Prevalence and regional distribution of childhood overweight and obesity in Shandong Province, China

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Background: **The rising prevalence of childhood obesity was observed in China. This study assessed the prevalence and district distribution of childhood obesity in Shandong Province, China.**

Methods: **A cross-sectional study was conducted in the province. A total of 42 275 students (21 222 boys and 21 053 girls) aged 7-18 years from 16 districts participated in this study. Height and body weight of all subjects were measured, and the body mass index (BMI) was calculated. The prevalence of overweight and obesity was obtained according to the International Obesity Task Force (IOTF) cut-offs.**

Results: **In 2010, the prevalence rates of combined overweight and obesity reached 26.86% in urban boys, 18.32% in rural boys, 14.36% in urban girls, and 11.31% in rural girls, respectively. An increasing trend was observed in the prevalence of overweight and obesity from the low socioeconomic status (SES) group to the moderate and high SES groups. The prevalence rates of combined overweight and obesity in the three SES groups were 18.46%, 21.08% and 27.31% in boys and 10.43%, 12.42% and 15.18% in girls, respectively.**

Conclusions: **There is a high level of overweight and obesity among children and adolescents in Shandong Province, China. The distribution of childhood obesity is positively associated with the regional SES.**

World J Pediatr 2013;9(2):135-139

Key words: **child and adolescent; district difference; prevalence; obesity; overweight**

Original article

Introduction

The prevalence of childhood overweight and obesity has increased in developed countries and in many parts of developing countries.[1,2] Because of the rapid increase of prevalence rates, its severe co-morbidities, and costly consequences, obesity has become an increasingly important public health problem in children and adolescents.[3] The rising prevalence of childhood obesity has also been observed in China.[4-7] In 2005, a study reported geographic differences in childhood obesity prevalence rates: the prevalence rates of combined overweight and obesity among children and adolescents aged 7-18 years vary from 5.0% to 32.5% in boys and 3.9% to 17.6% in girls of the western rural region and northern coastal cities of China, respectively.[8]

Shandong Province is an important eastern littoral province with a population of 95.79 million in 2010. The present study aimed to analyze the prevalence and district distribution of childhood overweight and obesity in Shandong Province, China.

Methods

The study was approved by the Ethical Committee of the Shandong Center for Disease Control and Prevention.

Study population

In 2010, a cross-sectional study was conducted in Shandong Province. A total of 42 275 students aged 7-18 years (21 222 boys and 21 053 girls) from 16 districts in Shandong Province participated in the study. All students voluntarily joined this study and provided written informed consent. The sampling method was

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doi: 10.1007/s12519-012-0392-y

a stratified multistage sampling based on selected primary and secondary schools. The information about gross domestic product (GDP) per capita of the 16 districts in 2010 was obtained from the official website of Shandong Provincial Statistics Bureau (http://www.stats.com.cn/tjsj/tjsj.asp). The 16 districts were divided into three groups [high socioeconomic status (SES), moderate SES and low SES] according to their GDP per capita in 2010. High SES was defined as GDP per capita above 8000 dollars (including Jinan, Qingdao, Yantai, Weihai and Dongying), moderate SES was defined as GDP per capita above 5000 but below 8000 dollars (including Zibo, Weifang, Taian, Laiwu, Binzhou and Jining), and low SES was defined as GDP per capita below 5000 dollars (including Rizhao, Dezhou, Liaocheng, Linyi and Heze). To show the district distribution of obesity prevalence, all sub-populations were re-divided into six regions: a) high SES urban areas; b) moderate SES urban areas; c) low SES urban areas; d) high SES rural areas; e) moderate SES rural areas; and f) low SES rural areas.

Measurements

All measurements were conducted by a team of trained technicians in each of the 16 districts. Each technician was required to pass a training course for anthropometric measurement organized by the investigation team in Shandong Province. All measurements were taken using the same type of apparatus and followed the same procedures recommended by Cameron.[9] Metal column height-measuring stands (each 200 cm long with 0.1 cm precision) were used to measure height. The subjects were required to stand straight on the instruments barefoot and comfortably. Weight was measured with lever scales (each weighs 120 kg with 0.1 kg precision) while the subjects wore their underwear only.

