

Original Article

Food group intake among adolescents in Guangzhou city compared with the Chinese dietary guidelines

Cai-Xia Zhang PhD¹, Yu-Ming Chen PhD¹, Wei-Qing Chen PhD¹, Yi-Xiang Su MD², Cui-Ling Wang MD¹, Jiang-Nan Wu MD¹

¹Guangdong Provincial Key Laboratory of Food, Nutrition and Health, Department of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, People's Republic of China

²Department of Nutrition, School of Public Health, Sun Yat-sen University, Guangzhou, People's Republic of China

Food group intake in adolescents has many health implications. However, no study has been conducted to assess food group intake among Chinese adolescents. Objective: The purpose of this study was to evaluate food group intakes among Chinese adolescents living in Guangzhou city and the proportion of adolescents surveyed meeting the Chinese dietary guidelines, and the Chinese food pagoda for a balanced diet 2007. Methods: A school-based cross-sectional survey was conducted in Guangzhou city between October 2006 and April 2007. A random sample of 2977 adolescents, aged 12 to 17 years, was interviewed. A self-administered semi-quantitative food frequency questionnaire was used to estimate food group intakes of adolescents. Results: A high percentage of adolescents consumed too little plant foods including vegetables, fruit, and soybean products. Only 9%, 14% and 6% of adolescents surveyed reached the minimum daily recommended intake levels for vegetables, fruit, and soybean products and nuts. Nearly 70% of the studied adolescents consumed dairy less than the recommended daily intake and more than 20% adolescents reached the recommended amounts for cereals and eggs. More than one-third (35.6%) of adolescents did not meet any food group recommendations. And no adolescents reached all eight food group recommendations. An inadequate consumption of calcium and iron among adolescents was also found. Conclusions: The results of this study indicate that most adolescents living in Guangzhou city are not meeting the current recommendations for intakes of the various food groups.

Key Words: adolescents, China, Chinese dietary guidelines, food group intake, nutrients

INTRODUCTION

Adolescence is an important growth and development period which has implications for future nutrition status.¹ It is well accepted that an individual's eating habits begin to form early in life and dietary habits developed during adolescence can carry into adulthood.^{2,3} Furthermore, dietary intake patterns during adolescence can influence future risk of obesity, type 2 diabetes, cardiovascular disease, hypertension and cancer.⁴⁻⁶ Given the many health implications of adolescent nutrition, there is an urgent need to study the dietary intakes of adolescents.

Chinese dietary guidelines and the Chinese food pagoda 2007 were developed by the Chinese Nutrition Society in 2007 (<http://www.cnsoc.org/cn/nutrition.asp?s=9&nid=467>).⁷ Dietary adequacy, variety and moderation are addressed through dietary recommendations in the Chinese dietary guidelines and the Chinese food pagoda 2007. The dietary recommendations presented in the Chinese food pagoda 2007 are intended for all healthy Chinese individuals aged six years and above. So far, there is limited information, however, on how well Chinese adolescents adhere to these recommendations.

The present study aimed to examine the consumption

level of food groups among Chinese adolescents living in Guangzhou city and the extent to which their diets met the recommended intakes in a cross-sectional descriptive survey.

SUBJECTS AND METHODS

Study subjects

During the period October 2006 to April 2007, a school-based cross-sectional survey was conducted in Guangzhou urban districts to investigate dietary intake among adolescents. Multistage cluster sampling technique was used to choose the study sample. In the first stage, 26 high schools were randomly selected. In the second stage, one class from each grade of these schools was randomly chosen and 72 classes were finally selected.

Corresponding Author: Dr Yu-Ming Chen, Department of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou 510080, People's Republic of China.

Tel: +86-20-87330605; Fax: +86-20-87330446

Email: chenym@mail.sysu.edu.cn

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All students in the selected classes were invited to participate in this study. Students under 12 or over 17 years of age were excluded in the final data analysis. A total sample of 2,977 schoolchildren from the selected 26 schools constituted the subjects of the study.

Dietary assessment

A food frequency questionnaire (FFQ) was used to collect information on the weekly consumption of 81 foods or food groups that consist of the most commonly consumed foods in China. The instrument was self-administered in the classroom while teachers and research staff monitored the participants. Each participant was required to report their usual consumption frequency as the number of time per week and the average amount of food eaten each time. A commonly used portion size was specified for each food (eg, slice, glass, or unit, such as one apple or banana). For foods without a discrete portion size such as vegetables and meat, a medium bowl was used to estimate their usual portion size. Food photographs and full scale food portion visual aids for the reference portion sizes were provided to help participants estimate and record the amounts of food consumed. The weekly frequency of consumption of each food was multiplied by reported portion size to obtain the total amount of each food in grams consumed per week and then dividing by seven in order to get the amount of daily intake.

