

## Short Communication

# Dietary habits and overweight/obesity in adolescents in Xi'an City, China

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This study explored the association between dietary habits and overweight and obesity in adolescents from Xi'an City, China. A cross-sectional sample of 1804 adolescents was recruited in 2004 from 30 junior high schools in six districts of Xi'an City, northwest China. Weight and height was measured and eating habits assessed using a self-administered questionnaire. Logistic regression was used to identify dietary patterns associated with overweight and obesity and adjusted for socio-demographic factors. Consumption of foods and beverages outside three main meals, and potato chips was more popular in boys than in girls, while girls consumed more fried food and soft drinks than boys. In boys, an increased consumption of soft drinks was associated with increased risk of overweight and obesity (1100 mL/day, OR: 1.9, 95% CI: 1.1-3.8), while consuming preserved fruit was associated with decreased risk (OR: 0.6, 95% CI: 0.5-0.9). In girls, having breakfast outside the home (OR: 1.7, 95% CI: 1.1-2.3) and an increased consumption of energy-dense foods (OR: 1.7, 95% CI: 1.04-2.9), was associated with increased risk of overweight and obesity, while frequently having foods and beverages outside the three main meals (OR: 0.6, 95% CI: 0.4-0.9) was associated with decreased risk. The consumption of breakfast outside the home, soft drinks and energy-dense fast foods were positively associated with overweight and obesity in adolescents. Future health education programs to prevent excess weight gain should target such unhealthy eating habits.

**Key Words:** dietary habits, adolescents, overweight and obesity, cross-sectional, China

## INTRODUCTION

Rapid shifts in the diets of the Chinese people have accompanied recent economic progress and environmental changes.<sup>1</sup> People are exposed to a wider variety of foods, including Western fast foods that are increasingly consumed, especially in urban areas.<sup>2</sup> The results of the 2002 China Health and Nutrition Survey showed large increases in fat and protein intakes and a decrease in fibre intake over the past two decades.<sup>1</sup> As a result, overweight and obesity and other diet-related, non-communicable diseases have become a major public health concern in cities.<sup>1</sup>

Dietary habits and their association with overweight and obesity have been studied in children in Western countries.<sup>3-5</sup> The identification of dietary patterns associated with obesity has aided the development of interventions to prevent excess weight gain via modification of unhealthy behaviours, for example nutrition education that targets soft drink consumption.<sup>6</sup>

A cross-sectional survey of adolescents in Xi'an City, northwest China, in 2004 demonstrated that the overall prevalence of overweight and obesity had reached 16%, based on the International Obesity Task Force (IOTF) BMI cut-offs.<sup>7</sup> More information about the dietary patterns of this urban adolescent population is required to plan effective interventions to prevent a further increase in adiposity. The aim of this study was to describe the eating habits of this sample of Chinese adolescents and to

identify which dietary patterns are associated with overweight and obesity.

## MATERIALS AND METHODS

### Study population

A total of 1804 adolescents aged 11-17 years attending junior high schools in six districts in Xi'an City were enrolled in this study in 2004. A multistage cluster sampling method was used, where 30 schools were selected proportionate to school population size from a frame of all junior high schools in the city. In each selected school, one class out of each grade was randomly chosen and from each class 20 students were selected using systematic random sampling.

Consent was sought hierarchically from: the Municipal Education Department, the district school health division, the school principal, as well as from the participants and their parents. Survey measurements were only taken from those children who agreed to participate in the study and

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whose parents had signed consent forms. The study protocol was approved by the Human Research Ethics Committee at the University of Newcastle and the Ethical Committee in Medical Research at Xi'an Jiaotong University.

### Measurements

Information about dietary habits was obtained using a self-administered questionnaire based on the US NHANES III study (DIET BEHAVIOR and NUTRITION-DBQ)<sup>8</sup> but modified for the local food culture of Xi'an City. For example, the food item "desserts" in the original questionnaire was deleted as Western desserts are not eaten in China. Focus group discussions, expert panel meetings at Xi'an Jiaotong University and a pilot study were conducted to discuss such changes and to test the wording of the translated questionnaire. The questionnaire consisted of 19 pre-coded topics that included the usual venues for eating the three main meals of the day, the frequency of eating at home or outside the home, the usual frequency of having foods and beverages such as Western fast food (KFC and McDonalds) and local fast food (beef and mutton soup), soft drinks, fruits, preserved fruits, sweets and chocolates, having foods and beverages outside the three main meals, and being selective about food (defined as only eating favourite foods and not eating foods that are disliked).<sup>9</sup> Respondents were asked to select an answer that most appropriately described their dietary habits.

