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Distribution of Sitting Height Ratio and its Association with Body Mass Index among Children and Adolescents in Shandong, China

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Abstract

Background: Sitting height ratio (SHR) is a useful parameter for assessing body proportion in clinical practice and other related fields. However, its association with body mass index (BMI) and obesity among children and adolescents is limited.

Methods: Data for this study were obtained from a large cross-sectional survey of schoolchildren. A total of 42 348 students (21 248 boys and 21 100 girls) aged 7–18 years participated in this study. SHR was calculated as sitting height (SH) divided by total height. The BMI cutoff points recommended by the International Obesity Task Force (IOTF) were used to define overweight and obesity.

Results: Children and adolescents aged 7–18 years in the 'high SHR' group (≥75th) had higher BMI than those in the 'low SHR' group (<25th) in all age groups (P<0.01), the range of differences being 1.28–1.55 kg/m^2 for boys, and 1.06–1.90 kg/m^2 for girls. The overall prevalence of overweight and obesity were 13.40% and 4.28% for boys, and 8.11% and 1.18% for girls in the 'low SHR' group, the corresponding figures were 19.69% and 9.45% for boys, and 14.06% and 3.68% for girls in the 'high SHR' group, the latter is significantly higher than the former (P<0.01).

Conclusion: High SHR is associated with overweight and obesity, considering the adverse health effects of obesity, individuals with high SHR should be given special attention.

Keywords: Sitting height ratio; Body mass index; Overweight; Obesity; Child and adolescent

Introduction

Anthropological studies divided height into its components: trunk (upper body) and leg (lower body) length. In practice, sitting height (SH) used to represent trunk length and leg length was estimated by subtracting SH from total height. Measurement of body proportion is useful in assessing the growth and development of children and adolescents [1]. Sitting height ratio (SHR, sitting height/height×100) is a commonly used parameter in the clinical diagnosis of disproportionate growth disorders; a larger SHR indicates relatively shorter legs for total height [2,3]. In this article, based on provincial data in 2010, we report the distribution of SHR and its association with obesity among children and adolescents in Shandong, China.

Methods

Data for this study were obtained from a large cross-sectional survey of schoolchildren. A total of 42,348 students (21,248 boys and 21,100 girls) from 16 districts in Shandong Province, students of Han nationality, aged 7–18 years, participated in the National Surveys on Chinese Students' Constitution and Health, which were carried out in September to October 2010. All subjects voluntarily joined this study with informed consents. The sampling method was stratified multi-stage sampling based on selected primary and secondary schools. Six public schools (two primary schools, two junior high schools and two senior high schools) from each of the 16 districts in Shandong were randomly selected and invited to participate in the study. From the selected schools, two classes in each grade were selected, and all students of the selected classes were invited to join the study.

All measurements were performed by well-trained health professionals in each of the 16 districts using the same type of apparatus and followed the same procedures. Height without shoes and SH were measured using metal column height/sitting height measuring stands (Yilian, TZG; Shanghai Yilian Science & Education Equipment Company, Limited) to the nearest 0.1 cm. The SH was obtained adapting a removable box (60 cm) to the stadiometer, where the child was sat with the trunk erect and the head in the Frankfurt plane. SHR was calculated as SH divided by total height×100. Weight was measured using lever scales to the nearest 0.1 kg while the subjects wore their underwear only. Body mass index (BMI) was calculated by dividing the total weight in kg by the total height in m^2 (kg/m^2). The BMI cutoff points recommended by the International Obesity Task Force (IOTF) were used to define overweight and obesity [4].

Results

The age- and sex-specific quartiles for SHR of children and adolescents were calculated, individuals in the upper fourth (≥75th) were defined as 'high SHR', and those in the lower fourth (<25th) were defined as 'low SHR', respectively. Comparisons of BMI between the two groups were made by t-test, and comparisons of overweight and obesity frequencies between the two groups were made by x^2 test. All

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analyses were performed with the statistical package SPSS/PC + version 11.5.

Age/ years	Boys								Girls						
	n	Mean ± SD	15th	25th	50th	75th	85th		n	Mean ± SD	15th	25th	50th	75th	85th
7	1755	54.60 ± 1.94	53.08	53.7	54.6	55.46	55.9		1790	54.90 ± 2.35*	53.3	54	55	56	56
8	1901	53.77 ± 1.82	52.31	52.9	53.9	54.86	55.2		1819	53.96 ± 1.69*	52.7	53	54	55	55
9	1742	53.25 ± 2.58	51.82	52.5	53.4	54.42	55		1822	53.49 ± 1.87*	52.1	53	54	54	55
10	1809	52.87 ± 2.41	51.45	52.1	53	53.82	54.3		1824	53.19 ± 1.97*	51.8	52	53	54	55
11	1796	52.50 ± 3.31	51.19	51.8	52.7	53.74	54.2		1757	53.04 ± 1.93*	51.7	52	53	54	55
12	1782	52.26 ± 2.04	50.6	51.4	52.4	53.32	53.8		1721	53.06 ± 2.02*	51.6	52	53	54	55
13	1762	52.18 ± 3.17	50.71	51.4	52.3	53.24	53.8		1761	53.15 ± 2.24*	51.8	52	53	54	55
14	1672	52.40 ± 2.15	51.08	51.6	52.6	53.42	53.9		1706	53.39 ± 2.04*	52	53	54	55	55
15	1811	52.66 ± 2.05	51.17	51.8	52.8	53.77	54.3		1782	53.52 ± 1.90*	52.1	53	54	55	55
16	1718	52.85 ± 1.74	51.42	52	53	53.86	54.3		1681	53.56 ± 2.51*	52.2	53	54	55	55
17	1737	52.95 ± 2.52	51.39	52	53.2	54.02	54.5		1725	53.59 ± 1.80*	52.6	53	54	55	55
18	1763	53.01 ± 2.51	51.66	52.4	53.4	54.23	54.8		1712	53.61 ± 2.92*	52.4	53	54	55	55

Table 1: Mean, standard deviations (SD) and percentile values for SHR of Shandong Chinese children by sex and age.

