

## Short Communication

# Obesity prevalence and time trend among youngsters in China, 1982-2002

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Purpose of present study is to describe the prevalence and trend of overweight and obesity, as well as its co-existence with stunting, among youngsters in China, from 1982 to 2002. Data from children 7-17 years of age from three cross-sectional national surveys: "1982 China National Nutrition Survey" (5 334 boys and 4 793 girls), "1992 China National Nutrition Survey" (8 048 boys and 7 453 girls) and "2002 China National Nutrition and Health Survey" (23 242 boys and 21 638 girls) were used in this study. Overweight and obesity were defined according to age, sex specific BMI cut-off points from the International Obesity Task Force, while stunting was defined as height-for-age below -2 standard deviation from the NCHS/WHO reference median value. **Results:** Overweight prevalence of Chinese youngsters was 1.2%, 3.7% and 4.4%, while the obesity prevalence was 0.2%, 0.9% and 0.9% in 1982, 1992 and 2002, respectively. Both the overweight and obesity prevalence and their increment were higher among boys in urban areas. In 1982, 28.4% of overweight and 69.6% of obese youngsters were stunted, this decreased to 22.0% and 46.4% in 1992, and then to 5.7% and 7.7% in 2002, respectively. **Conclusion:** The prevalence of overweight and obesity in Chinese youngsters were low in 1982. There has been a rapid increase since then. If this trend continues, overweight will soon reach epidemic proportions. Stunting among overweight and obese youngsters decreased dramatically at the same time.

**Key Words:** Chinese youngsters, overweight, obesity, trend, stunting

## INTRODUCTION

During the past two decades, China has experienced rapid socio-economic and nutritional transitions. A 10-fold increase in the per capita gross domestic product paralleled an increase in energy-dense foods, a decrease in transport related physical activity and an increase in leisure time inactivity.<sup>1-6</sup> Average daily food intake from animal source increased from 61g in 1982 to 159g in 2002, cooking oil consumption increased by 10g each decade, while the cereal grains and vegetable intakes decreased more than twenty percent.<sup>2</sup> At the same time, television and car ownership increased remarkably, while public transport became more and more popular in China.<sup>1</sup>

With these rapid transitions, China is experiencing a double burden of malnutrition. Previous studies indicated that overweight and obesity prevalence among Chinese youngsters increased rapidly during the last two decades, but these were based on the data from only a few provinces in China.<sup>7,8</sup> The "National Surveys on Students Constitution and Health" routinely investigate the obesity prevalence in 31 provinces of China, but body weight was not measured in the fasting state, which will have decreased the accuracy of the obesity estimation.<sup>9</sup> So the purpose of current study is firstly to present national estimates of overweight and obesity prevalence for youngsters between 7 and 17 years in China, as well as its trends in the last 20 years.

The phenomenon of childhood obesity accompanied by stunting has been reported in developing countries as well as in developed countries, particularly in countries experiencing economic transition, where stunting remains a major problem, changes in incomes and eating practices lead to obesity at the same time. Popkin, Richards and Montiero found a significant association between stunting and overweight in children of Russia, Brazil, China and the Republic of South Africa.<sup>10</sup> The income-adjusted prevalence ratios of being overweight for a stunted children ranged from 1.7 to 7.8. Similar associations were also found among Chinese children under 5 years, the overweight prevalence increased less rapidly or even decreased when the prevalence of stunting decreased.<sup>11</sup> But no study had considered the co-existence of stunting when they reported the obesity prevalence and its trends among youngsters in China. These individuals with increased weight and shorter length need specific attention, especially from the side of public health. So, the second

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purpose of the present paper was to describe the phenomenon of co-existence of stunting and obesity, as well as its trends in the last 20 years.

## SUBJECTS AND METHODS

### *Sampling Procedure*

Three national surveys on nutrition were conducted respectively in 1982, 1992 and 2002, i.e. 1982 China National Nutrition Survey (1982 CNNS), 1992 China National Nutrition Survey (1992 CNNS) and 2002 China National Nutrition and Health Survey (2002 CNNHS).

