Prevalence of grade 1, 2 and 3 thinness is associated with lower socio-economic status in children in Shanghai, China

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Abstract

Objective: We aimed to investigate the prevalence of grade 1, 2 and 3 thinness among Chinese children and to explore their associations with socio-economic status (SES).

Design: A population, school-based cross-sectional study using multistage, stratified cluster random sampling. Grade 1, 2 and 3 thinness, overweight, obesity and severe obesity were defined by the International Obesity Task Force BMI cut-offs.

Setting: Seven districts of Shanghai, China.

Subjects: Chinese children aged 3–12 years (*n* 84 075).

Results: In boys and girls, respectively, the prevalence of grade 1 thinness was 8·89 % and 11·78 %, of grade 2 thinness was 2·80 % and 3·74 %, and of grade 3 thinness was 2·23 % and 2·93 %. Compared with urban children, suburban children had higher prevalence of thinness. Children whose parent had low education had higher prevalence of grade 1, 2 and 3 thinness than those whose parent had high education. The prevalence of grade 2 and 3 thinness, obesity and severe obesity in low-SES children was higher than that in high-SES children, and the prevalence of grade 1 thinness was lower than that in high-SES children. Particular patterns of prevalence of grade 1, 2 and 3 thinness appeared in low-, middle- and high-SES children.

Conclusions: The study describes associations of SES with grade 1, 2 and 3 thinness, overweight, obesity and severe obesity in Shanghai children. The patterns of thinness and obesity in Shanghai provide further insights into BMI patterns in mega-cities in developing countries.

Childhood obesity is an important public health issue worldwide and a growing threat to child health[1]. However, childhood thinness has received relatively less attention and fewer studies have reported the prevalence of thinness. Childhood thinness is an important indicator of malnutrition or eating disorders, which may influence cognitive development and school performance[2,3]. A few studies in the UK[3], Australia[4,5], Haiti[2], Mexico[6], Nigeria[7], Pakistan[8] and India[9] have examined the issue of underweight or thinness. To our knowledge, one Chinese study has included a thinness outcome. That study in Shandong Province, China, found a double

burden of overweight and thinness among children and the overall prevalence of thinness was 9·78 % in boys and 15·07 % in girls[10]. However, Shanghai is a mega-city; it is quite different in social conditions, economic development, health policy and historical context compared with Shandong. In view of the lack of data, thinness is worthy of attention for Shanghai children.

The association between thinness and low socio-economic status (SES) has become less pronounced in China over the last few decades[11]. Children in low-SES families are more vulnerable to inadequate nutrition, with a greater intake of higher-energy foods and lower levels of physical activity. It is not common to find childhood obesity and malnutrition issues existing side by side[12].

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However, different studies have found positive, negative or no correlations between SES and obesity or thinness in children, thus it is difficult to draw general conclusions[13–16].

Several epidemiological studies have been carried out to assess the prevalence of overweight or obesity among Shanghai children[17–22], but there are few data about the prevalence of thinness in Chinese children. Here, we conducted a secondary analysis of data collected as part of a large cross-sectional survey of autism spectrum disorder to investigate the prevalence of grade 1, 2 and 3 thinness and the comprehensive distribution of thinness, overweight and obesity among 3–12-year-old children in Shanghai. We also explored whether SES is associated with BMI in children to understand the relationship of SES with thinness better. Such information is of value in formulating effective public health policies for child health.

Materials and methods

Study design and sample

The study was a population, school-based cross-sectional study; it was part of a governmental population survey of autism spectrum disorder. We conducted multistage, stratified cluster random sampling in 3–12-year-old children across Shanghai, China in June 2014. The seventeen districts of Shanghai were stratified into eight urban in the central area and nine suburban districts in suburban areas according to the geographical and social population distribution; people living in urban and suburban districts were defined urban and suburban residents. We randomly chose three urban districts (Yangpu, Xuhui, and Jing'an) and four suburban districts (Minhang, Pudong, Fengxian and Chongming) by a random number generator. Kindergartens and elementary schools were sampled randomly from a list of schools, and the number of students recruited was chosen according to the proportion of students in each selected administrative district to the total sampled districts. In total, 134 of 949 (14·12 %) kindergartens and seventy of 436 (16·06 %) elementary schools were sampled, and 84 075 of 576 621 (14·58 %) children were recruited. Our study used children's family social environment and growth questionnaires. Unified and trained teachers distributed questionnaires to students, asked students to take the questionnaire home and students' parents fill in the questionnaire. The teachers collected the completed questionnaires and then returned them to the investigator. Parents offered their child's information regarding age, sex, weight, height, family income, education levels, etc. in the questionnaire by self-report. Participants with complete weight and height data constituted the final sample.