Socio-economic information was collected from consenting parents of the participants using a self-administered questionnaire that included questions on parental education and occupation and an inventory of household assets for computing a wealth index.

Children's height and weight were measured during May to November in 2004 by trained field workers using standard methods,<sup>10</sup> as previously described.<sup>7</sup> Briefly, height without shoes was measured and was recorded to the nearest 0.1cm. Body weight was measured without shoes but with underwear in summer or light clothes in autumn to the nearest 0.1kg. Parental self-reported weight and height were also recorded.

### Data analysis

Data was entered using EpiInfo 3.2 and checked and cleaned before analysis using STATA 9 where the "svy" commands were used to adjust for sampling design by employing Taylor linearized variance estimation. Chi-square tests were used to compare the dietary habits of boys vs girls. Backward stepwise multivariate logistic regression was used to identify dietary factors associated with overweight and obesity, adjusted by associated socio-economic factors and parental BMI.

Overweight and obesity were defined using the IOTF age- and gender- specific BMI cut-offs.<sup>11</sup> The outcome variable of the regression analysis was combined overweight and obesity, while independent variables were dietary factors and socio-economic factors. Odds ratios (ORs) and 95% confidence intervals (CIs) of significant variables were calculated.

## RESULTS

Among the 1804 students invited to join the survey, 1792 (99%) agreed to participate and had their height and weight recorded, 1768 parents completed the socio-economic information and reported their height and weight and 1774 adolescents completed the dietary questionnaire. There were 899 male students (50.2%) and 893 females. The mean age of the participants was 13.9 (SD  $\pm$  1.0) years, ranging from 11.1 to 17.1 years. The overall prevalence of overweight and obesity combined was 16.3% (12.7% overweight). Overweight and obesity was more prevalent in boys than in girls (19.4% vs 13.2%,  $p < 0.05$ ). Overweight and obesity was significantly associated with socioeconomic status such as parental education, residence, and household wealth in this population. For example, adolescents from wealthier families had a higher prevalence of overweight/obesity compared with those from less wealthy families (22.4% in the top tertile of wealth, 15.9% in the middle, and 10.7% in the low wealth category,  $p < 0.01$ ).<sup>7</sup>

A total of 1661 (93%) adolescents usually have breakfast, with half eating it outside the home. Nine hundred and eighty-three (55%) adolescents consumed food and beverage outside three main meals at least once during a usual day, most frequently in the afternoon. Fifty-two percent of adolescents consumed soft drinks at least once a day, of which 86% had more than a bottle (550ml) daily. Adolescents usually consumed ice cream more frequently than soft drinks (1.3 times/week (95% CI: 1.1-1.3) for ice cream vs 1.2 times/week (95% CI: 1.2-1.4) for soft drinks,  $p = 0.049$ ), while soft drinks were more frequently consumed than fruit and vegetable juice (1.2 times/week (95% CI: 1.1-1.3) vs 1.1 times/week (95% CI: 1.01-1.2),  $p = 0.04$ ).

Boys had foods such as potato chips between meals more frequently than girls. Girls consumed fried foods more frequently and drank larger amounts of soft drinks than boys. More girls tended to add sugar to foods and ate local energy-dense food more frequently than boys. A higher percentage of girls reported eating Western fast food than boys. All these gender differences were statistically significant (Table 1).

Table 2 compares the percentage of overweight and obesity by dietary pattern. A higher prevalence of overweight and obesity was found in those skipping breakfast and consuming more soft drinks and Western and local fast foods. In comparison, those frequently consuming foods outside main meals, consuming sweets or preserved fruits or being selective about foods were less likely to be overweight and obese. These patterns were all statistically significant between subgroups.