Statistical analyses

Body mass index (BMI) was calculated (weight in kilograms divided by the square of height in meters), and the prevalence rates of overweight and obesity were obtained according to the International Obesity Task Force (IOTF) cut-offs.[10] The ratio of overweight to obesity in each group was determined, and overweight and obesity frequencies among different groups were compared by the chi-square test. Analyses were made with the statistical package SPSS/PC+ version 11.5. $P<0.05$ was considered statistically significant.

Results

Prevalence of overweight and obesity

Table 1 shows the prevalence of overweight and obesity among children and adolescents aged 7-18 years in Shandong Province. In 2010, the overall prevalence of overweight was 18.81% (urban boys), 13.54% (rural boys), 11.94% (urban girls) and 9.54% (rural girls), respectively (χ^2=421.26, $P<0.001$). The overall prevalence of obesity was 8.05% (urban boys), 4.78% (rural boys), 2.42% (urban girls) and 1.77% (rural girls), respectively (χ^2=629.12, $P<0.001$). There was a great variation between different sub-populations with the highest prevalence of combined overweight and obesity noted for the urban boys (26.86%), in the middle field the rural boys (18.32%) as well as the urban girls (14.36%), and with the lowest prevalence for the rural girls (11.31%) (Fig. 1).

Table 1. Prevalence of overweight and obesity in children and adolescents aged 7-18 years in Shandong Province, China, 2010

Age y	Urban boys				Rural boys				Urban girls				Rural girls			
	n	Over %	Obe %	Over+Obe %	*n*	Over %	Obe %	Over+Obe %	*n*	Over %	Obe %	Over+Obe %	*n*	Over %	Obe %	Over+Obe %
7.5	862	15.43	9.86	25.29	893	15.45	9.85	25.30	905	12.04	5.75	17.79	885	13.45	5.42	18.87
8.5	956	15.90	9.00	24.90	945	15.66	9.10	24.76	909	13.86	3.63	17.49	910	12.20	2.64	14.84
9.5	874	22.20	10.64	32.84	868	16.94	6.22	23.16	909	15.18	2.75	17.93	913	13.03	2.41	15.44
10.5	918	22.55	10.68	33.23	891	18.41	5.61	24.02	926	16.09	3.13	19.22	898	12.81	3.12	15.93
11.5	916	25.55	8.52	34.07	880	16.70	5.45	22.15	903	14.06	2.55	16.61	843	12.81	1.42	14.23
12.5	922	22.34	10.09	32.43	860	15.00	3.37	18.37	854	14.75	1.64	16.39	867	7.84	1.04	8.88
13.5	866	21.13	9.01	30.14	896	13.28	4.58	17.86	852	12.56	1.41	13.97	909	8.03	0.77	8.80
14.5	844	17.65	6.87	24.52	828	10.75	2.29	13.04	868	10.48	1.96	12.44	838	8.83	0.84	9.67
15.5	894	18.23	6.94	25.17	917	10.91	3.49	14.40	930	8.28	2.37	10.65	852	7.51	0.70	8.21
16.5	898	15.14	5.57	20.71	820	8.66	3.29	11.95	867	7.96	1.61	9.57	814	6.76	0.86	7.62
17.5	884	15.16	4.52	19.68	853	9.50	1.88	11.38	869	8.98	0.92	9.90	856	5.37	1.17	6.54
18.5	873	14.09	4.70	18.79	864	10.53	1.50	12.03	819	8.55	0.98	9.53	857	5.13	0.58	5.71
Total	10 707	18.81	8.05	26.86	10 515	13.54	4.78	18.32	10 611	11.94	2.42	14.36	10 442	9.54	1.77	11.31

Over: overweight; Obe: obesity.