Family income was collected in nine categories (<10 000, 10 000–30 000, 30 000–50 000, 50 000–100 000, 100 000–150 000, 150 000–200 000, 200 000–300 000, 300 000–500 000 and >500 000 Chinese Yuan); the number of missing values for family income was 1560 (2·15 %). SES was divided into low, middle and high levels according to total family income using cut-offs of 50 000 and 200 000 Chinese Yuan according to the definition of social science[23,24]. Most households comprised three persons, including two adults and one child according to the special Chinese family planning policy. Parental education was also collected, it was divided into three categories of low (illiterate, primary school and junior school), middle (high school, technical school and college) and high (undergraduate, master and doctor). Local residents were defined as those children born in Shanghai; children born in other provinces were considered the migration population.

Data entry and quality control

Data were inputted using EpiData 3·1 (EpiData Association, Odense, Denmark) and a logic error check was applied. We examined the consistency by randomly sampling 15 % of the questionnaires for repeat data entry to ensure inputted data were correct.

BMI was calculated as weight divided by the square of height (kg/m^2). The International Obesity Task Force definitions of thinness, overweight and obesity were used according to the centile curves of BMI cut-offs at age 18 years of respectively 18·5, 17·0 and 16·0 kg/m^2 for grades 1, 2 and 3 thinness, 25·0 kg/m^2 for overweight, 30·0 kg/m^2 for obesity and 35·0 kg/m^2 for severe obesity[25]; these provide age- and sex-specific cut-off points for children aged 2–18 years. Overweight excluded obesity, and obesity excluded severe obesity.

The questionnaires were unified and anonymous and the code for each child was independent and unique. Parents were given notification and information about the investigation at the beginning of the questionnaire, to reduce non-response bias. Teachers participating in the survey underwent training so that they could give detailed instructions for filling, distribution and collection of the questionnaires to reduce bias in the study. The study was approved by the Institutional Review Boards of the Shanghai Municipal Commission of Health and Family Planning.

Statistical analysis

The prevalence of thinness, overweight and obesity was calculated directly and the χ^2 test was performed to compare rates between boys and girls, urban and suburban groups, and low-, middle- and high-SES groups. In single variable logistic regression analysis, the odds ratio and 95 % confidence interval were determined to estimate the relative risk of thinness, overweight and obesity. Two-sided P values <0·05 were considered statistically significant. All analyses were conducted using the statistical software package IBM SPSS Statistics Version 21.

Results

In total 84 075 questionnaires were distributed, of which 81 384 completed questionnaires were returned, a response rate of 96·80 %. Complete data on weight and height were available for 72 349 children, including 38 550 boys and 33 799 girls aged 3–12 years.

Table 1 shows the prevalence of grade 1, 2 and 3 thinness according to age and sex. Overall, the prevalence of thinness was 13·92 % for boys and 18·45 % for girls; grade 1 thinness was present in 8·89 % of boys and 11·78 % of girls, grade 2 thinness in 2·80 % of boys and 3·74 % of girls, and grade 3 thinness occurred in 2·23 % of boys and 2·93 % of girls (all $P < 0.01$). Subtotal, the prevalence of grade 1, 2 and 3 thinness in boys aged 3–7 years was higher than in boys aged 7–12 years; however, the prevalence of grade 1 and 2 and total thinness in 3–7-year-old girls was lower than that in 7–12-year-old girls. There was an obvious variation in thinness by sex.