Dietary patterns associated with overweight and obesity varied between boys and girls. More overweight and obese boys skipped breakfast, whereas a higher percentage of overweight and obese girls ate breakfast outside their home. Boys were more likely to be overweight and obese if they ate Western fast food more frequently or if they were not selective about their foods. In girls, a higher percentage of overweight and obesity was found amongst those who consumed beef and mutton soup more frequently, but those who consumed sweets and chocolates more frequently were less likely to be overweight

**Table 1.** Dietary patterns by gender in adolescents, Xi'an City, 2004

Dietary factor	n	Male		Female	
		% <sup>†</sup>	95% CI	% <sup>†</sup>	95% CI
Frequency of breakfast outside home (times/week) *					
None	495	30.9	27.9-34.0	25.4	22.5-28.3
1-2	409	23.2	20.4-26.0	23.3	20.4-26.1
3-4	405	22.5	19.7-25.3	23.5	21.7-26.3
≥5	452	23.4	20.6-26.2	27.8	24.9-30.8
Frequency of consuming food outside 3 main meals (times/day) *					
None	303	12.7	10.9-14.8	21.8	18.8-25.0
<1	485	27.7	24.7-30.8	27.3	23.9-30.9
1-3	739	45.6	42.0-49.2	37.9	33.8-42.3
>4	240	14.1	11.1-17.6	13.1	10.6-16.0
Frequency of fried foods (times/week) *					
<1	795	48.9	45.6-52.2	41.0	33.7-44.3
1-3	785	42.5	39.2-45.8	46.5	43.2-49.8
>4	185	8.6	6.8-10.5	12.5	10.3-14.7
Frequency of potato chips (times/week) *					
None	998	52.6	49.3-55.9	61.0	57.8-64.3
1-3	604	36.8	33.6-40.0	31.3	28.2-34.4
>4	160	10.6	8.6-12.7	7.7	5.9-9.4
Frequency of Western fast foods (times/month) *					
<1	1386	82.7	80.1-85.2	78.6	75.8-81.3
>1	334	17.3	14.8-19.9	21.5	18.7-24.2
Frequency of mutton and beef soup *					
None	481	36.6	33.2-40.1	27.7	24.4-30.9
<1/month	630	42.0	38.4-45.5	42.5	38.9-46.0
1-3/month	285	17.0	14.3-19.7	20.9	18.0-23.8
>1/week	100	4.4	2.9-5.9	9.0	6.9-11.0
Usual amount of soft drink (ml/day) *					
0	852	51.8	48.5-55.1	42.4	39.1-45.6
1-550	602	17.9	15.4-20.5	20.5	17.8-23.2
551-1100	211	16.6	14.1-19.0	21.2	18.5-23.9
> 1100	127	13.7	11.4-16.0	16.0	13.6-18.4
Add sugar to foods *					
Yes	738	38.9	35.6-42.1	44.8	41.5-48.1
No	1027	61.1	57.9-64.4	55.2	51.9-58.5
Selective about food **					
Yes	977	58.0	54.3-61.6	53.8	50.7-56.8
No	782	42.0	38.4-45.7	46.2	43.2-49.3

\* Chi-square test shows  $p < 0.05$

<sup>†</sup>The proportion of boys vs girls by dietary habits

<sup>‡</sup>Selective about food defined as selectively eating favourite foods and avoiding other foods<sup>9</sup>

and obese. These patterns were all statistically significant between subgroups.

Table 3 shows the ORs of dietary factors associated with overweight and obesity, after adjustment for significant socio-demographic factors (age, gender, residence and household wealth index) and parental BMI. In the overall sample, having one bottle of soft drink a day increased the risk of overweight and obesity by 50% (OR: 1.5, 95% CI: 1.2-2.4) and in an apparent dose-response pattern, having two bottles a day increased the risk of overweight and obesity by 70% (OR: 1.7, 95% CI: 1.1-2.7). Adolescents who were not selective about the foods they consumed were 1.5 times (95% CI: 1.1-2.0) more likely to be overweight and obese. Those consuming preserved fruit were 40% less likely to be overweight and obese (OR: 0.6, 95% CI: 0.5-0.9).

Dietary factors associated with overweight and obesity in boys differed from those for girls. In boys, a daily intake of more than two bottles of soft drink was associated with an increased risk of overweight and obesity by 90%. Not being selective about food increased the risk of

overweight and obesity by 60% (OR: 1.6; 95% CI: 1.1-2.4) and consuming preserved fruit was associated with decreased risk of overweight and obesity by 40% (OR: 0.6; 95% CI: 0.4-0.8). In girls, consuming breakfast outside the home (OR: 1.7, 95% CI: 1.1-2.3) and an increased consumption of energy-dense foods (OR: 1.7, 95% CI: 1.04-2.9), was associated with increased risk of overweight and obesity, while frequent consumption of foods and beverages outside main meals (OR: 0.6, 95% CI: 0.4-0.9) was associated with decreased risk of overweight and obesity. Girls consuming sweets and chocolates were 50% less likely to be overweight and obese compared to those who did not (OR: 0.5, 95% CI: 0.3-0.8).