The 1982 CNNS covered 25 provinces and three municipalities, all administrative units directly under the control of central government with the exception of Tibet.<sup>12</sup> A two-stage random sampling method was used to select the survey households. Four to 20 survey sites were chosen in each province/municipality proportional to its population size, and a cluster of 50 households were randomly sampled from each selected survey site. A total of 256 survey sites was finally chosen, including about 12,000 households and 71,000 individuals. In addition 546 institutional units covering 166,000 individuals were surveyed, including factories, schools, kindergartens, and governmental institutions etc.<sup>12</sup> The characteristics of the study population were compared with those of the 3rd National Population Census (1980), and no significant differences were found, indicating a good representation of the total population.<sup>13</sup>

Stratified multi-stage cluster random sampling method called the "8×2×2×30 program" was used in the 1992 CNNS. The primary unit was the "country/city", the secondary unit was the "township/district" and the tertiary unit was the "village/neighborhood". There were eight primary units sampled from each province, two secondary units from each primary unit, two tertiary units (study sites) from each secondary unit. Thirty two study sites were selected in each province and a total of 960 study sites were randomly selected. Thirty households were sampled from each study site as subjects of the survey. Finally, a total of 100 201 subjects aged 2 years and above from 28 000 households completed the survey.<sup>14</sup> The characteristics of the study population were compared with those of the 4th National Population Census, and no significant differences were found, thus indicating that it is representative of the whole population.<sup>15</sup>

The 2002 China National Nutrition and Health Survey is a nationally representative cross-sectional survey that covered 31 provinces, autonomous regions and the municipalities directly affiliated to the Central Government (Hong Kong, Macao and Taiwan were not included). Multistage cluster sampling method was used for subject selection. Stage 1: all the 2860 counties/districts/cities of China were divided into six areas (big cities, medium and small cities, rural 1, 2, 3 and 4) based on its type and the level of economic development (from high to low). Twenty-two counties/districts/cities from each area were randomly selected. A total of 132 counties/districts/cities were randomly selected at this Stage. Stage 2: three townships/sub-districts were randomly selected from each selected counties/districts/cities. A total of 396 townships/sub-districts was randomly selected at this Stage. Stage 3: two villages/neighborhood committees were randomly

selected from the selected townships/sub-districts. A total of 792 villages/neighborhood committees were randomly selected at this Stage. Stage 4: 90 households were randomly selected from each village/neighborhood, and finally, a total of 71 971 households were randomly selected to represent the national data.<sup>16</sup> The comparison of the characteristics of study population with the 5th National Population Census showed that the study population is representative for the whole population.<sup>17</sup>

Subjects from subgroups of the 1982 CNNS, 1992 CNNS and 2002 CNNHS, aged 7 to 17 years old, were included in the present study.

### *Anthropometrical measurement*

Fasting body weight was measured in the morning to the nearest 0.10 kg with a balance-beam scale while the subjects were wearing lightweight clothing. Height was measured to the nearest 0.1 cm using a standard steel strip stadiometer in bare footed subjects.

The estimation of the prevalence of overweight and obesity was based on cut-off points derived from international data, as recommended by the Childhood Obesity Working Group of the International Obesity Task Force.<sup>18</sup>

Stunting was defined as height-for-age below -2 standard deviation (Z-score) from the NCHS/WHO reference median value.<sup>19</sup>

The protocol of the survey was approved by the Ethical Committee of the National Institute for Nutrition and Food Safety, Chinese Center for Disease Control and Prevention. Signed consent forms were obtained from both the parents or guardians as well as the children themselves.

### *Statistical analysis*

Considering the sampling method of equal-sample-size of the six areas and the proportion difference between the sampling and whole population, the overweight and obesity prevalence in 2002 was weighted by the population proportion of six classified areas according to the data from the China Fifth National Population Census.<sup>1</sup> In order to adjust for the changes in age distribution across the surveys, estimates of overweight and obesity prevalence were age-adjusted, by the indirect method, to the sex specific age distribution of the Fifth National Population Census.<sup>1</sup> The proportion of stunted youngsters was calculated among the overweight and obese subjects. Trend estimates for urban and rural areas separately were available only for 1992 and 2002 because these surveys had similar urban/rural information. Cox regression analysis was used to estimate the Prevalence Ratios of overweight and obesity between boys and girls, as well as between urban and rural youngsters, where survival time is artificially set equal to 1.

