

Short Communication

Changes in the nutritional status of children and adolescents in Shandong, China

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Abstract

Objective: Nutritional status during childhood plays an important role in the human life cycle. The present study examined the prevalence trends in different grades of nutritional status (thinness, normal weight, overweight and obesity) among children and adolescents in Shandong, China.

Design: Data for the study were obtained from six cross-sectional surveys of schoolchildren carried out in 1985, 1995, 2000, 2005, 2010 and 2014. Height and weight of all children were measured; BMI was calculated from their height and weight. International BMI cut-offs were used to define thinness, overweight and obesity.

Setting: Shandong Province, China.

Subjects: A total of 56 045 students aged 7–18 years were included in the current analysis.

Results: In the past 29 years, the prevalence of thinness decreased from 18.22% and 23.45% in 1985 to 7.18% and 9.49% in 2014 for boys and girls, respectively. Conversely, the prevalence of combined overweight and obesity increased from 1.79% and 1.66% in 1985 to 31.12% and 20.11% in 2014 for boys and girls, respectively.

Conclusions: The nutritional profile of Shandong children and adolescents had an obvious change over the past 29 years. Special attention should be paid to controlling the rapid rise of childhood overweight and obesity.

Keywords
Thinness
Overweight
Obesity
Prevalence
Child and adolescent

Nutritional status during childhood plays an important role in the human life cycle. The importance of child growth as an indicator for tracking the nutritional and health status of populations is well recognized⁽¹⁾. Obesity and thinness are two of the most common nutritional disorders and both are associated with health consequences. Childhood obesity increases the risk of obesity in adulthood and is associated with CVD risk factors such as hypertension, diabetes and dyslipidaemia^(2–4). Thinness can also result in problems such as osteoporosis, pubertal delay, menstrual irregularity, increased susceptibility to infections, hypothermia, thinning hair and premature mortality^(5,6).

The worldwide prevalence of childhood overweight and obesity has increased dramatically during the past decades, both in developing and developed countries^(7–9). Recent reports indicate that the increase in childhood obesity is much more rapid in developing countries than in developed countries⁽¹⁰⁾. As a populous country, China has now joined the worldwide epidemic of obesity owing to its rapid economic growth and urbanization^(11,12). In the

present paper, based on provincial data in 1985, 1995, 2000, 2005, 2010 and 2014, we report the prevalence trends in different grades of nutritional status (thinness, normal weight, overweight and obesity) among children and adolescents in Shandong, China.

Participants and methods

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

Study population

Data for the present study were obtained from six national surveys on students' constitution and health carried out by the government in 1985, 1995, 2000, 2005, 2010 and 2014 in Shandong Province, China. A total of 56 045 students in Shandong Province of Han nationality, aged 7–18 years, were included in the current analysis (14 458 in 1985, 7198 in 1995, 8498 in 2000, 8568 in 2005, 7577 in 2010 and 9746

Table 1 The sample size in each survey of children and adolescents (*n* 56 045) aged 7–18 years, Shandong Province, China, 1985–2014

Age/years	Boys						Girls					
	1985	1995	2000	2005	2010	2014	1985	1995	2000	2005	2010	2014
7	612	300	318	344	316	419	612	300	357	343	302	427
8	612	300	361	371	318	406	612	300	364	362	323	381
9	612	300	331	357	305	422	612	300	334	359	315	412
10	612	300	395	377	320	413	612	300	376	388	325	405
11	612	300	376	354	301	416	612	299	379	366	317	407
12	611	300	337	362	340	397	612	300	326	343	303	386
13	611	300	363	355	305	410	612	300	361	365	308	411
14	612	300	325	350	305	398	612	300	323	324	320	388
15	612	300	368	363	314	420	612	300	370	340	328	401
16	612	300	372	371	306	423	612	300	353	359	305	415
17	612	300	363	386	310	412	612	300	324	352	306	403
18	612	300	358	343	343	396	384	299	364	334	342	378
Total	7342	3600	4267	4333	3783	4932	7116	3598	4231	4235	3794	4814

in 2014). The sample size of age groups in each survey is given in Table 1. The sampling method was stratified multistage sampling based on economic status, drawn from Jinan (the capital and the political, economic and cultural centre of Shandong Province), Yantai (an eastern coastal and developed city) and Jining (a western inland developing city) as survey areas, and using randomly selected primary and secondary schools; the sample proportions in these three areas in each survey were equal. Six public schools (two primary schools, two junior high schools and two senior high schools) from each of the three 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. Most importantly, the schools from which the students were sampled were selected by a leading group in Shandong Province and in general have not allowed change since 1985, and the method and quality control of measurements in the six surveys were the same⁽¹³⁾.