In total 44 034 children were local residents and the prevalence of thinness was 12·83 % for boys, 17·09 % for girls; 25 757 children belonged to the migration population and the prevalence of thinness was 15·50 % for boys, 21·18 % for girls. The prevalence of thinness in local residents was lower than that in the migration population for both boys and girls ($P < 0.01$). Our results revealed that the prevalence of thinness decreased with age in boys, especially grade 1 thinness, while thinness in girls showed a relatively smooth prevalence. There was generally a higher prevalence of thinness in girls above 5 years of age.

Overall, in suburban and urban areas respectively, the prevalence of grade 1 thinness was 10·18 % and 9·51 % (OR = 1·11; 95 % CI 1·09, 1·14), of grade 2 thinness was 3·32 % and 2·73 % (OR = 1·21; 95 % CI 1·09, 1·35) and of grade 3 thinness was 2·73 % and 1·92 % (OR = 1·42; 95 % CI 1·25, 1·61). Suburban children were more likely to be thin. Figure 1 shows histograms of the prevalence of grade 1, 2 and 3 thinness in boys and girls in the three urban and four suburban districts. The prevalence of grade 1 thinness in girls was significantly higher than that in boys in both urban and suburban districts (all $P < 0.01$). There was a significant sex difference in the prevalence of grade 2 thinness in some urban (Xuhui, $P = 0.02$) and suburban districts (Pudong, $P < 0.01$; Minhang, $P < 0.01$). For grade 3 thinness, there was a significant sex difference in prevalence in one urban district (Jin'an, $P < 0.01$) and three suburban districts (Pudong, $P < 0.01$; Minhang, $P < 0.01$; Fengxian, $P = 0.04$). There was a significant difference between overall urban and suburban districts in the prevalence of grade 1 thinness for boys ($P = 0.01$), grade 2 thinness for girls ($P < 0.01$) and grade 3 thinness for both boys and girls ($P < 0.05$); the prevalence of thinness in suburban districts was higher than that in urban districts.

In low-, middle- and high-SES boys (Fig. 2), the prevalence of grade 2 thinness (3·23 %, 2·68 %, 2·47 %), grade 3 thinness (2·96 %, 1·97 %, 1·81 %), obesity (5·99 %, 5·56 %, 4·32 %) and severe obesity (3·90 %, 3·01 %, 2·50 %) was higher in the low-SES group; however, the prevalence of grade 1 thinness (8·29 %, 8·92 %, 9·82 %), healthy weight (58·47 %, 60·37 %, 63·08 %) and overweight (17·16 %, 17·48 %, 16·00 %) was higher in high-SES group. The pattern was similar in girls (Fig. 3), except that the prevalence of overweight was higher in low SES and the trend of grade 2 thinness was not obvious. Low-SES children were more likely to have grade 2 or 3 thinness, overweight and obesity, while high-SES children were more likely to have grade 1 thinness ($P < 0.05$) both in boys and girls. In the logistic regression analysis (Table 2), the OR for thinness was higher in low SES. For example, low-SES boys were more likely to be thin than high-SES boys (grade 2 thinness: OR = 1·55, 95 % CI 1·27, 1·89; grade 3 thinness: OR = 2·10, 95 % CI 1·68, 2·63). Meanwhile, parental education was a clear and consistent correlate of grade 3 thinness for boys and girls and of grade 2 thinness for boys.

Discussion

The present paper describes a large, randomly sampled, population, school-based field survey of grade 1, 2 and 3 thinness, overweight, obesity and severe obesity in the mega-city of Shanghai. Our study uniquely provided the prevalence of thinness as 15·76 % for boys and 17·72 % for girls aged 3–6 years in Mainland China and gives a valuable insight into thinness and obesity issues in Shanghai children. The high prevalence of overweight, obesity, severe obesity and thinness within the same group of children suggests that Shanghai is currently in the midst of a nutritional transition as the proportion of grade 2 and 3 thinness in low-, middle- and high-SES children is higher than that of severe obesity for both boys and girls (Figs 2 and 3). Hardy *et al.* reported that the proportion of thinness in low, middle and high SES is lower than that of obesity in both boys and girls in an Australian population[26]. Our findings also provide evidence of substantial consistency in prevalence of thinness between urban and suburban districts, local and migrant populations, among low-, middle- and high-SES groups. The prevalence of thinness in local residents was lower than that in the migration population in both boys and girls, and the prevalence of thinness in urban districts was lower than that in suburban districts, because the proportions of local residents and high-SES children in urban districts are higher than those in suburban districts.

