evaluate the relationship between postural abnormalities and associated factors. Participants' demographic data and physical activity levels were collected using questionnaires, and spinal curvature was assessed using a spinal mouse device and photogrammetry. Statistical analysis was performed using IBM SPSS software, version 22, and a Pearson correlation coefficient was used to examine the relationship between variables.

Results: The study revealed a high prevalence of postural abnormalities, with FHP being the most prevalent (84.5%), followed by lumbar lordosis (79.8%), and posterior kyphosis (34.7%). Factors, such as age, BMI, waist-to-hip ratio, and physical activity were significantly associated with the occurrence of postural abnormalities.

Conclusion: A study on male university students showed that FHP, posterior kyphosis, and lordosis are common postural abnormalities with varying degrees of occurrence. FHP was the most prevalent type of abnormality. Age and BMI were correlated with the prevalence of postural abnormalities, and kyphosis was more common among younger students. BMI was also significantly related to the prevalence of postural abnormalities, and physical activity was associated with the prevalence of FHP.

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Highlights

• Postural abnormalities are a prevalent issue among individuals, the incidence of which varies based on age, occupation, and lifestyle.

• It is essential to identify and address risk factors to prevent the development or progression of postural abnormalities.

• Physical activity is essential to maintain good posture and prevent postural abnormalities.

Plain Language Summary

Poor posture can lead to health problems, such as back pain and musculoskeletal disorders. University students are especially at risk of developing poor posture due to prolonged sitting and studying. Our study focused on male students in Tehran City, Iran, to understand how common poor posture is and what factors are associated with it. By taking photographs and analyzing them, we identified different types of postural abnormalities, such as forward head posture (FHP), posterior kyphosis, and lumbar lordosis. The study showed that the prevalence of postural abnormalities among male students of Tehran University was high. The most common type of abnormality was forward head posture, followed by increased lumbar lordosis and posterior kyphosis. Overall, this study provides crucial insights into the prevalence and factors associated with postural abnormalities in male students of Tehran University. The findings have crucial implications for developing interventions to prevent or treat poor posture, ultimately contributing to better long-term health outcomes for university students.

1. Introduction

Postural abnormalities are a common problem among the general population, which if not addressed, can lead to various musculoskeletal problems [1]. The prevalence of these abnormalities is high in both developing and developed countries [2]. Among the most common postural abnormalities are forward head posture (FHP), kyphosis, and lumbar lordosis [3]. These abnormalities can cause various musculoskeletal problems, such as neck and back pain, headaches, and even breathing difficulties in severe cases [4].

Several factors have been identified as contributing to the development of postural abnormalities, including age, body mass index (BMI), and physical activity [5, 6]. In addition, evidence shows that certain occupations, such as those involving prolonged sitting, may increase the risk of postural abnormalities [7].

The prevalence of postural abnormalities in young adults, including university students, has been widely investigated. Some studies suggest that a high prevalence of postural deviations exists in young adults, with FHP being the most prevalent deviation [8-10]. In addition, previous studies have reported the relationship between spinal flexibility, kyphosis, and lordosis [11, 12]. Arshadi and Rajabi [11] found that increased spinal flexibility is associated with decreased thoracic kyphosis, while Samadi and Arshadi [12] reported that increased spinal flexibility is associated with decreased lumbar lordosis. Spinal curvature is also associated with body weight [13, 14] and physical activity level [15, 16]. Korovessis et al. [13] and Hoseinifar et al. [14] reported that individuals with greater body weight are more likely to have greater spinal curvature. On the other hand, Van Niekerk et al. [15] and Zagyapan et al. [16] found that individuals who engage in higher levels of physical activity are less likely to have spinal curvature.

Poor posture may lead to muscular imbalances [17]. Resistance exercises can improve postural deviations by strengthening the weak muscles that contribute to the deviation [18]. Therefore, a high level of physical activity may have a positive effect on postural abnormalities. In addition, several studies have reported a relationship between body weight and postural abnormalities. Rahimibashar and Motahari [19] reported a high prevalence of overweight and obesity among nursing students at the Islamic Azad University of Lahijan City, Iran. They suggested that being overweight and obese can contribute to the development of postural abnormalities.

