

The relationship of height, weight and body mass index with curvature of spine kyphosis and lordosis in 12-15-year old male adolescents of Tehran

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Abstract

Normal curvature of the spine might be changed as a result of its non-fixed feature. The aim of this study was to investigate the relationship between height, weight and body mass index (BMI) with curvature of the spine kyphosis and lordosis in 12-15-year-old male adolescents of Tehran. This was a correlational study in which 97 accessible healthy boy students from Tehran region 2 (13.8 ± 0.8 years old) participate were selected. After measuring height (157.4 ± 8.6 cm), weight (52.9 ± 11.9 kg) and calculating BMI (21.2 ± 3.9 kg/m²), the spinal mouse was used to spinal assessment. To investigate the relationship between study variables Pearson correlation coefficient was used. The results of Pearson correlation coefficient showed there was no statistically significant relationship between study variables including height and kyphosis curvature ($r = -0.047$, $p = 0.651$), height and lordosis curvature ($r = -0.026$, $r = 0.800$), weight and kyphosis curvature ($r = 0.015$, $p = 0.883$), weight and lordosis curvature ($r = 0.052$, $p = 0.610$), body mass index and kyphosis curvature ($r = 0.059$, $p = 0.566$), and body mass index with lordosis curvature ($r = 0.084$, $p = 0.413$). Therefore, although it seems that anomalies of the spine have high prevalence among the students, the results of this study showed that height, weight and body mass index could not be considered as an appropriate criterion to associate of kyphosis and lordosis angles in the studied population.

Keywords: Body Height, Body Weight, BMI, Spinal Curvatures, boy students.

INTRODUCTION

In addition to advantages such as transfer of physical labor from human beings to machinery, convenience and availability of facilities, life in the present era has also brought disadvantages including the reduction of physical activity, more energy storage in the form of fat, laziness and ultimately obesity. Weight gain and obesity not only affect the body's cardiovascular system but also can impair the proper function of body muscles and joints as well as body's upright position (22,35).

Body mass index (BMI) is known as a standard for identifying normal weight range. People who are in the range of 18.5 to 25 kg per square meter are in normal condition(8). A lower value indicates underweight and a higher value indicates risk of obesity and overweight, which are both undesirable. Underweight and overweight people respectively

suffer due to lack of muscle mass and necessary muscular strength and exertion of too much force for movement and hence premature fatigue. In addition, changes in the body composition can play a significant role in the body's mechanical position and the muscular skeletal structure (23).

The spine is an important part of the skeletal system stretching like an S. The curve adjusts the pressures and stresses and causes the better performance of the muscles attached to it (15). The spinal alignment and natural curves are of great importance in maintaining the structure and supporting the organs situated within. Therefore, increased or decreased curvature can negatively affect the normal function of these organs (24,33,35) and other vertebral curves (35). Accordingly, the factors affecting the spine curvature have long been of interest to researchers to the effect that some of

them have especially focused their study on adolescence age as the period of physiological and physical changes. In this regard, mention can be made of Taheri Tizabi et al. (32) who studied 636 male adolescents aged 12-17 to investigate the relationship of height, weight and BMI with kyphosis and lordosis during growth period. In this study, a flexible ruler was used to evaluate kyphosis and lordosis. The researchers reported a significant and positive relationship of kyphosis with lordosis, height and weight. They also concluded that there was a positive and significant relationship of lordosis with the participants' BMI and weight (15). In a separate study conducted in 2012 year, the relationship between thoracic kyphosis and stature of 90 female adolescents aged 13-18 was studied. The researchers observed a strong, positive and significant relationship between thoracic kyphosis angle and the stature (1). In this respect, 1373 participants were examined from ages 3 to 14 in a longitudinal study to determine the relationship between childhood BMI and adolescent postural status. The results showed that there was a significant relationship between childhood obesity and complications of lumbar lordosis in adolescence (31). Similarly, in a study carried out to determine the relationship of body type with kyphosis curvature and spine lordosis in female adolescents aged 15-17, no significant relationship was observed (17). Similarly, in a separate study, the relationship of BMI and height with prevalence of vertebral deformity in 17-year-old female and male adolescents was studied before their conscription. Measuring the spine abnormalities using X-ray, the researchers reported a positive relationship between height and vertebral deformity and also they observed that a higher-than-normal BMI may have a protective effect on spinal deformity(9).