In our study, 16·04 % of Shanghai children were thin (13·92 % for boys, 18·45 % for girls). Based on the same International Obesity Task Force reference[27], Zhang *et al.* reported the prevalence of thinness to be 8·72 % in boys and 14·90 % in girls aged 7–12 years in Shandong Province[28]; these values are lower than the prevalence of

Table 1 Prevalence of thinness in boys and girls aged 3–12 years (n 72 349), Shanghai, China, June 2014

	Total sample		Grade 1 thinness					Grade 2 thinness					Grade 3 thinness					Total thinness			
	Boys	Girls	Boys		Girls			Boys		Girls			Boys		Girls			Boys		Girls	
	n	n	n	%	n	%	P§	n	%	n	%	P§	n	%	n	%	P§	n	%	n	%
Age group (years)																					
3·0–	122	135	16	13·11	17	12·59	0·90	3	2·46	2	1·48	0·57	3	2·46	4	2·96	0·80	22	18·03	23	17·04
3·5–	1057	950	135	12·77	117	12·32	0·76	53	5·01	34	3·58	0·11	35	3·31	37	3·89	0·48	223	21·10	188	19·79
4·0–	2228	2019	246	11·04	237	11·74	0·47	100	4·49	91	4·51	0·98	74	3·32	75	3·71	0·49	420	18·85	403	19·96
4·5–	2703	2377	304	11·25	287	12·07	0·36	67	2·48	89	3·74	0·01	87	3·22	79	3·32	0·83	458	16·94	455	19·14
5·0–	2337	2143	225	9·63	255	11·90	0·01	95	4·07	57	2·66	0·01	86	3·68	84	3·92	0·67	406	17·37	396	18·48
5·5–	2844	2425	287	10·09	298	12·29	0·01	67	2·36	83	3·42	0·02	57	2·00	70	2·89	0·04	411	14·45	451	18·60
6·0–	2504	2279	234	9·35	177	7·77	0·05	40	1·60	84	3·69	<0·01	55	2·20	63	2·76	0·21	329	13·14	324	14·22
6·5–	2560	2189	210	8·20	214	9·78	0·06	55	2·15	65	2·97	0·07	44	1·72	53	2·42	0·09	309	12·07	332	15·17
Subtotal	16 355	14 517	1657	10·13	1602	11·04	0·01	480	2·93	505	3·48	0·01	441	2·70	465	3·20	0·01	2578	15·76	2572	17·72
7·0–	2476	2082	201	8·12	225	10·81	<0·01	88	3·55	97	4·66	0·06	44	1·78	70	3·36	<0·01	333	13·45	392	18·83
7·5–	2587	2273	215	8·31	298	13·11	<0·01	65	2·51	83	3·65	0·02	55	2·13	74	3·26	0·01	335	12·95	455	20·02
8·0–	2515	2166	197	7·83	268	12·37	<0·01	74	2·94	92	4·25	0·02	76	3·02	59	2·72	0·54	347	13·80	419	19·34
8·5–	2817	2495	230	8·16	296	11·86	<0·01	74	2·63	79	3·17	0·24	73	2·59	60	2·40	0·66	377	13·38	435	17·43
9·0–	2368	2108	223	9·42	292	13·85	<0·01	70	2·96	82	3·89	0·09	40	1·69	67	3·18	<0·01	333	14·06	441	20·92
9·5–	2216	1882	159	7·18	250	13·28	<0·01	78	3·52	85	4·52	0·10	31	1·40	55	2·92	<0·01	268	12·09	390	20·72
10·0–	1897	1616	136	7·17	173	10·71	<0·01	47	2·48	86	5·32	<0·01	29	1·53	37	2·29	0·10	212	11·18	296	18·32
10·5–	2187	1891	165	7·54	247	13·06	<0·01	38	1·74	62	3·28	<0·01	35	1·60	49	2·59	0·03	238	10·88	358	18·93
11·0–	1809	1582	147	8·13	194	12·26	<0·01	45	2·49	48	3·03	0·33	17	0·94	31	1·96	0·01	209	11·55	273	17·26
11·5–	1323	1187	97	7·33	136	11·46	<0·01	22	1·66	46	3·88	<0·01	19	1·44	24	2·02	0·26	138	10·43	206	17·35
Subtotal	22 195	19 282	1770	7·97	2379	12·34	<0·01	601	2·71	760	3·94	<0·01	419	1·89	526	2·73	<0·01	2790	12·57	3665	19·01
Total	38 550	33 799	3427	8·89	3981	11·78	<0·01	1081	2·80	1265	3·74	<0·01	860	2·23	991	2·93	<0·01	5368	13·92	6237	18·45

