ORIGINAL ARTICLE

Demographic characteristics related to body posture in early adolescence

İlkşan DEMİRBÜKEN, Bahar ÖZGÜL, Eren TİMURTAŞ, Emir ŞAHİN, Murat Dinçer ÇEKİN,
Saadet Ufuk YURDALAN, Mine Gülden POLAT

Purpose: To investigate the effects of age, height, weight, body mass index (BMI) and gender on adolescent posture.
Methods: Five-hundred and thirty-one participants (220 girls and 311 boys) were included in our study. After demographic data (age, height, weight and BMI) were recorded, posture was assessed by New York Posture Rating Chart (NYPR) which consist of 13 questions and total posture scores were obtained. Pearson correlation test was used to analyze the relationship between NYPR scores and demographic data. The Independent t test was used to compare NYPR scores of boys and girls
Results: A significant negative correlation was found between postural scores and age, weight and BMI of participants (p<0.05). There was no significant difference in NYPR postural scores between boys and girls (p=0.167). In intragroup assessment of girls and boys, there was a significant negative correlation between postural scores and demographic parameters except BMI for girls (p<0.05) whereas no significant correlation was detected for boys (p>0.05).
Conclusion: Posture becomes worse as the age increases in early adolescence. Gender is not a parameter affecting posture in this period. The posture of girls is negatively affected from increased demographic measures except BMI whereas posture of boys is not affected from demographic parameters.
Keywords: Adolescence, Posture, Body mass index.

Erken adölesan dönemde demografik özelliklerin vücut postürü ile ilişkisi

Amaç: Yaşın, boy uzunluğunun, vücut ağırlığının, vücut kütle indeksinin ve cinsiyetin adölesan postürü üzerine etkisini incelemektir.
Yöntem: Çalışmamızda 531 katılımcı (220 kız ve 311 erkek) yer almaktadır. Demografik verilerin (yaş, boy uzunluğu, vücut ağırlığı ve vücut kütle indeksi (VKİ) alınmasının ardından, postür 13 soruluk New York Postür Skalası (NYPS) ile değerlendirildi ve total postür skorları elde edildi. Pearson korelasyon testi NYPS skoru ile demografik veriler arasındaki ilişkiyi belirlemekte kullanıldı. Bağımsız T testi, kız ve erkek bireylerin NYPS skorlarının karşılaştırılması amacıyla kullanıldı.
Bulgular: Bireylerin postür skorları ile yaş, vücut ağırlığı ve VKİ arasında anlamlı düzeyde negatif bir korelasyon saptandı (p<0.05). Kızlar ve erkekler arasında NYPS arasında anlamlı düzeyde herhangi bir fark belirlenmedi (p=0.167). Kızlarda postüral skorlar ile VKİ hariç demografik parametreler arasında negatif korelasyon saptanırken (p<0.05), erkek bireylerde bu parametreler arasında korelasyon bulunmadı (p>0.05).
Sonuç: Erken adölesan dönemde yaş ilerledikçe postür kötüleşmektedir. Bu dönemde cinsiyet postürü etkileyen bir parametre olarak görülmemektedir. Erkeklerin postürü demografik parametrelerden etkilenmemekteyken, kızların postürü VKİ hariç artan demografik değerlerin artışından negatif yönde etkilenmektedir.
Anahtar kelimeler: Adölesan, Postür, Beden kütle indeksi

İ Demirbüken, B Özgül, E Timurtaş, E Şahin, SU Yurdalan, MG Polat: Marmara University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, İstanbul, Türkiye.
MD Çekin: Marmara University Faculty of Health Sciences, Department of Health Management, İstanbul, Türkiye.
Corresponding author: Bahar Özgül: fztbaharozgul@gmail.com

Adolescence is the period during which anatomical and physiological growth and changes occur at a tremendous pace. While the onset of adolescence period varies among children, World Health Organization (WHO) defines this period as years between 10 and 19.[1] In this period, girls gain on average 9 cm (0-25) and 8.3 kg/year whereas boys gain on average 10.3 cm (0-28) and 9 kg/year, and these developmental changes for boys are completed two years later than girls. This rapidly progressive period is defined as "pubertal growth spurt".[2]

In consequence of development of secondary sex characteristics, which coincides with the period of pubertal growth spurt, gender differences in physical characteristics appear between boys and girls. Due to increased releasing of male hormones that cause an increase in muscle mass; straight-lined, square bodies of boys become broader at the shoulders and more tapered at the waist, forming the familiar triangular shape of male adults. As for girls, the percentage of body fat increases at higher rate relative to muscle mass and this additional fat mass is deposited in the middle part of the body. Females' straight-lined, square bodies become wider and broader at the hips, buttocks, and chest, forming the familiar hour-glass shape of female adults.[3]

Rapid development due to hormonal changes in the tissues of muscle, bone and cartilage cause static problems like postural misalignment and dynamic problems like muscle imbalance and coordination deficits. In this period, bones are still cartilaginous in some parts of the body; ligaments have insufficient strength; and developmental imbalance could appear between muscles and bones.[4,5] Increased body mass, as another developmental change may also have negative effects on postural alignment of adolescents.[6] All these factors could trigger or increase the risk of musculoskeletal disorders like pes cavus, pes planus, scoliosis, hypolordosis, hyperkyphosis resulting in poor posture.