Medical university students are a particularly crucial group to study because they are at high risk of musculoskeletal problems due to the demands of their training and long hours spent studying [20]. The current study used standardized measures to assess the prevalence of FHP, degree of kyphosis, and lumbar lordosis among male students in Tehran, City, Iran, medical universities. The study has also explored the potential relationship between these conditions and body weight and physical activity levels. By examining these factors, this study can provide valuable insights into the potential risk factors for spinal alignment issues in this population and inform future interventions aimed at improving spinal health and related outcomes.

Therefore, this study was conducted to investigate the prevalence of FHP, posterior kyphosis, and lumbar lordosis, and the relationship between these abnormalities with age, BMI, and physical activity in male students of Tehran universities.

2. Materials and Methods

This cross-sectional study was conducted on students in medical science universities (Tehran City, Iran, Shahid Beheshti, and Rehabilitation Sciences and Social Welfare University) during 2017-2018. Using Cochran's formula, 400 students were randomly selected as the research population by a two-stage clustering sampling method among 4233 students. In the first stage, clusters of students were selected based on their faculties. In the second stage, a random sample of 400 students aged 18-30 was selected from within each cluster. The selected students were invited to participate in the study, and those who agreed to participate were enrolled as participants. This approach helped to reduce the potential for bias in the selection of participants and improve the generalizability of the findings.

All participants in this study have read and signed the consent form. Participants were informed of the process and purpose of the study and had the right to withdraw from the study at any time if they were not satisfied.

Following the acquisition of written consent, participants' personal information, such as their name, age, and educational level, was documented in a questionnaire. Demographic information, including age, weight, BMI, and waist-to-hip ratio (WHR) were obtained, and subjects completed a physical activity questionnaire. The questionnaire used in the article includes two questions, have you engaged in any physical activities in the past week, such as walking, cycling, running, etc.?, how many minutes of physical activity have you had per session?, Physical activity less than 150 minutes per week is considered undesirable, 150-300 minutes is relatively desirable, and more than 300 minutes is desirable [21].

The objectives and method of the study were elucidated to the participants before the spinal curvature assessment. The study utilized the spinal mouse device, manufactured by Idiag AG, Voletswil Company in Switzerland, to measure the kyphosis and lordosis angles of the spine. The spinal mouse is a non-invasive device that has been approved by some researchers as highly reliable to measure spinal curvatures [22, 23]. The assessment was performed twice by the same examiner, who was experienced in using the spinal mouse. The equipment and assessment procedures were the same on both test days. Participants were instructed to stand comfortably with their head looking forward and focused on an eye-level marker, feet shoulder-width apart, knees straight, and hands hanging beside their body. The examiner marked the C7 spinous process and the top edge of the S2 vertebra, after which the spinal mouse device was placed on the defined C7 spinous process and moved along the spine's midline to the top of the second sacral vertebra at a constant speed. This process was repeated twice, and the mean was calculated and analyzed as the degree of kyphosis and lumbar lordosis for each subject.

To measure the angle of FHP, we employed photogrammetry [24], a method of measuring the position and orientation of objects using photographs or images. In this study, we captured a photograph of the participant's head and neck from a side angle, using a high-quality digital camera. The procedure involved identifying and marking two spinous process landmarks of the seventh cervical vertebra and the tragus of the ear, which was performed by a trained person. To ensure that the participant did not hold their head in a fixed position, we asked them to close their eyes and gently flex and extend their neck three times. This helped create a neutral position in the head area, which was crucial to eliminate any potential bias in the measurement. This process accounted for any natural variation in head position, ensuring accurate results. Finally, the angle of the FHP was calculated from the captured image while the participant stood in a natural position with their head looking straight ahead. The angle was measured as the distance between a line drawn from the seventh cervical vertebra to the tragus of the ear and a line drawn perpendicular to the ground. IBM SPSS software, version 22 was used for statistical tests. Central inclination and dispersion indices were used to describe the quantitative data. The Pearson correlation coefficient was used to examine the relationship between variables. All statistical tests were conducted at a 95% confidence level ($P<0.05$).