§P value from χ^2 test comparing the prevalence in boys and girls.

Table 2 Association between urbanicity, socio-economic status, parental education and thinness in boys and girls aged 3–12 years (*n* 72 349), Shanghai China, June 2014

Sex	Factor	Category	*n*	%	Grade 1 thinness OR	Grade 1 thinness 95 % CI	Grade 2 thinness OR	Grade 2 thinness 95 % CI	Grade 3 thinness OR	Grade 3 thinness 95 % CI
Boys	District	Urban	8020	20·82	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Suburban	30 499	79·18	1·13*	1·04, 1·24	1·15	0·98, 1·34	1·32*	1·10, 1·58
	Family income	High	6037	16·00	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Middle	20 969	55·58	0·98	0·89, 1·08	1·18	0·98, 1·42	1·23	0·99, 1·52
		Low	10 720	28·42	0·98	0·87, 1·11	1·55*	1·27, 1·89	2·10*	1·68, 2·63
	Mother's education	High	9907	25·86	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Middle	15 091	39·38	1·07	0·97, 1·17	1·37*	1·16, 1·62	1·51*	1·24, 1·85
		Low	13 319	34·76	1·11*	1·01, 1·22	1·79*	1·52, 2·12	2·58*	2·12, 3·13
	Father's education	High	11 339	29·59	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Middle	15 316	39·96	1·03	0·95, 1·13	1·25*	1·07, 1·46	1·75*	1·44, 2·11
		Low	11 671	30·45	1·08	0·98, 1·18	1·58*	1·34, 1·86	2·81*	2·32, 3·40
Girls	District	Urban	7291	21·59	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Suburban	26 475	78·41	1·09*	1·01, 1·19	1·36*	1·17, 1·58	1·69*	1·41, 2·02
	Family income	High	5507	16·63	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Middle	18 515	55·90	0·95	0·88, 1·05	1·00	0·85, 1·18	1·20	0·99, 1·47
		Low	18 515	27·48	0·96	0·87, 1·07	1·17	0·98, 1·40	2·10*	1·68, 2·55
	Mother's education	High	9242	27·49	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Middle	13 823	41·12	1·02	0·94, 1·11	1·07	0·92, 1·23	1·47*	1·22, 1·77
		Low	10 553	31·39	1·10*	1·01, 1·21	1·27*	1·09, 1·47	2·88*	2·41, 3·45
	Father's education	High	10 499	31·23	1·00	Ref.	1·00	Ref.	1·00	Ref.
		Middle	13 827	41·17	0·96	0·88, 1·04	1·10	0·96, 1·26	1·42*	1·19, 1·69
		Low	9256	27·56	1·06	0·97, 1·16	1·20*	1·03, 1·40	2·96*	2·49, 3·52