## DISCUSSION

This is the first reported assessment of dietary habits in adolescents in Xi'an City. In this study, dietary patterns varied significantly between boys and girls. Some dietary habits, such as consuming breakfast outside the home, increased consumption of soft drinks, frequent consumption of energy-dense food, snacking, being selective about

**Table 2.** Percentage of overweight/obesity<sup>†</sup> and dietary habits in adolescents, Xi'an City, 2004

Dietary factor	Overall			Male		Female	
	n/N <sup>‡</sup>	%	95% CI	%	95% CI	%	95% CI
Skipping breakfast usually *							
No	265/1655	16.0	13.6-18.6	18.6	15.4-22.2	13.4	10.7-16.5
Yes	21/112	18.8	9.1-34.7	26.6	12.3-48.2	8.3	3.4-19.1
Out for breakfast usually *; **							
No	126/762	16.6	13.7-20.1	21.6	16.8-27.4	12.3	9.5-15.8
Yes	137/888	15.4	12.8-18.5	16.2	13.3-19.4	14.7	11.2-18.9
Frequency out for lunch (times/week)							
None	160/936	17.1	14.7-19.8	19.4	15.9-23.4	14.9	11.3-19.2
1-2	64/441	14.5	10.5-19.7	18.8	12.7-26.5	10.1	6.7-15.0
3-4	17/178	9.6	5.7-15.6	11.4	5.2-23.1	7.8	3.8-15.3
≥5	44/207	21.3	13.0-32.7	25.0	14.4-39.7	17.5	9.5-29.9
Frequency of morning snacking (times/day) *							
<1	187/1000	18.7	15.2-22.7	22.0	17.2-27.7	15.2	12.0-19.1
1-2	83/649	12.8	10.0-16.2	15.0	10.9-20.4	10.8	7.6-15.1
≥3	16/118	13.5	8.5-20.9	16.6	8.9-27.5	10.7	5.7-19.2
Frequency of afternoon snacking (times/day)							
<1	161/882	18.3	15.1-22.0	20.4	16.3-25.3	15.7	12.1-20.1
1-2	109/747	14.6	11.2-18.9	18.5	12.7-26.0	11.6	8.4-15.8
≥3	16/138	11.5	7.6-17.3	14.3	9.3-21.3	8.2	3.6-17.7
Frequency of having foods outside 3 main meals (times/day) *							
Never	64/303	21.1	15.9-27.4	21.6	15.4-29.3	20.4	13.8-29.0
< 1	84/485	17.3	13.5-22.0	19.6	13.7-27.3	15.1	11.3-19.9
1-3	103/739	13.9	10.9-17.7	18.2	13.0-25.0	10.4	7.0-15.1
≥ 4	35/240	14.6	11.6-18.2	17.2	12.1-24.0	12.1	7.1-20.0
Usual consumption of soft drinks (ml/day) *							
0	118/852	13.9	7.6-20.1	16.5	7.4-25.7	11.7	3.2-20.2
1-550	101/602	16.8	9.5-24.1	18.8	8.9-28.6	14.5	3.8-25.3
551-1500	46/211	21.8	9.9-33.7	25.9	10.2-41.5	16.8	1.5-35.2
>1500	27/127	21.3	5.8-36.7	25.6	6.9-44.3	13.3	1.3-40.5
Frequency of sweets or chocolates (times/week) *, ***							
None	115/580	19.8	15.5-25.0	21.2	16.2-27.3	18.4	13.1-25.1
1-3	116/796	14.6	12.2-17.3	18.2	14.1-23.2	11.0	8.1-14.8
4-6	35/256	13.7	9.8-18.7	17.3	11.6-25.1	10.1	6.0-16.5
≥ 7	18/132	13.6	8.8-20.5	19.0	11.7-29.4	8.7	3.7-19.1
Having preserved fruits usually *; **							
No	214/1182	18.1	15.0-21.7	21.5	17.5-26.2	14.6	11.4-18.5
Yes	70/582	12.0	9.0-15.8	14.1	9.7-20.1	10.0	6.9-14.4
Frequency of Western fast food (times/month) *							
None	115/838	13.7	11.0-17.0	16.7	13.4-20.6	10.7	7.5-14.9
< 1	125/635	19.7	15.5-24.6	23.2	16.9-31.0	16.3	11.8-21.9
≥ 1	43/248	17.3	11.9-24.6	20.0	12.9-29.7	14.8	8.9-23.6
Frequency of mutton & beef soup (times/month) *, ***							
Never	64/481	13.3	9.7-18.0	18.5	12.5-26.7	9.4	6.3-13.8
< 1	125/630	19.8	15.7-24.8	21.1	15.9-27.5	18.5	13.7-24.6
1-4	44/285	15.4	10.9-21.3	18.5	11.6-28.1	11.7	7.6-17.6
≥ 4	20/100	20.0	14.0-27.7	26.9	17.2-39.4	6.1	1.4-23.1
Selective about food *; ** ††							
Yes	133/977	13.6	11.6-15.9	15.8	13.2-18.8	11.6	8.7-15.2
No	150/782	19.2	15.0-24.3	22.9	16.6-30.6	15.1	11.6-19.5