3. Results

The subjects' variables included the mean age, weight, BMI, waist circumference, physical activity, and the degree of FHP, posterior kyphosis, and lumbar lordosis, which are described in detail in Table 1. The information provided in Table 1 shows that the dispersion between the mean age, weight, BMI, physical activity, and the degree of forward head deviation is low, but the dispersion between the mean posterior kyphosis and lumbar lordosis is high.

Our study results showed that the highest frequency of abnormality was related to FHP. According to Table 2, 84.5%, 34.7%, and 79.8% of the samples had abnormalities of FHP, posterior kyphosis, and lumbar lordosis, respectively.

Based on Table 3, a significant correlation was observed between the age of the subjects and the occurrence of abnormalities in the kyphotic posture. (P=0.002). However, no significant difference was observed in the prevalence of FHP and lumbar lordosis between the two age groups (P>0.05).

Table 4 presents the distribution of subjects in 3 groups based on their BMI. A significant correlation was observed between the BMI of the subjects and the incidence of FHP, posterior kyphosis, and lumbar lordosis abnormalities (P≤0.05).

In the current study, the WHR of the subjects was tested and recorded. Based on the collected data, a significant correlation was observed between the WHR of the subjects and the risk of certain health abnormalities, such as FHP. However, no significant difference was observed in the prevalence of posterior kyphosis and lumbar lordosis based on the WHR (Table 5).

The results showed a statistically significant relationship for FHP (P=0.04) between abnormality and physical activity level, with a higher proportion of individuals with abnormal FHP having a relatively desirable physical activity level compared to individuals with desirable physical activity levels. For posterior kyphosis and lumbar lordosis, no statistically significant relationship was observed between abnormality and physical activity level with P of 0.16 and 0.07, respectively (Table 6).

According to the results of this study, 84.5% of the students were affected by FHP. As can be seen in Table 7, 28.2% of the students under study were simultaneously affected by both FHP and posterior kyphosis. Additionally, 70.8% of the students were simultaneously affected by FHP and lumbar lordosis.

According to the results of this study, 34.7% of students were suffering from posterior kyphosis. As shown in Table 8, 28.2% of the students under study were simultaneously suffering from FHP and posterior kyphosis. Additionally, 24.5% of the students simultaneously had posterior kyphosis and lumbar lordosis.

According to the results of this study, 79.7% of students were diagnosed with lumbar lordosis. As can be seen in Table 9, 70.8% of the studied students were simultaneously affected by the abnormality of lumbar lordosis and FHP. Additionally, 24.5% of students were simultaneously affected by posterior pelvic tilt and lumbar lordosis.

Table 1. Descriptive findings related to quantitative variables of men studied

Variables	Mean±SD
Age (y)	23.5±3.4
Weight (Kg)	73.95±1.16
BMI (Kg/m²)	23.75±3.56
WHR	0.86±0.09
Physical activity level	18.7±1.2
FHP	46.44±5.58
Posterior Kyphosis	42.72±16.07
Lumbar lordosis	15.35±10.1

Abbreviations: BMI: Body mass index; WHR: Waist-to-hip ratio; FHP: Forward head posture.

Table 2. Frequency of postural abnormalities in the examined samples

Abnormality	No (%)	
	Normal	Abnormal
FHP	62(15.5)	338(84.5)
Posterior kyphosis	261(62.25)	139(34.7)
Lumbar lordosis	81(20.2)	319(79.8)

FHP: Forward head posture.

PHYSICAL TREATMENTS

Table 3. Prevalence of postural abnormalities by age group of participants

Abnormality	No. (%)				P
	Age (y)				
	<25		>25		
	Normal	Abnormal	Normal	Abnormal	
FHP	52(13)	264(66)	10(2.5)	74(18.5)	0.31
Posterior kyphosis	194(48.5)	122(30.5)	67(16.7)	17(18.5)	0.002
Lumbar lordosis	68 (17)	248 (62)	13 (3.3)	71 (17.7)	0.22

FHP: Forward head posture.