## RESULTS

The sample size from the three national surveys is shown in Table 1.

### *Prevalence*

The prevalence of overweight and obesity of Chinese youngsters aged 7-17 years in 2002 was 4.4%, the obesity prevalence was 0.9% (Table 2). More boys and more

urban children tended to be overweight or obese than their respective counterparts. After adjusting for confusing factors including: family economic level, parents' educational level and careers, as well as relative effects of sex,

**Table 1.** Number and percentage of participants in sex and age groups by survey

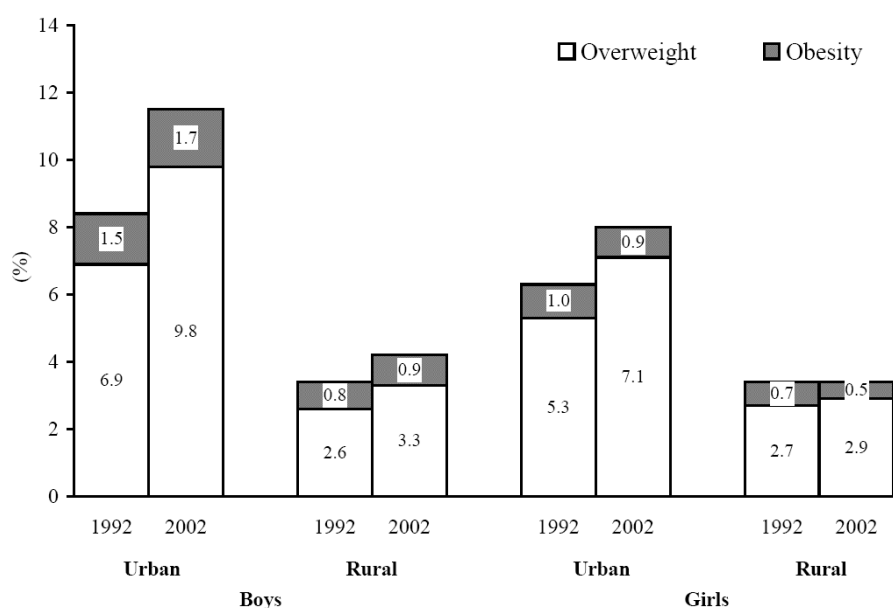
Age (yrs)	1982				1992				2002			
	Boys		Girls		Boys		Girls		Boys		Girls	
	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)
7-	138	2.6	147	3.1	801	10.0	730	9.8	2655	11.4	2444	11.3
8-	318	6.0	281	5.9	801	10.0	690	9.3	2705	11.6	2487	11.5
9-	322	6.0	359	7.5	784	9.7	690	9.3	2751	11.8	2566	11.9
10-	368	6.9	364	7.6	929	11.5	847	11.4	2727	11.7	2657	12.3
11-	364	6.8	387	8.1	770	9.6	651	8.7	2864	12.3	2745	12.7
12-	475	8.9	440	9.2	750	9.3	667	8.9	3013	13.0	2791	12.9
13-	448	8.4	418	8.7	763	9.5	701	9.4	1888	8.1	1689	7.8
14-	515	9.7	417	8.7	702	8.7	654	8.8	1592	6.8	1479	6.8
15-	477	8.9	504	10.5	605	7.5	622	8.3	1351	5.8	1274	5.9
16-	757	14.2	692	14.4	624	7.8	607	8.1	989	4.3	867	4.0
17-	1152	21.6	784	16.4	519	6.4	594	8.0	707	3.0	639	3.0
Total	5334	100.0	4793	100.0	8048	100.0	7453	100.0	23242	100.0	21638	100.0