SES variation in overweight/obesity prevalence

There were significant differences in the prevalence of overweight and obesity among children and adolescents in different SES groups. The overall prevalence of overweight in the three SES groups (low, moderate, high) were 13.76%, 16.04% and 18.26% in boys (χ^2=52.17, P<0.001), and 8.92%, 10.38% and 12.55% in girls (χ^2=49.14, P<0.001), respectively. The overall prevalence of obesity in the three SES groups were 4.70%, 5.04% and 9.05% in boys (χ^2=143.79, P<0.001), and 1.51%, 2.04% and 2.63% in girls (χ^2=21.29, P<0.001), respectively. Fig. 2 shows the prevalence of combined overweight and obesity by age in different SES groups: an increasing trend was observed from the low SES group to the moderate and high SES groups in all age groups (7-18 years). The average prevalence rates were 18.46%, 21.08% and 27.31% in boys (χ^2=170.51, P<0.001), and 10.43%, 12.42% and 15.18% in girls (χ^2=71.64, P<0.001), respectively.

Table 2 shows that the prevalence of combined overweight and obesity in high SES urban areas was 31.59% in boys and 16.74% in girls (7-18 years) and thereby much higher compared to the other SES groups. The prevalence of both overweight and obesity was the highest in the high SES urban areas (20.55%, 11.04% for boys and 13.84%, 2.90% for girls), and lowest in the low SES rural areas (10.52%, 2.53% for boys and 7.74%, 0.98% for girls).

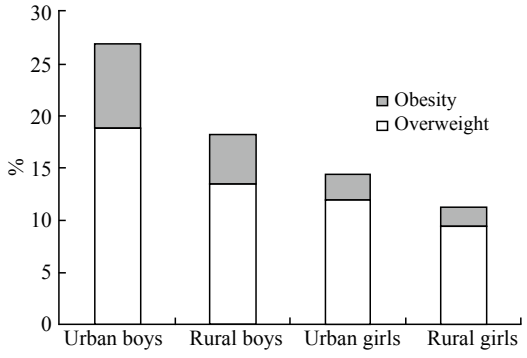

Fig. 1. The prevalence of combined overweight and obesity in urban and rural children and adolescents in Shandong Province, China, 2010.

Discussion

In 2010, the prevalence of combined overweight and obesity among school children and adolescents was found to be 22.63% (boys) and 12.85% (girls) respectively. Thus, the prevalence of obesity/overweight in Shandong Province, China has already approached that in developed countries.[11,12] Because

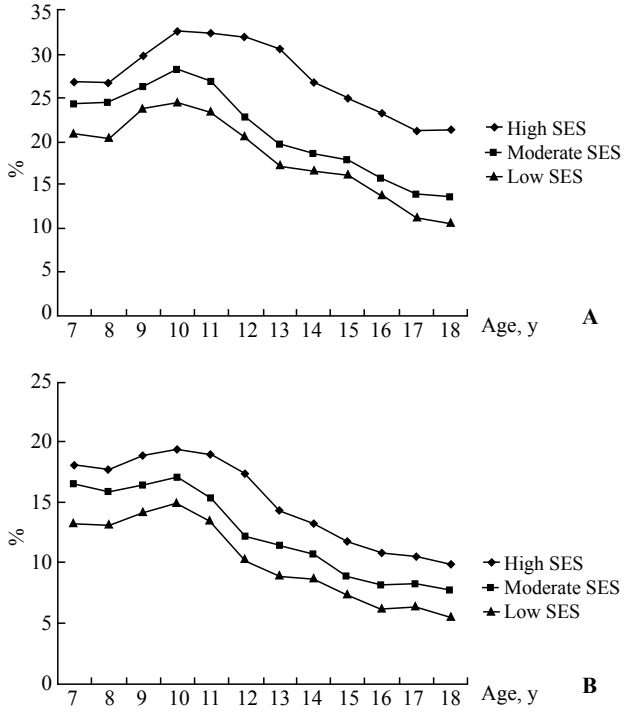

Fig. 2. Prevalence of combined overweight and obesity in boys (**A**) and girls (**B**) aged 7-18 years in different socioeconomic status (SES) districts in Shandong Province, China, 2010.