Given the literature, it is obvious that few studies have been conducted on this age range. Furthermore, with an increase in the age range of the participants, there are conflicting results some of which suggest a relationship (1, 3, 5, 10, 12, 14, 18, 32) and some suggest no relationship(6,7,17,19, 36,37) of height, weight and BMI with curvature kyphosis and spine lordosis. In addition, different measurement tools have been used for assessment. It should also be noted that standing upright is one of the fundamental human postures that is inherently unstable and susceptible to change (29). In this respect, if a natural alignment of the spine only affects a person's appearance, the concern will be a matter of cosmetic nature, but if these changes

become permanent, though rare, they can cause pain and physical disorders, respiratory problems or damage to internal organs (22,24,35). Accordingly, the present study was conducted to answer if there is any relationship of height, body weight and BMI with kyphosis curvature and spine lordosis in male adolescents aged 15-12 of Tehran, and to help reduce their negative effects on stature and body's vital organs through appropriate corrective exercises or weight control.

MATERIALS & METHODS

This study is of descriptive and correlational nature. The study population consisted of male students aged 12 to 15 in district 2 of Tehran. As for the selection method, the researchers randomly visited 3 schools in the district and explained the intent and consent of their study to the school authorities. In the break time, the students gathered by the authorities and received the general research guidelines. In total, 97 students (29, 32 and 36 out of each respective school) with a mean age and standard deviation of 13.8 ± 0.8 years, accepted to cooperate as participants. After ensuring about their physical health and no history of spinal surgery and lumbar pain or acute or chronic lumbar, skeletal, or muscular disease, the general explanations were given to the participants regarding the test. They were asked to come in the school on the day of the test with informed consent from their parents. On the test day, they were re-enquired by the assessor about any possible musculoskeletal pain and then were given information on the study implementation. Sahand® electronic precision balance with mechanical height gauge model BSR 85 (with a precision of up to one centimeter and weighing up to 50 grams) was used to measure the height and weight of the subjects. For this purpose, the subjects were asked to go on the balance barefoot and with minimal wear and stand upright on taking a deep breath. Then the experimenter recorded the height and weight of the participant by setting the bar of the height gauge and letting the plate touch on the subject's head. To calculate BMI, the equation of weight in kilograms divided by the square of height in meters was used. The Swiss-made spine assessment device (Spinal Mouse®) version 8 was used to evaluate the spine alignment with high validity ($r=0.95$) (27) and reliability ($r=0.93$) (34). Each subject was asked to stand normally on upper wear in front of the examiner. Having the necessary expertise in working with spinal mouse, the assessor marked the seventh

cervical vertebrae as the most prominent cervical vertebrae after bending the head forward and sticking the chin to the chest wishbone. Then he continued with touching any of the thoracic vertebrae and marking them down to S2 (intergluteal cleft). In the next step, putting the spinal mouse ball on the seventh cervical vertebrae and moving it down to the intergluteal cleft (vertebrae S2), the experimenter measured the spine alignment of the subjects. Spinal mouse data were transferred to the notebook via Telemetry. Then, kyphosis of dorsal vertebrae and lordosis of lumbar vertebrae were detected. After data normalization by Kolmogorov-Smirnov test, Pearson's correlation coefficient (at $p < 0.05$) was used to find the relationship between variables. SPSS software version 17 was used in all the steps.

RESULTS

The sample population consisted of 97 male adolescents aged 12 to 15 (mean age 13.8 ± 0.8). The personal details of the participants are given in Table 1. The results of Pearson correlation of the variables (height, weight and body mass index with kyphosis and lordosis curvature) are reported in Table 2.

Table 1. Demographic characteristic of participants (N=97).

Demographic characteristic	mean \pm SD
Age	13.8 \pm 0.8
Height (cm)	157.4 \pm 8.6
Weight (kg)	52.9 \pm 11.9
BMI (kg per m ²)	21.2 \pm 3.9
Kyphosis (degrees)	44.2 \pm 7.3
Lordosis (degrees)	29.4 \pm 7.2

Table 2. Results of Pearson correlation coefficient between variables.

Variables	Correlation coefficient	p	Result
Height and kyphosis	-0.047	0.651	NS
Height and lordosis	-0.026	0.800	NS
Weight and kyphosis	0.015	0.883	NS
Weight and lordosis	0.052	0.610	NS
BMI and kyphosis	0.059	0.566	NS
BMI and lordosis	0.084	0.413	NS

NS: No Significant ($p > 0.05$)

According to the results of correlation coefficient (Table 2), there were negative correlation between height with Kyphosis and lordosis, and a positive correlation between weight with kyphosis and lordosis as well as body mass index with

kyphosis and lordosis. However, these correlation coefficients were not significant statistically.