<sup>†</sup> Overweight/obesity in adolescents defined by IOTF cut-offs<sup>11</sup>

<sup>‡</sup> n/N: the number of overweight/obese students by dietary habits subgroups

\* Chi-square test showed significant difference in the prevalence of overweight/obesity in the overall sample

\*\* Chi-square test showed significant difference in the prevalence of overweight/obesity in boys

\*\*\* Chi-square test showed significant difference in the prevalence of overweight/obesity in girls

**Table 3.** Dietary factors associated with overweight/obesity<sup>†</sup> in adolescents in Xi'an City, 2004

Dietary factors	Overall sample		Male		Female	
	OR a*	95% CI*	OR a*	95% CI*	OR a*	95% CI*
Breakfast outside home <sup>F</sup>						
No	1.0		1.0		1.0	
Yes	1.2	0.6-2.4	1.0	0.5-2.0	1.7	1.1-2.3
Snacking <sup>F</sup>						
No	1.0		1.0		1.0	
Yes	0.6	0.4-1.0	0.8	0.5-1.4	0.6	0.4-0.9
Usual consumption of soft drinks (ml/day) <sup>O;M</sup>						
0	1.0		1.0		1.0	
1-550	1.2	0.9-1.6	1.2	0.8-1.8	1.3	0.8-2.2
551-1100	1.5	1.2-2.4	1.4	0.9-2.4	1.3	0.6-3.0
>1100	1.7	1.1-2.7	1.9	1.1-3.8	1.0	0.2-4.6
Consumption of sweets and chocolates <sup>O;F</sup>						
No	1.0		1.0		1.0	
Yes	0.6	0.4-0.9	0.8	0.6-1.2	0.5	0.3-0.8
Consumption of mutton and beef soup <sup>‡F</sup>						
No	1.0		1.0		1.0	
Yes	1.3	0.8-2.2	1.2	0.7-1.8	1.7	1.04-2.9
Consumption of preserved fruits <sup>O;M</sup>						
No	1.0		1.0		1.0	
Yes	0.6	0.5-0.9	0.6	0.4-0.8	0.7	0.4-1.1
Selective about food <sup>††O;M</sup>						
Yes	1.0		1.0		1.0	
No	1.5	1.1-2.0	1.6	1.1-2.4	1.3	0.8-2.0

<sup>†</sup> Overweight/obesity in adolescents defined by IOTF cut-offs<sup>11</sup>

\* OR<sub>a</sub>: Odds ratio of factors associated with overweight/obesity adjusted for socio-demographic factors including age, gender, residence, household wealth, and parental BMI, 95% CI: 95% confidence interval

<sup>‡</sup> A local high energy-density Chinese food

<sup>††</sup> Selective about food defined as selectively eating favourite foods and avoiding other foods<sup>9</sup>

<sup>O</sup> significant factor of overweight/obesity in overall sample, <sup>M</sup> Significant factor in males, <sup>F</sup> Significant factor in females

food and consuming preserved fruits, sweets and chocolates were associated with overweight and obesity in adolescents after adjustment for socio-demographic factors. However, due to the cross-sectional nature of the survey causality cannot be established.