PHYSICAL TREATMENTS

Table 4. Prevalence of postural abnormalities categorized by BMI of the participants

Abnormality	No. (%)						P
	BMI						
	≤18.5		18.5-25		≥25		
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	
FHP	5(1.3)	8(2)	36(9)	227(56.8)	21(5.3)	103(25.8)	0.04
Posterior kyphosis	8(2)	5(1.3)	183(45.8)	80(20)	70(17.5)	54(13.5)	0.04
Lumbar lordosis	0	13(3.3)	37(9.3)	226(56.5)	44(11)	80(20)	≤0.001

BMI: Body mass index; FHP: Forward head posture.

PHYSICAL TREATMENTS

Table 5. Prevalence of postural abnormalities based on WHR

Abnormality	No. (%)						P
	WHR						
	≤0.94		0.95-0.99		≥1		
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	
FHP	53(13.3)	299(74.9)	3(0.8)	35(8.8)	5(1.3)	4(1)	0.002
Posterior kyphosis	236(59.1)	116(29.1)	21(5.3)	17(4.3)	4(1)	5(1.3)	0.14
Lumbar lordosis	68(17)	284(71.2)	12(3)	26(6.5)	0	9(2.3)	0.06

WHR: Waist-to-hip ratio; FHP: Forward head posture.

PHYSICAL TREATMENTS

Table 6. Prevalence of postural abnormalities based on the level of physical activity of the subjects

Abnormality	No. (%)						P
	Physical Activity Level						
	Undesirable		Relatively Desirable		Desirable		
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	
FHP	42(10.5)	256(64)	20(5)	64(16)	7(1.7)	11(2.7)	0.04
Posterior kyphosis	115(28.7)	233(58.2)	26(6.5)	19(4.7)	4(1)	3(0.7)	0.16
Lumbar lordosis	65(16.2)	283(70.7)	15(3.75)	27(6.75)	2(0.5)	8(2)	0.07

FHP: Forward head posture.

Table 7. Prevalence of FHP and its relationship with other abnormalities

Abnormality	Posterior Kyphosis		Lumbar Lordosis	
	-	+	-	+
FHP-, (%)	9	6.5	6.5	9
FHP+, (%)	56.3	28.2	13.8	70.8
P	0.19		<0.001	

FHP: Forward head posture.

Table 8. Prevalence of posterior kyphosis and its relationship with other abnormalities

Abnormality	FHP		Lumbar Lordosis	
	-	+	-	+
Posterior kyphosis -, (%)	9	56.3	10	55.3
Posterior kyphosis +, (%)	6.5	28.2	10.3	24.5
P	0.19		0.001	

FHP: Forward head posture.

Table 9. Prevalence of lumbar lordosis and its association with other abnormalities

Abnormality	FHP		Posterior Kyphosis	
	-	+	-	+
Lumbar lordosis -, (%)	6.5	13.8	10	10.3
Lumbar lordosis +, (%)	9	70.8	55.3	24.5
P	0.001		<0.001	

FHP: Forward head posture.

4. Discussion

In this study, the prevalence of FHP, posterior kyphosis, and lumbar lordosis among male students in Tehran universities was evaluated and compared with factors, such as age, weight, WHR, BMI, and physical activity. Our study results showed that the highest frequency of abnormality was related to FHP, and 84.5%, 79.8%, and 34.7% of the samples had an abnormality in FHP, lumbar lordosis, and posterior kyphosis, respectively.

The highest frequency of these abnormalities was observed in the age group under 25 years old. The lack of a significant correlation between age and the prevalence of FHP and lumbar lordosis in this study suggests that other factors may play a more significant role in the development of these conditions. Previous studies have identified several risk factors for FHP and lumbar lordosis, such as poor ergonomics, prolonged sitting, lack of physical activity, and obesity [4, 26].

In this study, the Mean±SD of BMI and WHR in students were 23.75±3.56 and 0.86±0.09, respectively, which were in the normal range. A significant correlation was also observed between the BMI of the subjects and the occurrence of some abnormal postures such as FHP, posterior kyphosis, and lumbar lordosis. Additionally, according to the collected data, a significant correlation was observed between the physical activity of the subjects and the risk of some abnormal postures, such as FHP. Furthermore, a significant correlation was observed between the WHR of the subjects and the occurrence of FHP, and these abnormalities were more common in students with a WHR below 0.94.