Ref., reference category.
Model 1: univariate logistic regression, adjusted for age.
*Statistically significant: *P* < 0·05.
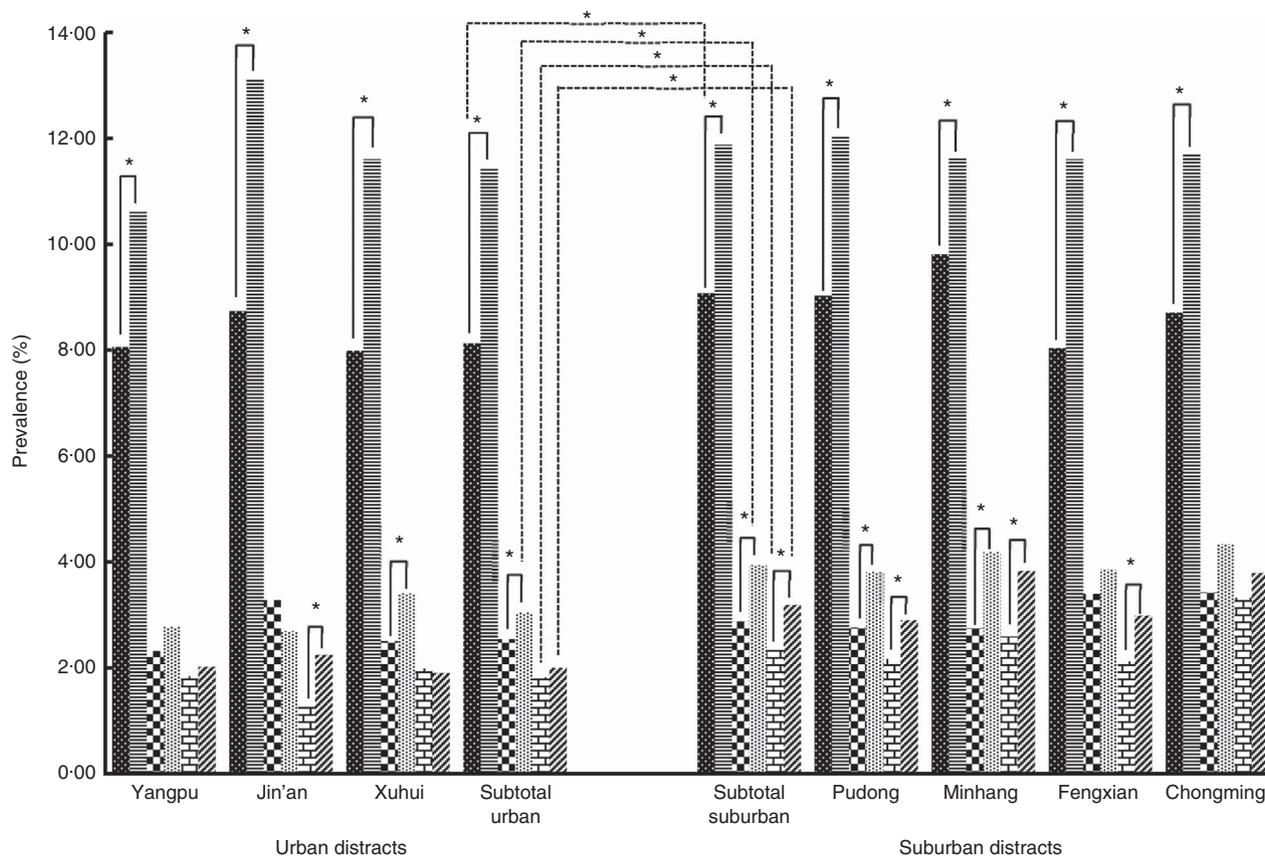
Fig. 1 Prevalence of grade 1, 2 and 3 thinness in boys and girls aged 3–12 years (n 72 349) from three urban districts (Yangpu, Jing'an, Xuhui) and four suburban districts (Pudong, Minhang, Fengxian, Chongming) in Shanghai, China, June 2014: ▓, boys with grade 1 thinness; ▤, girls with grade 1 thinness; ◨, boys with grade 2 thinness; ▦, girls with grade 2 thinness; ⊟, boys with grade 3 thinness; ▨, girls with grade 3 thinness. Subtotal urban and subtotal suburban represent mean prevalence of the above three urban and above four suburban districts, respectively. *Statistically significant difference in prevalence between boys and girls (χ^2 test): $P < 0.05$
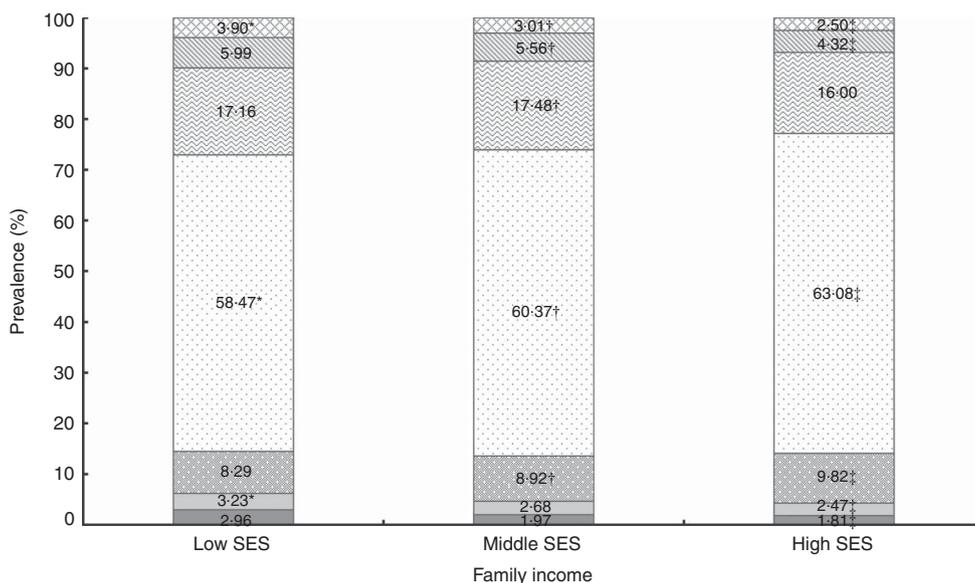
Fig. 2 Distribution of the prevalence of thinness, overweight and obesity in boys aged 3–12 years (n 38 550) of low, middle and high socio-economic status, Shanghai, June 2014: ▧, severe