Both the direction and extent of the association between soft drinks and overweight in this study are similar to that observed in Western countries. A US national survey found that children drinking 255 or more grams of soft drink per day consumed approximately 200 kcal/day more than those who did not consume soft drinks.<sup>12</sup> A longitudinal study in the US showed a high intake of sugary drinks over 19 months predicted the development of obesity in 12 year-old children. It was estimated that an increase of one can of soda per day increased the risk of obesity by 1.6 times.<sup>5</sup> Other studies in China and in the US have also found that a higher consumption of sweet drinks is associated with overweight.<sup>13,14</sup> The modification of dietary behaviours<sup>6</sup> and changes in school policies and environment<sup>15</sup> to decrease the consumption of soft drinks have been reported to reduce the risk of excess weight gain and obesity in adolescents in Western countries. Our finding of an association between soft drink consumption and overweight and obesity in adolescents suggests that soft drinks should be targeted in intervention programs to prevent excess weight gain in adolescents in urban China.

Being selective about foods was negatively associated with overweight/obesity, but data about what kinds of foods the adolescents preferred was not collected in this

study and warrants further exploration. A study among students in four coastal cities in China reported a similar level of selective eaters (69% of the junior high students) and the top two disliked foods were strongly flavoured fatty meats and fish.<sup>16</sup> A study exploring the eating patterns and nutrient intake of preschoolers in Canada found that selective eaters consumed less total fat, energy and protein than children who did not report selective eating behaviours; and were more likely to consume below dietary recommendations for fruits, vegetables and meat.<sup>17</sup>

We found that the frequent consumption of Western fast food or local energy-dense food was associated with overweight and obesity in this urban Chinese population. Frequent consumption of energy-dense foods would be expected to increase the intake of fat and total energy and in turn increase the risk of developing obesity. An analysis of the nutrient composition of fast foods showed that most fast foods have more than twice the energy density of that recommended for healthy diets (more than 525 kJ/100g).<sup>18</sup> A longitudinal study in a representative sample of US adolescents found that fast food consumption was associated with increased weight gain from adolescence to adulthood.<sup>19</sup> A cross-sectional study in four eastern coastal cities in China reported similar results.<sup>20</sup>

Consuming food outside main meals is popular among adolescents in junior high schools, with 43% of adolescents reported having consumed morning snacks and 50% afternoon snacks in the week prior to our survey. A prospective study in the US concluded that snacks may have low nutritional value, but they were not important deter-

minants of weight gain among children.<sup>21</sup> In this study, consuming foods outside main meals was negatively associated with overweight and obesity in girls. National dietary intake data from 1991 to 1997 reported that fruit remained a major component of "foods between main meals" and more than 200g/day was consumed as snacks in 1997.<sup>22</sup> Our food consumption data in this population also showed the same results (unpublished data). In contrast, American children have snacks high in energy such as salty fried snacks, desserts, candy and soft drinks.<sup>23</sup> Therefore it is likely that the snacks consumed differ between Chinese and Western adolescents.

The dietary habits of adolescents in Xi'an provide important clues to construct messages for future programs to promote healthy eating among adolescents. When the dietary factors associated with overweight and obesity in China are similar to those observed in the West, the experience with Western intervention programs may have relevance for prevention programs in China. When easily available foods and drinks are potentially obesogenic (soft drinks, energy-dense fast food), it is imperative to equip adolescents with information and skills to help them make eating choices that will be beneficial for their health.

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#### AUTHOR DISCLOSURES

There is no conflict of interest to declare.