*Significant difference between boys and girls (p<0.01).

The mean, SD and percentile values of SHR in the sample are shown in Table 1. Girls had higher SHR than boys in all age groups (7–18 years). The 50th percentiles of SHR declined from 7 years to 11 years in girls and 13 years in boys, and then increased slightly until 18 years in both boys and girls. The 50th percentiles of SHR changed from 54.75 in girls and 54.60 in boys, at 7 years old, to their lowest values of 53.15 in girls (aged 11 years) and 52.34 (aged 13 years) in boys, and then rose to 54.00 in girls and 53.37 in boys at 18 years old.

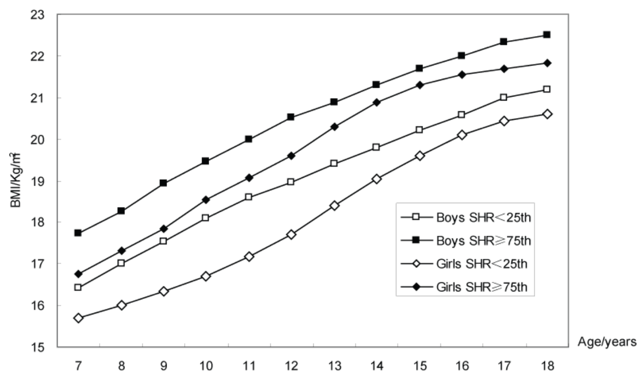

Figure 1: Mean values of BMI for boys and girls with high (≥75th) and low (25th) SHR.

Children and adolescents aged 7–18 years in the 'high SHR' group (≥75th) had higher BMI than those in the 'low SHR' group (<25th) in all age groups (P<0.01), the range of differences being 1.28–1.55 kg/m^2 for boys, and 1.06–1.90 kg/m^2 for girls (Figure 1).

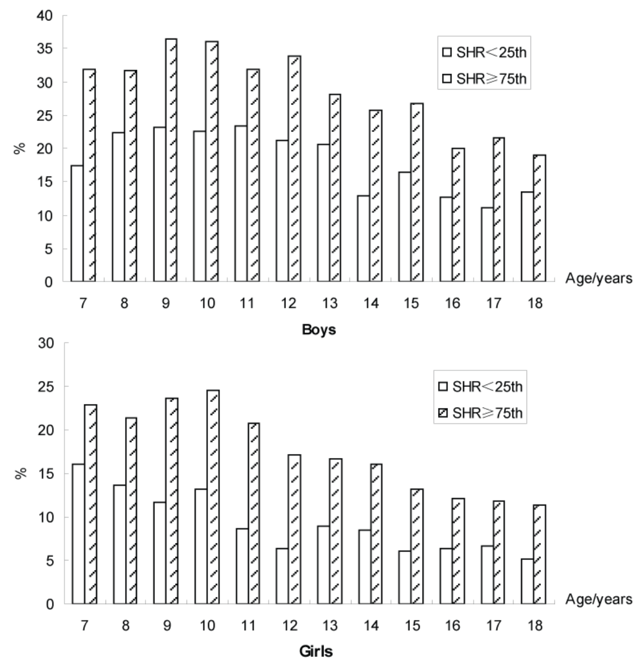

Figure 2: The prevalence of combined overweight and obesity in boys and girls with high (≥75th) and low (25th) SHR.

The overall prevalence of overweight and obesity were 13.40% and 4.28% for boys, and 8.11% and 1.18% for girls in the 'low SHR' group, the corresponding figures were 19.69% and 9.45% for boys, and 14.06%

and 3.68% for girls in the 'high SHR' group, the latter is significantly higher than the former (P<0.01). The prevalence of combined overweight and obesity among children and adolescents aged 7-18 years in the 'low SHR' and 'high SHR' groups are shown in Figure 2.

The prevalence of combined overweight and obesity were 11.0–23.4% for boys and 5.2–16.0% for girls in the 'low SHR' group, the corresponding figures were 19.1–36.4% for boys and 11.4–24.5% for girls in the 'high SHR' group. For both boys and girls, x^2 test indicated that children and adolescents with 'high SHR' had higher prevalence of combined overweight and obesity than their peers with 'low SHR', statistical significant differences were observed in all age groups (P<0.05).

Prevalence of overweight and obesity among children and adolescents have been ranked as a worldwide public health concern. More importantly, increased rates of overweight and obesity, as well as associated chronic diseases, have been recently observed in many countries [5-7]. As a populous country, China has now joined the world epidemic of obesity with its rapid economic growth and urbanization [8,9]. In 2010, it was estimated that 9.9% of Chinese school-aged children and adolescents were overweight and 5.1% were obese, representing an estimated 30.43 million individuals [10]. We are facing serious challenge and should take corresponding measures to control childhood overweight and obesity. In this study, we found that SHR is associated with overweight and obesity, children and adolescents with high SHR had higher prevalence of overweight and obesity than their peers with low SHR, and should be given special attention.

Conclusion

One limitation of the present study is that the absence of detailed information concerning family environment, nutritional status, dietary patterns and physical activity at the individual level limited our study.

Conflict of Interest

There are no conflicts of interest on behalf of any of the authors.

Acknowledgment

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