obesity; ▨, obesity; ▥, overweight; ⬚, healthy weight; ▨, grade 1 thinness; ▢, grade 2 thinness; ▨, grade 3 thinness. *Statistically significant difference in prevalence between low SES and middle SES (χ^2 test): $P < 0.05$; †statistically significant difference in prevalence between middle SES and high SES (χ^2 test): $P < 0.05$; ‡statistically significant difference in prevalence between low SES and high SES (χ^2 test): $P < 0.05$
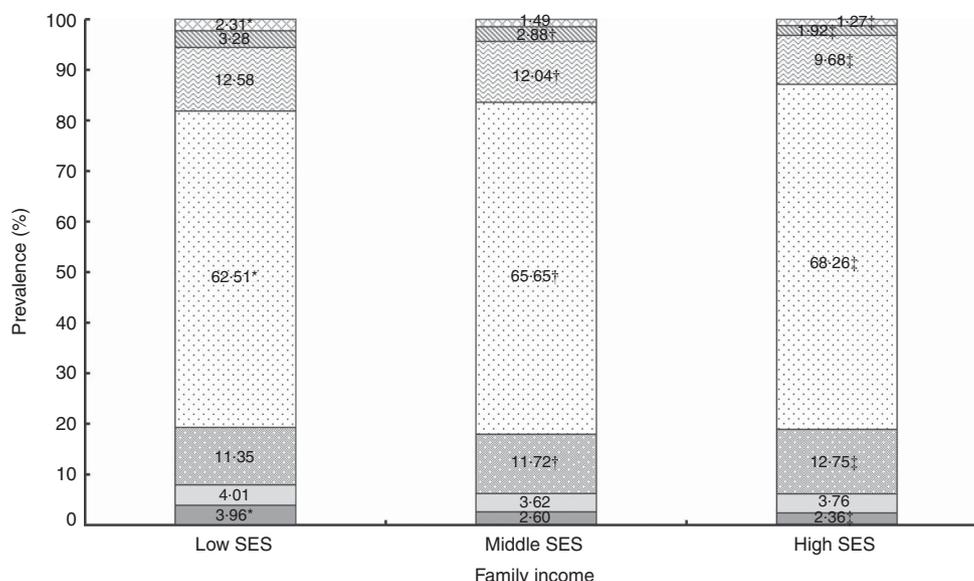
Fig. 3 Distribution of the prevalence of thinness, overweight and obesity in girls aged 3–12 years (*n* 33 799) of low, middle and high socio-economic status, Shanghai, June 2014: ▨, severe obesity; ▨, obesity; ▨, overweight; ▢, healthy weight; ▨, grade 1 thinness; ▢, grade 2 thinness; ▪, grade 3 thinness. *Statistically significant difference in prevalence between low SES and middle SES (χ^2 test): $P < 0.05$; †statistically significant difference in prevalence between middle SES and high SES (χ^2 test): $P < 0.05$; ‡statistically significant difference in prevalence between low SES and high SES (χ^2 test): $P < 0.05$