**Table 2.** Overweight and obesity prevalence<sup>1,2</sup> among Chinese youngsters in 1982, 1992, 2002 (%)

Sex	Age (y)	Overweight			Obesity			Overweight and Obesity		
		1982	1992	2002	1982	1992	2002	1982	1992	2002
Boy	7-12	1.7	3.9	5.0	0.3	1.5	1.4	2.0	5.4	6.5
	13-17	0.5	3.7	4.6	0.1	0.4	0.7	0.7	4.1	5.3
	Total	1.1	3.8	4.9	0.2	1.0	1.1	1.4	4.8	5.9
Girl	7-12	1.3	3.9	3.3	0.2	1.4	0.7	1.5	5.3	4.0
	13-17	1.2	3.0	4.6	0.0	0.1	0.5	1.3	3.1	5.2
	Total	1.3	3.5	3.9	0.1	0.8	0.6	1.4	4.3	4.5
Total	7-12	1.5	3.9	4.2	0.2	1.4	1.1	1.7	5.4	5.3
	13-17	0.8	3.4	4.6	0.1	0.2	0.6	0.9	3.6	5.2
	Total	1.2	3.7	4.4	0.2	0.9	0.9	1.3	4.4	5.2

<sup>1</sup> Overweight and obesity defined using International Obesity Task Force standards;<sup>18</sup>

<sup>2</sup> The prevalence was age standardized according to the Fifth National Population Census.<sup>1</sup>



**Figure 1.** Comparison between 1992 and 2002 of overweight and obesity among Chinese youngsters aged 7-17 years, by urban and rural.

<sup>1</sup> Overweight and obesity defined using International Obesity Task Force standards;<sup>18</sup>

<sup>2</sup> Prevalence was age standardized according to the Fifth National Population Census.<sup>1</sup>

**Table 3.** Stunting<sup>1</sup> proportion (%) among overweight and obese<sup>2</sup> youngsters

Sex	Age (y)	Among normal weight youngsters (%)				Among overweight youngsters (%)				Among obese youngsters (%)			
		Urban		Rural		Urban		Rural		Urban		Rural	
		1992	2002	1992	2002	1992	2002	1992	2002	1992	2002	1992	2002
Boy	7-12	15.7	4.6	33.9	19.4	10.8	1.9	34.8	10.3	34.7	1.9	56.3	20.4
	13-17	17.8	10.4	35.9	25.1	2.9	4.0	23.9	15.4	21.4	2.3	50.0	16.3
	Total	16.6	5.5	34.7	21.5	7.6	2.2	30.8	12.2	31.7	1.9	55.4	19.4
Girl	7-12	15.7	4.8	35.7	21.4	17.0	2.6	42.3	8.4	36.1	3.5	57.7	27.7
	13-17	14.9	8.8	27.8	21.3	16.3	7.8	21.6	15.3	40.0	14.3	50.0	17.9
	Total	15.3	5.4	32.3	21.4	16.7	3.5	30.8	12.3	36.4	4.4	57.0	25.0
Total	7-12	15.7	4.7	34.7	20.4	12.9	2.2	37.6	9.6	35.5	2.5	57.0	23.1
	13-17	16.3	9.6	31.9	23.3	8.5	5.8	22.6	15.3	26.3	7.6	50.0	17.0
	Total	16.0	5.5	33.6	21.5	11.0	2.7	30.8	12.2	34.1	2.9	56.2	21.6

<sup>1</sup>The subjects whose height-for-age z scores were less than -2 according to CDC/WHO 1978 reference;

<sup>2</sup>Overweight and obesity defined using International Obesity Task Force standards;<sup>18</sup>

living areas and age, the adjusted overweight and obese prevalence ratio of boys to girls was 1.5 and the urban to rural was 2.5, respectively.

### Trends

Trends of the overweight and obesity prevalence from 1982 to 2002 are shown in Table 2. The age standardized prevalence of overweight and obesity increased three fold in 20 years. Age-standardized prevalence of obesity among boys increased from 0.2% in 1982 to 1.0% in 1992, and continued to 1.1% in 2002. Among girls, a remarkable increase of obesity prevalence was found from 1982 to 1992, but not between 1992 and 2002. The obesity prevalence decreased from 1.4% in 1992 to 0.7% in 2002 for girls aged 7-12 years, while the rate increased from 0.1% to 0.5% for girls aged 13-17 in the same period (Table 2).