Table 2. Prevalence of overweight and obesity in children and adolescents of different socioeconomic status in Shandong Province, China, 2010

Populations	Male				Female			
	n	Over, %	Obe, %	Over+Obe, %	*n*	Over, %	Obe, %	Over+Obe, %
a. High SES urban areas	4048	20.55	11.04	31.59	3966	13.84	2.90	16.74
b. Moderate SES urban areas	3534	18.39	5.66	24.05	3528	11.39	2.21	13.60
c. Low SES urban areas	3125	16.99	6.88	23.87	3117	10.11	2.05	12.16
d. High SES rural areas	3840	15.83	6.95	22.78	3790	11.19	2.35	13.54
e. Moderate SES rural areas	3549	13.69	4.42	18.11	3488	9.35	1.86	11.21
f. Low SES rural areas	3126	10.52	2.53	13.05	3164	7.74	0.98	8.72
Chi-square		161.51	252.24	397.89		80.21	33.99	114.95
P value		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001

SES: socioeconomic status.

substantial socioeconomic and urban-rural disparities exist in childhood obesity/overweight, the prevalence of combined overweight and obesity varied from 31.59% in the high SES urban boys to 8.72% in the low SES rural girls.

A previous study[13] confirmed that the population distribution of childhood obesity is associated with SES, and the patterns vary from country to country. Studies[14-19] from developed countries showed that high SES youths are less likely to be obese than their lower SES counterparts. In contrast, in developing countries such as Indonesia, Brazil and China, high SES youths are more likely to be obese than their lower SES counterparts.[8,20,21] The reasons are quite complex and may be related to the local socioeconomic status, process of urbanization, living environments, nutritional status, dietary pattern and physical activity.

Similarly, reports[22,23] from developed countries showed that rural children have a higher risk of overweight and obesity compared with urban children, while developing countries report a reverse association.[8,24] This study indicated that boys and girls from urban areas were more likely to be obese than their peers from rural areas which may be related to the urban-rural difference in SES, living conditions and lifestyle. In 2010, the income per capita and Engel's coefficient were 19 946 RMB and 0.32 for urban residents and 6990 RMB and 0.38 for rural residents in Shandong Province, respectively (http://www.stats.com.cn/tjsj/tjsj.asp). A Chinese national study[25] reported that urban youths spend 0.8 more hours every day on sedentary activity than their rural counterparts. Compared to rural families, urban families own more televisions, video disc players and computers.[26] It makes urban children have more time for watching TV, playing video games and less time for physical activity than rural children. A study has shown that 80% of students do daily physical exercise less than one hour in Shandong Province, China. The short duration of physical activity may be an important cause that leads to a rapid increase in the prevalence of overweight and obesity.[27]

The traditional Chinese diet is shifting towards a diet with high fat, high energy density and low dietary fiber. These changes resulted in rapid increases in the prevalence of overweight and obesity and dietary-related chronic non-communicable diseases.[28] In the mainland of China, the annual energy contribution from fat is increasing, with the individual daily consumption of animal products increasing from 66 to 167 grams in rural areas, and from 114 to 215 grams in urban areas between 1982 and 2002.[29] In Shandong Province, the individual daily intake of fat and percentage energy from fat increased from 54.4 grams and 21.1% in 1992 to 83.1 grams and 36.2% in 2002, respectively.[30]

The strength of this study is that the database comes from a large representative sample of children and adolescents in Shandong Province, China. We reported the prevalence of overweight and obesity by IOTF reference norm, which allows comparison with similar studies performed in other countries. However, this study has several limitations. The absence of detailed information at the individual level limited our study. Lack individual SES information probably underestimated the true effects of SES on obesity.

In summary, this study demonstrated that the prevalence of childhood obesity/overweight is wide in Shandong Province, one of the populous provinces in China. The distribution of childhood obesity is positively associated with the regional SES, indicating that children and adolescents from more developed districts are more likely to be obese than those from less developed districts.

Acknowledgements

Surveys on students' constitution and health are conducted under the auspices of the Department of Education in Shandong Province, China. We are grateful to all the team members and participants. Special thanks are also given to Mr. B Yu and Mr. HY Xu for providing the survey data.

Funding: This research was supported by medical and health program of Shandong (2009-HE049).

Ethical approval: The study was approved by the Ethical Committee of the Shandong Center for Disease Control and Prevention.

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

Contributors: Zhang YX designed the study and wrote the first draft. Wang SR conducted the statistical analysis. The final manuscript was approved by all the authors.

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Received December 21, 2011
Accepted after revision February 23, 2012