DISCUSSION

Researchers conducted in Iran indicates that more than 50 percent of students and adolescents suffer from postural abnormalities (2,16,26). On the other hand, if these anomalies are not diagnosed and treated in early stages, they sometimes cause irreversible complications including early muscle fatigue, joint changes, and imbalance in the body position (22). In this respect, the present study intends to investigate the relationship of height, weight and body mass index with the curvature of the thoracic and lumbar vertebrae in male adolescents. The results showed that there was no significant relationship between the variables. Regarding the absence of a significant relationship between height and kyphosis curvature, the findings of this study were consistent with the results of some studies (7,11,30) and were inconsistent with the results of other studies (1,9,32). The inconsistency between the findings of this study and those by Taheri Tizabi et al. (32) is attributable to the different tools used for assessment of spine alignment as well as the age range of the participants, because the range of 15 to 18 years of age coincides with male adolescence and growth differences appear mostly in this age. Therefore, according to some studies, poor posture such as hunched posture in tall adolescents during this period may lead to posture kyphosis (25). The inconsistency of the findings with results of Awad (1) can be attributed to his population under study who were females. As Salvo (25) reported in his study, posture Kyphosis is caused mostly in females because they hide their breast growth in adolescence.

The study found no significant relationship between height and curvature of the lordosis. This finding is in line with the results of some studies (11,32) and inconsistent with the results of other studies (1,9). This inconsistency can be explained regarding the difference between study populations of the present study and the above-mentioned ones. For example, Awad (1) had performed his research on a female adolescent population of which the samples suffered from akypnosis with an angle above 40 degrees. Similarly, Hershkovich (9) studied 17-year-old female and male adolescents before their conscription. His sample consisted of participants suffering from deformities and functional disabilities. In contrast, healthy subjects with no

reported disability or pain were examined in the present study.

In addition, the present study found no significant relationship between weight and kyphosis curvature. This finding is in line with the results of some studies (6,7,31) and inconsistent with the results of other studies (14,32). Therefore, it seems that the precision of the assessment device (Spinal Mouse) used in this study compared with flexible ruler (32) along with heterogeneity of the population is the reason behind this inconsistency. The subjects of the study by Lang-Tapia (14) were composed of 659 men and women over 20 years. As the researcher had observed in his research, with increased age of the subjects, they suffered increased thoracic kyphosis. The present study also suggests an insignificant relationship between weight and curvature of the lumbar lordosis in the subjects.

The results are consistent with some studies (6,36,37) and inconsistent with other studies (14,20,32) is inconsistent. The inconsistency can be attributed to the race of the subjects besides the precision of the measurement tool (32) and their age(14,20). It should be noted that Lang-Tapia (2011) conducted his study in Australia. His population is racially different from that of the present study. In fact, spine curvature can be affected by race (13).

The present study shows an insignificant relationship between BMI and kyphosis curvature, which agrees with the findings of some researchers (5,10,12) and is inconsistent with the other studies (3). During a 10-year longitudinal study of adult men and women suffering backache, Bergenudd (3) had come to the conclusion that BMI was related with kyphosis in females. However, this relationship in his study could have been influenced by gender (12,14,21,37), and no separate study found any relationship between these changes. It seems that other studies (5,10,12) have confirmed the results of this study regarding this issue.

The findings of the present study indicate no significant relationship between BMI and lordosis curvature, which is in line with the results of some studies (19,24,28,37) and inconsistent with results of other studies (4,5,9,10,12,18,32). Although the inconsistency between the results can be attributed to the age difference in the study populations (4,5,10,12) or use of a flexible ruler instead of spinal mouse for measurement (10,12,32), it should be noted that the subjects of this study were healthy adolescents who had no previous history of back

pain or injury while the population of similar studies consisted of subjects with slight back pain or a history of previous spine injury or deformity (4,9,10,18), which could affect the research results.

In sum, although postural abnormalities are common among students, the present study confirms that the calculation of height, weight and body mass index cannot be a relevant criterion to predict angle change of kyphosis and lordosis in the study population. Therefore, it is recommended a similar study is carried out on the female adolescents of the same age range and compare the results with those of the present study to clarify the matter. Moreover, other conditions such as changes in physical activity, nutrition, mental state or social culture may affect the stature of healthy people throughout their life, which stresses further study in this field.

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