A study by Greve conducted among young adults found a correlation between BMI and postural balance [25]. Another study investigated the association between BMI and spinal deformities. It found that below-normal BMI is associated with the severity of spinal deformities, while above-normal BMI appears to have a protective effect. However, the specific relationship between BMI and kyphosis was not explicitly mentioned in this study [26]. A study by Rabieezadeh et al. showed that height, weight, and BMI could not be considered as an appropriate criterion to associate kyphosis and lordosis angles in students of Tehran [27].

Guo et al. demonstrated in their research that a BMI of more than 24 kg/m^2 or a WHR of more than 0.85 can lead to increased spinal curvature. They also observed a significant correlation between BMI and lumbar lordosis, but no correlation between height and weight and lumbar lordosis when considered as independent variables [28]. These results are consistent with the findings of our study. In our study, a significant correlation was observed between the BMI of participants and the occurrence of postural abnormalities, such as FHP, kyphosis, and lumbar lordosis. Moreover, a significant correlation was observed between the prevalence of kyphosis and lumbar lordosis among the students.

A study by Abdullah et al. found a significant relationship between BMI and lordosis, and found no relationship between BMI and kyphosis [29]. The findings of the Malepe et al. study demonstrated no significant relationship between BMI and kyphosis as well as scoliosis [30].

Despite the low level of physical activity, the students' BMI was in the normal range, which may be due to reasons, such as the reception of health education in universities, cultural attitudes towards physical activity, and other environmental factors. Previous studies have also reported the relationship between physical activity and posture. A study by de Calcaterra et al. suggested that prevention programs should not only focus on reducing body weight but also on establishing correct postural habits from an early age of childhood and adulthood [31].

The results of our study showed that the highest prevalence of abnormalities among the research sample was FHP, followed by lumbar lordosis, and posterior kyphosis, respectively, at 84.5%, 79.8%, and 34.7% of the sample affected. In 2010 [32], the highest percentage of musculoskeletal disorders in Isfahan University students were reported in the following order, kyphosis at 34.42%, FHP at 94.38%, and lordosis at 56.29%. In the study by Malepe et al., kyphosis was observed the most common type of postural deviation among the University of Venda students [30].

Based on the results of the present study, the lowest prevalence of abnormality among male medical university students was kyphosis with a frequency of 34.7%. While, in the study conducted by Bahrami and Farhadi, they referred to the inequality of the shoulders as the lowest abnormality in the studied boys in Lorestan Province, Iran [33]. Therefore, it can be concluded that individuals may experience specific abnormalities and complications based on geographical, cultural, and social differences.

Identifying these complications provides an opportunity for rehabilitation and physical education specialists to strive to correct them by providing specific movements and behavioral patterns.

The study's results also highlight the need for postural screening and education programs for students in medical universities. These programs should focus on the prevention and management of postural deviations and musculoskeletal pain, as well as the promotion of physical activity and healthy weight management.

5. Conclusion

The results of this study showed that in male university students participating in the present study, postural abnormalities, including FHP, posterior kyphosis, and lordosis, are significantly prevalent with varying degrees of occurrence. FHP was the most common type of postural abnormality observed among these students. Age and BMI were correlated with the prevalence of postural abnormalities among students, such that the prevalence of kyphosis was much higher among students younger than 25 years compared to students older than 25 years. A significant correlation was observed between the prevalence of postural abnormalities and the BMI of students. Additionally, a significant relationship was observed between the prevalence of FHP and the physical activity of students.

Limitations and future research

One limitation of this study is its cross-sectional design, which does not allow for causal inferences to be made. Additionally, the study only included male medical students in Tehran universities, which may limit the generalizability of the findings to other populations. Future research should employ longitudinal and comparative designs to investigate the causal relationships between postural alignment, body weight, physical activity, and musculoskeletal pain in diverse populations. Finally, future research should evaluate the effectiveness of postural screening and education programs in improving postural alignment and preventing musculoskeletal pain among other populations. In addition, we suggest further research to examine the long-term consequences of postural abnormalities.

Ethical Considerations

Compliance with ethical guidelines

The local Ethics Committee of the University of Social Welfare and Rehabilitation Sciences approved the whole research process (Code: 97/801/4017/1).

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Authors' contributions

All authors contributed equally to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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