Posture, defined as the relative arrangement of body parts, can be influenced by intrinsic and extrinsic factors, such as physiologic alterations due to human growth and development.[7] In recent years, childhood and adolescence postural deformities have been of growing concern due to the observations that there seems to be an increase in musculoskeletal problems compared to previous generations.[8] Since the adolescent growth spurt is a critical period for musculoskeletal development and axial growth,[9] poor posture in this age group may be reason of important health problems in the subsequent years.[10,11]

The determination of onset and/or increase of postural misalignment in adolescent age group based on differences in the demographic characteristics is beneficial to predict the risk of musculoskeletal problems which might appear in adulthood. Although physical alterations due to rapid growth of the musculoskeletal system in adolescence were identified, there is lack of researches investigating the effects of demographic characteristics on adolescent posture of girls and boys. Up to knowledge there is no evidence indicating relation between demographics and body posture particularly at early adolescence period. At this period, posture may be affected by increasing age, height, weight, body mass index (BMI). The aim of this study was to investigate the effects of age, height, weight, BMI and gender on adolescent posture.

METHODS

Five hundred and fifty-eight individuals (236 girls and 322 boys) aged 11-15 years from three secondary schools in Istanbul, Turkey were included in the study, that was carried out between October 2013 and June 2014. Considering financial and time limitation, a district of Istanbul was determined with randomization method. Three schools that have taken bureaucratic permissions were chosen to include in the study. The schools included in the study reflect the typical secondary school properties. The research proposal was approved by the ethics committee of the Institute of Health Sciences, Marmara University. The participants and their parents were informed about the procedure and signed the informed consent before the study. The adolescents were excluded if they had any lower and upper extremities or spinal surgery or injury in the last 6 months, difference in length of lower extremities, any diagnosis with

neurological, visual or balance disorders, metastatic disease affecting spines, or inability to achieve test postures.

The demographic data (age, gender, height, and weight). Body weight and height were measured by *Omron* mark weighbridge and *MR200 brand Mesitas* mark height scale. BMI is calculated by following formula: Bodyweight in kilograms divided by height in meters squared. Postural assessment was conducted by using New York Posture Rating Chart (NYPR). NYPR is a cheap, easily and rapidly applicable subjective postural assessment method that is used commonly for clinical postural evaluation. The rating chart is used to assess 13 areas of the body, based on the assumption that posture is the alignment of the body and its segments. 13 regions (head, neck, shoulder, scapula, upper thoracic, waist, rips, abdomen, hips, knees, legs, feet and toes) are assessed in two different positions (lateral and posterior). A score is allocated to each area according to the position: 5 points to the correct position; 3 points for a slight deviation, and 1 point for a pronounced deviation. Total score is between 18-90 points. Higher the points better the postural alignment.[12] All measurements were conducted by the same physiotherapist. Demographic characteristics and NYPR scores of subjects are shown in Table 1.

Statistical analysis

The sample size was found 384 people in % 95 confidence level and 0.05 margin of error. The obtained data was statistically analyzed using the one sample Kolmogorov-Smirnov test to determine the normal distribution. Descriptive statistics were presented as mean values and standard deviation (SD). Pearson correlation test was used to investigate if there were a significant relationship between NYPR scores and demographic data (age, height, weight and BMI). Independent-t tests was used to compare NYPR scores of boys and girls. A p value <0.05 was considered significant. All analysis were performed with the SPSS 11.5 statistical package.

RESULTS

Of 236 girls and 322 boys in our study, 27 participants were excluded from the analysis as they did not meet the inclusion criteria. The data from 220 girls and 311 boys, totally 531 participants were analyzed (Table 1).

A significant negative correlation was found between postural scores and age, weight and BMI of participants (p<0.05, Table 2). There was no significant difference between boys and girls in NYPR posture scores (p<0.05, Table 1).

There was a significant negative correlation between postural scores and demographic parameters except BMI for girls, while no significant correlation was detected between postural scores and demographic parameters for boys (p>0.05, Table 2).

DISCUSSION

The result of this study demonstrated that increasing age, weight, and BMI have negative relation on adolescent body posture.