Anthropometric measurements and definitions

All measurements were performed by well-trained health professionals in each of the three districts using the same type of apparatus and following the same procedures⁽¹³⁾. Each professional is required to pass a training course for anthropometric measurement organized by the investigation team in Shandong. Height without shoes was measured using metal column height-measuring stands to the nearest 0.1 cm. Weight was measured using lever scales to the nearest 0.1 kg while the students wore light clothes. BMI was calculated from their height and weight (kg/m^2). The BMI cut-off points recommended by the International Obesity Task Force were used to define overweight and obesity⁽¹⁴⁾. Thinness was also defined by the international BMI cut-offs⁽¹⁵⁾.

Statistical analyses

The prevalence of thinness, overweight and obesity in different survey years was determined. The χ^2 test was

used to show significant differences between different years. All analyses were performed with the statistical software package SPSS version 11.5. Significance was defined at the 0.05 level.

Results

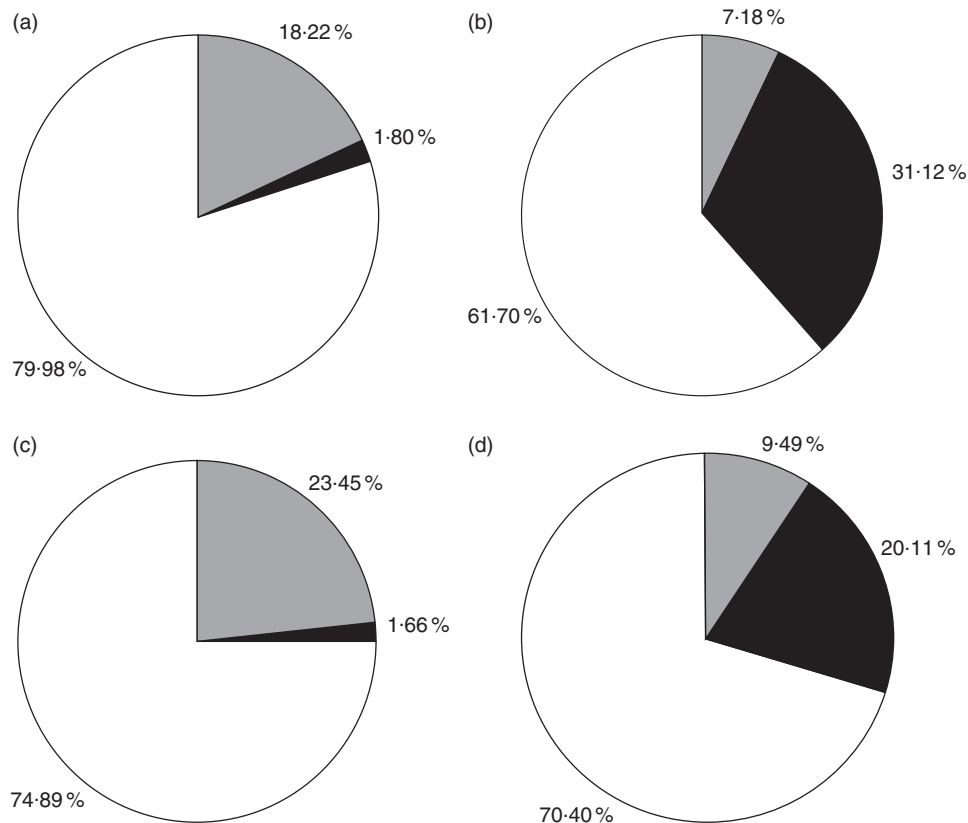
The prevalence of thinness, overweight and obesity among children and adolescents aged 7–18 years old in different years is shown in Table 2. A decreasing trend was observed in the prevalence of thinness, from 18.22% and 23.45% in 1985 to 7.18% and 9.49% in 2014 for boys and girls, respectively ($P < 0.01$). This represents a decrease of 11.04% in boys and 13.96% in girls. On the contrary, an increasing trend was observed in the prevalence of overweight and obesity. The prevalence of combined overweight and obesity increased from 1.79% and 1.66% in 1985 to 31.12% and 20.11% in 2014 for boys and girls, respectively ($P < 0.01$). This represents an increase of 29.32% in boys and 18.45% in girls. During the 29-year period, the nutritional profile of children and adolescents had an obvious change (Fig. 1). A decreasing trend was observed in the proportion of normal weight, from 79.98% and 74.89% in 1985 to 61.70% and 70.40% in 2014 for boys and girls, respectively. This represents a decrease of 18.28% in boys and 4.49% in girls.