Among urban youngsters, from 1992 to 2002, the overweight prevalence increased by 38% and obesity by 5%, among those living in rural areas, the overweight prevalence increased by 17%, while the obesity prevalence decreased by 7%. Separate by gender, increasing trends were found among boys with regard to both overweight and obesity prevalence and in both urban and rural areas. The largest increase with regard to overweight was 42%, found in urban boys, while the least was in rural girls (Figure 1). The trends of obesity prevalence has increased among boys and decreased among girls, especially among rural girls.

### Co-existence of stunting and obesity

The percentage of stunted youngsters among the overweight youngsters was 28.4%, 22.0% and 5.7% in 1982, 1992 and 2002, respectively. Among the obese youngsters it was 69.6%, 46.4% and 7.7% in 1982, 1992 and 2002, respectively.

The percentage of stunted youngsters among the overweight and obese in urban and rural areas was compared in Table 3. In 1992, 34.1% of the obese youngsters in urban areas were stunted and 56.2% in rural areas. This decreased dramatically from 1992 to 2002. In 2002, 2.9% of obese youngsters in urban area were stunted, while in rural areas it was 21.6%. In 1992, among overweight and obese subjects, stunting was more frequent among 7-12

years olds than 13-17 years olds, while in 2002, it was the reverse.

### DISCUSSION

The results of the present study provide compelling evidence for a strong increase in overweight and obesity prevalence among youngsters in China. Not being a problem in the 1980's, the overall overweight prevalence reached 4.4% while obesity prevalence reached 0.9% in 2002. This increase was higher: in boys than in girls, and in urban than in rural areas.

The prevalence and trend of childhood obesity could be compared to other studies in China. The "National Surveys on Students Constitution and Health (CNSSCH)" investigated the physical status and fitness of students in 31 provinces of China, excluding school-age children not going to school.<sup>9</sup> The obesity prevalence estimated by the 2000 CNSSCH using Chinese standard was 4.4% and 1.5% for urban and rural boys, 2.3% and 1.0% for urban and rural girls, which was similar to our results.<sup>9</sup> The "China Health and Nutrition Survey" is a longitudinal study in eight provinces, that confirms the results of our cross sectional comparisons.<sup>9</sup> The increase in the childhood obesity prevalence was of a similar magnitude.

Compared to other countries, the overweight and obesity prevalence in 2002 were still relatively low in China. As defined by the IOTF standards, the overweight (including obesity) prevalence of Chinese youngsters was 5.3% (9.7% in urban and 3.8% in rural), while it was more than 30% in the USA and almost 20% in Europe.<sup>20</sup> Nevertheless, the estimated absolute total number of overweight youngsters based on IOTF standards was 12 million in China. Compared to the latest estimates from the report by Lobstein, one in 10 children worldwide is overweight, a total of 155 million,<sup>21</sup> which means that 1 in 13 overweight children worldwide is living in China.

The present study found a decreasing trend of obesity prevalence among younger children from 1992 to 2002, which may be due to a prevalence of stunting. The same trend was also found in children under 5 years in China.<sup>11</sup> The overweight prevalence among Chinese children under 5 years was 1.7% in 1990, which rapidly rose to 11.1% in 1995, but decreased to 4.2% in 1998 and 3.1% in 2000. The association with increased weight and a

shorter length is thought to be due to a changed hormonal response in combination with a poor diet, rich in carbohydrates and low in protein, which resulted in the failure of linear growth.<sup>22,23</sup> When stunted children are faced with a higher-energy dense, higher fat diet, weight gain will coincide with sub-optimal linear growth.<sup>22-27</sup> Previous studies suggested that fat metabolism of stunted children was impaired to an extent that might lead to increased obesity and other metabolic shifts.<sup>26,28</sup> Energy intake per kilogram body weight and fasting respiratory quotient was significantly higher, while the resting metabolic rate and fasting fat oxidation were significantly lower in the stunted children compared with the control children, leading to obesity in at risk populations.<sup>25,26,28</sup> From 1982 to 1992, the overweight and obesity prevalence increased rapidly, partly due to the rapid increase in body weight and less rapid increase in height (high stunting prevalence). While from 1992 to 2002, the stunted proportion among overweight and obese youngsters decreased rapidly, so the increasing trend of childhood obesity was not as quick as the previous decade, and even decreased among the younger children. The average increment of height from 1992 to 2002 was 3.4-3.9cm and 2.0-3.3cm in youngster aged 7-12 y and 13-17y, respectively.<sup>29</sup>