#### REFERENCES

1. Wang D. Diet and nutrient intake of Chinese people. In: Qi X, Chen C, Ma J, Ming L, eds. Summary report of Chinese National Nutrition and Health Survey 2002. Beijing: People's Health Publishing House, 2005:18-25.
2. National Bureau of Statistics of China. China Statistics Yearbook. [cited 2007/9/24]; Available from: <http://www.stats.gov.cn/tjsj/indsj/2006/indexch.htm>.
3. Stone MA, Bankart J, Sinfield P, Talbot D, Farooqi A, Davies MJ, Khunti K. Dietary habits of young people attending secondary schools serving a multiethnic, inner-city community in the UK. *Postgrad Med J*. 2007;83:115-9.
4. Janssen I, Katzmarzyk P, Boyce W, Vereecken C, Mulvihill C, Roberts C, Currie C, Pickett W. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obes Rev*. 2005;6:123-32.
5. Ludwig D, Peterson K, Gortmaker S. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001; 357:505-8.
6. James J, Thomas P, Cavan D, Kerr D. Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomised controlled trial. *BMJ*. 2004;328:1236-42.
7. Li M, Dibley M, Sibbritt D, Yan H. An assessment of adolescent overweight and obesity in Xi'an City, China. *Int J Pediatr Obes*. 2006;1:50-8.
8. Centre for Disease Control and Prevention. Diet behaviour and nutrition-DBQ. Survey Questionnaire and Exam Component 2001-2002. Atlanta: CDC, 2003.
9. Chinese Nutrition Society (CNS). Dietary guidelines for Chinese residents. 2005. [cited 2005/4/30]; Available from: <http://www.cnsoc.org:80> Dietary Guidelines.
10. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, ILL: Human Kinetics; 1991.
11. Cole T, Bellizzi M, Flegal K, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320:1240-3.
12. Harnack L, Stang J, Story M. Soft drink consumption among US children and adolescents: national consequences. *J Am Diet Assoc*. 1999;99:436-41.
13. Hesketh T, Ding Q, Tomkins AM. Disparities in economic development in Eastern China: impact on nutritional status of adolescents. *Pub Health Nutr*. 2002;5:313-8.
14. Nicklas TA, Yang S, Baranowski T, Zakeri I, Berenson G. Eating pattern and obesity in children: The Bogalusa Heart Study. *Am J Prev Med*. 2003;25:9-16.
15. Centres for Disease Control and Prevention, USA. Make it happen! - school nutrition success stories. [cited 2007/8/14]; Available from: <http://apps.nccd.cdc.gov/MIH/MainPage.aspx>.
16. Ma GS, Hu XQ, Ma WJ, Pan H, Yang YL, Ju JY, Xu LC, Liu B. The food preference of children and adolescents in urban China. *Chinese Journal of School Doctor*. 2002;16: 107-9.
17. Dubois L, Farmer AP, Girard M, Peterson K. Preschool children's eating behaviours are related to dietary adequacy and body weight. *Euro J Clin Nutr*. 2007;61:846-55.
18. Prentice A, Jebb S. Fast food, energy density and obesity: a possible mechanistic link. *Obes Rev*. 2003;4:187-94.
19. Niemeier HM, Raynor HA, Lloyd-Richardson EE, Rogers ML, Wing RR. Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. *J Adolesc Health*. 2006;39:842-9.
20. Ma G. Environmental factors leading to paediatric obesity in the developing world. In: Chen C, Dietz W, eds. Nestle Nutrition Workshop Series. Philadelphia: Williams & Wilkins, 2002:195-206.
21. Field A, Austin S, Gillman M, Rosner B, Rockett HR, Colditz GA. Snack food intake does not predict weight change among children and adolescents. *Int J Obes*. 2004; 28:1210-6.
22. Liu Y, Zhai F, Popkin BM. Trends in eating behaviours among Chinese children (1991-1997). *Asia Pac J Clin Nutr*. 2006;15:72-80.
23. Nielsen SJ, Siega-Riz AM, Popkin BM. Trends in food locations and sources among adolescents and young adults. *Prev Med*. 2002;35:107-13.

## Short Communication

## Dietary habits and overweight/obesity in adolescents in Xi'an City, China

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### 中国西安市青少年饮食习惯和超重肥胖

本文探讨中国西安市青少年饮食习惯及其和超重肥胖的关系。2004年从西安市城郊6区30所学校抽取了1804名初中生进行调查。体重身高由统一培训的研究成员测量。饮食习惯由学生填写验证过的问卷采集。饮食习惯和超重肥胖的关系通过回归分析获得。结果显示：男生三餐之外零食及进食薯条次数明显多于女生；女生喝饮料及吃油炸食物多于男生。男生中，喝软饮料和超重肥胖呈正相关（每日1100毫升，OR: 1.9；95%可信区间：1.1-3.8）；吃果脯为负相关因素（OR: 0.6；95%可信区间：0.5-0.9）。女生中，在外早餐、食用高热量食物显著增加超重肥胖的风险。在这组研究人群中，和超重肥胖显著相关的饮食因素有：在外早餐、喝软饮料、食用高热量快餐食品。预防超重肥胖应当考虑这些饮食习惯。

**关键字：**饮食习惯、青少年、超重肥胖、横断面调查、中国