12·57 % for boys and 19·01 % for girls aged 7–12 years in present study, especially in grade 2 and 3 thinness (Table 1). The overall prevalence of thinness in our study (13·92 % for boys, 18·45 % for girls) is lower than values from Hong Kong[29] (16·7 % for boys, 22·3 % for girls), India[9] (58·30 % for total) and the Seychelles[30] (30·3 % for boys, 29·2 % for girls); and higher than values from Australia[4], the Netherlands[31], the UK[3], Nigeria[7], Cameroon[32] and Portugal[33]. The variation may be related to differences in race, rate of urbanization, socio-economic development and so forth.

The present study indicated that SES was significantly related to thinness in children. There was a particular SES pattern for thinness in both boys and girls. A significant negative association between SES level and prevalence of grade 3 thinness existed in our study, while SES level was positively associated with the prevalence of grade 1 thinness (Figs 2 and 3). Low-SES children were more likely to be overweight or obese than their higher-SES counterparts, and these findings were consistent with reports from Australia[4,13] but contrasted with reports from Shandong, China[14]. The discrepancy in the results may be related to differences in the proportion of urban population between Shanghai and Shandong and variations between districts in living standards, nutritional conditions and public health policies.

There was a higher risk of grade 2 thinness, grade 3 thinness and obesity in children living in lower-SES groups. People in high-SES groups or living in urban areas are more like to have higher intakes of energy, cholesterol, protein, total fat, SFA, PUFA and MUFA, and lower intakes of carbohydrates and fibre[34]. These dietary patterns, in conjunction with inadequate physical exercise, can result in sharp increases in childhood malnutrition issues. The present study suggests that thinness is a significant issue that is overlooked. As in some other developed and developing countries around the world, China faces a double burden of thinness and overweight arising from poor nutrition. The occurrence of thinness, overweight or obesity within the same group of children has been previously reported in countries undergoing nutritional transition[7,35,36]. Therefore, it is important to face the public health challenge posed by thinness. Special attention should be paid to controlling the tendency towards a polarization of nutritional status in children.

The strengths of our study include the following: (i) it was a large, representative, multistage proportional cluster sample of children aged 3–12 years; (ii) it found a particular pattern in grade 1, 2 and 3 thinness in different SES groups; (iii) it provided a comprehensive profile of the distribution of overall BMI status including grade 1, grade 2, grade 3 thinness, healthy weight, overweight, obesity and severe obesity in Shanghai; and (iv) it allowed us to explore the influence of SES, parental education and urban or suburban geography. However, some limitations should be acknowledged. First, data on children's height and weight from parental reports may be inaccurate. Second, the absence of sufficient and detailed information concerning dietary patterns, physical activity and socio-economic information at the individual level also limits our analysis. Factors related to both diet and socio-economics should be considered simultaneously in the exploration of thinness prevalence in future studies.

Conclusion

In conclusion, the present study found a higher prevalence of grade 2 and 3 thinness, obesity and severe obesity in children from low-SES groups and children living in suburban districts. The pattern of thinness and obesity in Shanghai provides further insights into BMI patterns in mega-cities in developing countries.

Acknowledgements

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