The strength of our data is that all three surveys are nationally representative. Both the fasting body weight and height of a large number of children were measured by trained investigators. In order to estimate the reproducibility, body weight of 2396 subjects and height of 2418 subjects in 2002 CNNHS were measured twice by different investigators. A high correlation was found between the two measurements (Weight:  $r=0.98$ ,  $p<0.01$ ; Height:  $r=0.99$ ,  $p<0.01$ ). The coefficients of variation between two measurements were 0.17% for weight and 0.12% for height. Detailed information about quality control were given elsewhere.<sup>30</sup> The most important problem is the comparability of the measurements over time since the different surveys spanned a period of 20 years. In order to minimize this problem, the training programs for the investigators were kept similar, and measurements were all carried out with same type of scales, organized by the same institute. Unfortunately, there was no exact record about the participation rate of individuals. Among the 792 villages/neighborhood committees randomly selected, 65 (8.2%) refused to participate in 2002 CNNHS. In such cases, another village/neighborhood committee was randomly chosen from the remaining ones.<sup>30</sup> According to the investigators who carry out the measurements in 2002, once the village/neighborhood committee decided to participate, the individual response rate was always more than ninety percent. In 1982 and 1992, it is expected to have been even more.<sup>30</sup>

In conclusion, obesity is an increasing problem among youngsters in China, especially in urban areas, although prevalence is still lower than in developed countries. The prevalence of overweight and obesity increased remarkably from 1992, continued to increase until 2002 and is expected to rise further. The stunting prevalence among overweight and obese youngsters decreased dramatically at the same period. This implies that 'simple and well-designed intervention studies in obese children and ado-

lescents, which can be transferred into usual clinical practice' are urgently needed in China.<sup>31</sup>

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#### AUTHOR DISCLOSURES

Yanping Li, Evert G Schouten, Xiaoqi Hu, Zhaohui Cui, Dechun Luan and Guansheng Ma, no conflicts of interest.

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## Short Communication

**Obesity prevalence and time trend among youngsters in China, 1982-2002**

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**中国儿童肥胖率及 1982-2002 年间变化趋势**

为了了解中国 7-17 岁儿童超重肥胖现况及其过去二十年间的变化趋势，以及超重肥胖儿童中生长迟缓者所占的比例，利用三个有全国代表性的营养调查，即 1982 年中国营养调查（男孩 5,334 人；女孩 4,793 人）、1992 年中国营养调查（男孩 8,048 人；女孩 7,453 人）和 2002 年中国居民营养与健康状况调查（男孩 23,242 人；女孩 21,638 人）数据进行分析。根据国际肥胖工作组推荐的年龄别性别体质指数标准定义儿童超重和肥胖，生长迟缓定义为身高低于 NCHS/WHO Z 评分标准的 2 个标准差。结果表明，1982、1992 和 2002 年我国 7-17 岁儿童超重率分别为 1.2%、3.7% 和 4.4%，肥胖率分别为 0.2%、0.9% 和 0.9%。城市男孩的超重肥胖率及其增长均最高。1982 年有 28.4% 的超重儿童同时生长迟缓（身高发育不足），肥胖儿童中该比例更高，达到 69.6%。1992 年超重和肥胖儿童中合并生长迟缓的比例分别为 22.0% 和 46.4%，到 2002 年，这两个比例分别降到 5.7% 和 7.7%。本研究认为虽然 1982 年中国儿童肥胖尚不成问题，但从 1992 年迅速上升。同时，生长迟缓性肥胖在肥胖儿童中的比例逐渐下降。

关键字：中国儿童、超重、肥胖、变化趋势、生长迟缓。