Discussion

During the past decades, China has experienced rapid socio-economic and nutritional transitions, which have led to a more obesogenic environment (e.g. increase in energy intake and decrease in physical activity)⁽¹⁶⁾. The traditional Chinese diet is shifting towards a diet with high fat, high energy density and low dietary fibre^(17,18). To the best of our knowledge, the present study is the first examining the shifts in nutritional profile among children and adolescents in Shandong, China, spanning 29 years and using internationally agreed standards. Our results

Table 2 Prevalence of thinness, overweight and obesity, according to gender, among children and adolescents (*n* 56 045) aged 7–18 years, Shandong Province, China, 1985–2014

Gender	Year	<i>n</i>	Thinness		Overweight		Obesity	
			%	95 % CI	%	95 % CI	%	95 % CI
Boys	1985	7342	18.22	17.34, 19.10	1.74	1.44, 2.04	0.05	0.00, 0.10
	1995	3600	15.19	14.02, 16.36	6.50	5.69, 7.31	1.64	1.23, 2.05
	2000	4267	11.13	10.19, 12.07	14.41	13.36, 15.46	5.41	4.73, 6.09
	2005	4333	10.85	9.92, 11.78	15.79	14.70, 16.88	5.42	4.75, 6.09
	2010	3783	9.25	8.33, 10.17	19.06	17.81, 20.31	9.33	8.40, 10.26
	2014	4932	7.18	6.46, 7.90	20.76	19.63, 21.89	10.36	9.51, 11.21
			$\chi^2 = 425.98, P = 0.0000$		$\chi^2 = 1448.30, P = 0.0000$		$\chi^2 = 926.70, P = 0.0000$	
Girls	1985	7116	23.45	22.47, 24.43	1.62	1.33, 1.91	0.04	0.00, 0.09
	1995	3598	21.12	19.79, 22.45	4.28	3.62, 4.94	0.53	0.29, 0.77
	2000	4231	16.17	15.06, 17.28	9.00	8.14, 9.86	2.25	1.80, 2.70
	2005	4235	17.02	15.89, 18.15	9.66	8.77, 10.55	1.96	1.54, 2.38
	2010	3794	16.00	14.83, 17.17	13.42	12.34, 14.50	2.42	1.93, 2.91
	2014	4814	9.49	8.66, 10.32	15.77	14.74, 16.80	4.34	3.76, 4.92
			$\chi^2 = 430.26, P = 0.0000$		$\chi^2 = 982.00, P = 0.0000$		$\chi^2 = 346.43, P = 0.0000$	

**Fig. 1** Changes in nutritional status (□, normal weight; ▒, thinness; ■, overweight and obesity) of children and adolescents (*n* 56 045) aged 7–18 years, Shandong Province, China, 1985–2014: (a) boys, 1985; (b) boys, 2014; (c) girls, 1985; (d) girls, 2014

show a rapid increase of overweight and obesity and a decrease of thinness in both boys and girls between 1985 and 2014.

The increasing prevalence of childhood obesity constitutes a serious public health problem in both developed and developing countries. In Shandong Province, the prevalence of obesity was only 0.05% and 0.04% for boys and girls, and the prevalence of overweight was less than

2% in 1985, indicating no obesity epidemic at that time. However, the prevalence rates of obesity plus overweight had reached 31.12% for boys and 20.11% for girls in 2014, indicating that childhood overweight and obesity has entered the extensively epidemic stage in this region at present. The reasons include mainly high-energy diet and lifestyle change from being active to sedentary⁽⁹⁾. Comprehensive strategies of intervention should include

periodic monitoring and education on nutrition, physical exercise and healthy dietary behaviour⁽¹¹⁾.

The current study examined the shifts in nutritional profile among children and adolescents in Shandong, China spanning 29 years. However, two limitations are noted. First, data for the study were acquired from six independent cross-sectional surveys spanning 29 years rather than from a longitudinal cohort study, thus preventing further assessment of cohort and time effects. Second, the absence of detailed information concerning living environments, dietary patterns and physical activity at the individual level also limited our study.

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