Negative correlation between age and posture scores shows that posture becomes worse as age advances in early adolescence. Epidemiological studies have shown a high prevalence of spinal postural deviations such as scoliosis in adolescents besides forward head posture and protracted shoulder.[13,14] Previously, some researches revealed postural alterations related with increasing age; especially increase of thoracic kyphosis and lumbar lordosis in the adolescence period.[8,15,16] Disturbed posture with increasing age may depend on rapid musculoskeletal development due to hormonal changes in adolescent growth.[3] In our study, the posture has been shown to be negatively correlated also with weight which leads to misalignment of pelvic and spinal regions in adolescents.[6,17,18] In addition, lowered longitudinal arch structure is more frequently seen in obese children.[19,20] An increased body mass is likely to have negative influences on many activities of daily life, including the control of postural stability and locomotion.[21] BMI and central obesity are the characteristics more strongly associated with nonneutral postural patterns (especially alterations in pelvic position and increase of lumbar lordosis) in adult population.[22-24] It is to be regretted that the incidence and severity of obesity has increased among children and adolescents in recent years.

Table 1. Demographic characteristics and New York Posture Rating Chart scores of subjects.

	Girls N=220	Boys N=311	Total N=531	t*	p
Age (year)	12.42±1.24	12.61±1.01	12.61±1.15	-1.905	0.057
Height (cm)	151.96±9.78	153.65±11.19	153.45±10.80	-1.772	0.077
Body weight (kg)	45.04±11.90	47.16±12.74	46.72+12.72	-1.902	0.058
Body mass index (kg/m^2)	19.27±3.68	19.82±3.69	19.59±3.78	-1.388	0.166
New York Posture Rating Chart	82.79±5.42	82.05±6.36	82.24±6.12	1.384	0.167

* Comparison between girls and boys.

Table 2. Correlation between demographic data and New York Posture Rating Chart scores of subjects.

	Girls N=220 r (p)	Boys N=311 r (p)	Total N=531 r (p)
Age (year)	-0.137 (0.042)*	-0.104 (0.079)	-0.122 (0.006)*
Height (cm)	-0.143 (0.035)*	-0.040 (0.503)	-0.082 (0.066)
Body weight (kg)	-0.154 (0.022)*	-0.077 (0.193)	-0.111 (0.013)*
Body mass index (kg/m^2)	-0.109 (0.106)	-0.090 (0.131)	-0.101 (0.024)*

* $p<0.05$. r: Pearson correlation coefficient.

Furthermore, the present study verified that there is no significant difference in NYPR posture scores between boys and girls. There are gender differences in thoracic kyphosis,[25,26] lumbar lordosis,[27] head and shoulder posture[28-30] in related researches. However, some authors report indifference in sagittal configuration between boys and girls.[15,16,31-32] Whereas postural differences between genders are evident in adulthood,[33-35] the results of the studies concerning children and adolescents are variable. Distinct results of these researches may be due to differences among postural assessment methods (e.g. inclinometer, radiography, photography, spinal mouse system). Though, comparing with other methods, NYPR scale is subjective and can evaluate only total posture score without distinguishing between body segments, it is an easy, inexpensive and ethical method unlike radiologic assessment.

When the intragroup assessment of girls and boys examined, posture is seen to be negatively affected by the age, height and weight in girls whereas demographic measures have no effect on posture of boys. The fact that

pubertal growth spurt in girls starts 2-3 years earlier than boys may negatively influence girls posture in this rapid growth period.[36] Therefore, negative correlation found in girls might be related with their faster and earlier pubertal growth, therefore weight gain in girls as a development change in this period may be a risk factor for post-adolescence years.

Study limitations

Limitation of our study was the inclusion of participants in early adolescence but not middle and late adolescence. Thus, further studies that might assess the subjects between 10-19 years of age would carry out a better understanding of the relation of demographic measures on body posture in adolescence. Additionally, the differences on demographic characteristics and posture relation between boys and girls should not be ignored for further assessments or studies in early adolescence. In other words, gender effect must be considered for sample eligibility.

Conclusion

Finally, the results of our study proved that body posture is related with age and weight in the early adolescence. Adolescence is

an important period for identification of postural disorders and taking precautions for the later ages. Poor posture in adolescents has more negative effects on health condition compared with adults because of their rapid growth of the musculoskeletal system along with other risk factors such as school bag weight and carrying style,[37,38] wearing unsuitable shoes (especially for girls),[39] and sedentary lifestyle.[11] This is why adolescents must be well-educated to maintain good posture and avoid triggering factors of poor posture. Accordingly, we suggest carrying out related follow up studies considering the effect of physical alterations on adolescent body posture in this rapid growth period.

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