The FFQ used in this study was adapted from the adult version which has been validated in Chinese women residing in Guangdong province.⁸ Two food items commonly consumed by adolescents that were not included in the original questionnaire were added (e.g. chocolate and other kinds of candies). For the current study, the reproducibility of the FFQ was examined in 99 adolescents who completed two FFQs, two to three months apart. The correlation coefficients between the two FFQs ranged from 0.42 (fat) to 0.52 (protein) for macronutrients, 0.37 (vitamin A) to 0.63 (vitamin C) for micronutrients and 0.33 (soy) to 0.58 (vegetables) for food groups. These results seemed to be comparable to the values reported by others.^{9,10}

Chinese food pagoda 2007 depicts eight food categories, including cereals, vegetables, fruit, meat, fish and shrimps, eggs, soybean products and nuts, and dairy products. Based upon this food pagoda, food items were aggregated into eight major food groups. Among 81 food items, cereals items included white rice, porridge, noodles, bread, cake and biscuits. Vegetable items included dark green leafy vegetables, cruciferous vegetables, melon, radish and pepper, carrot, tomato, starchy tubers, fresh corn, fresh beans, allium, mushroom and fungi. Fruit items included citrus fruits, apple, pear, peach, plum, banana, grape, litchi, longan, watermelon, papaya, cantaloupe, kiwi fruit, strawberry, pineapple, mango and durian. Meat was considered to be the sum of pork, beef, lamb, beef or pork liver, kidney, hearts, brain, tongues, sausage, ham, bacon, hot dogs, poultry (chicken, duck and goose meat). Fish and shrimps included freshwater fish, saltwater fish, canned fish, salted fish, crab, shrimp, prawn, squid, cuttle, scallops, mussel and whelk. Soybean products and nuts intake was estimated based on the intake of hard tofu, fried tofu pop, soft tofu, processed

soy products (tofu curd and vegetarian chicken); soy drink; bean curd pudding; soybean (fresh soybean and dried soybean); peanut, and walnut. Eight dairy food items (whole milk, whole milk powder, skim/low-fat milk, skim/low-fat milk powder, yoghurt, milk tea, cheese, and ice cream) were used to calculate the dairy intake. The daily intakes of food groups (in g) were calculated by summing intakes of individual foods in each food group for each participant. Two beverage items (fruit juices; coca cola and other soda water) were also included in the food list of the FFQ.

At baseline, 2,977 adolescents completed the FFQ. The basal metabolic rate (BMR) was calculated based on the Schofield Equation ($BMR=17.5 \times \text{weight} + 651$ for boys aged 10-18 years, and $BMR=12.2 \times \text{weight} + 746$ for girls aged 10-18 years).¹¹ The ratio of energy intake to estimated BMR was used to evaluate the under- and over-reporting. Extreme low- and high-energy students were identified using Goldberg's cut-off points (lower than 0.88 or above 2.72).^{12,13} Consequently, 614 students underreported and 77 over-reported their energy intakes and were excluded from this study. Individuals with >30 missing items (82 students) on the FFQ were also excluded, yielding a sample size of 2,204.

Anthropometric measurement

Anthropometric measurements were taken for all students by trained researchers. Weight was measured in underwear and without shoes with the standard physician beam scale to the nearest 0.1 kg, and height was measured barefoot and was recorded to the nearest 0.1 cm on standardized, wall-mounted height boards. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. The age- and sex-specific BMI reference for Chinese children and adolescents¹⁴ was used to define overweight and obesity. Written informed consent forms were obtained from adolescents and their parents. This study was approved by The Ethical Committee of School of Public Health, Sun Yat-sen University.

Statistical analysis

All data analyses were performed using SPSS 13.0 (SPSS Inc., Chicago, Illinois, USA). Due to the skewed distribution of data, the Wilcoxon rank-sum test was conducted to test median differences of food group intakes between boys and girls.

According to the Chinese food pagoda 2007,⁷ the recommended daily intake levels are 250-400 g for cereals, 300-500 g for vegetables, 200-400 g for fruits, 50-75 g for meat, 70-100 g for fish and shrimps, 25-50 g for eggs, 30-50 g for soybean products and nuts, and 300 g for dairy. The average daily food group intakes in adolescents were calculated. The percentage of adolescents meeting the food pagoda recommendation for each food group was determined. Intakes of nutrients that are considered to be indicative of or critical for proper nutrition among adolescents were also estimated based on the Chinese Food Composition Table,¹⁵ including protein, fat, carbohydrate, vitamin A, vitamin C, zinc, iron, and calcium. Average consumption levels of nutrients were evaluated and compared with the Chinese dietary refer-

ence intake.¹⁶ The food group intakes were also compared with the results of 2002 Chinese National Nutrition and Health Survey (2002 NNHS).¹⁷ In this paper, all *p*-values were two sided, and statistical significance was determined at the *p*<0.05 level.

RESULTS

The characteristics of adolescents were described in Table 1. The mean age (SD) of the study participants was 15.1 (1.9) years and 53.8% were girls. The mean (SD) height and weight was 167.8 (8.4) cm and 55.0 (11.2) kg for boys, 158.1 (5.8) cm, and 47.0 (7.2) kg for girls. The number of adolescents who were overweight or obese were: 79 (7.8%) and 37 (3.6%) for boys and 36 (3.0%) and 16 (1.3%) for girls, respectively.

Among boys, the mean consumption of cereals, vegetable, fruit, meat, fish and shrimps, eggs, dairy, and soybean products and nuts were: 268, 172, 106, 141, 45, 30, 275, and 13 g per day, respectively. The corresponding mean consumption in girls were: 176, 157, 108, 104, 41, 24, 249, and 10 g per day, respectively. The average daily consumption of vegetables, fruit, and soybean products and nuts were far below the minimum recommended intake (300 g for vegetables, 200 g for fruit, and 30 g for soybean products and nuts). Boys consumed significantly more cereals, meat, and dairy products than girls (*p*<0.001). However, fruit, fish and shrimps intakes were not significantly different by gender (Table 2).

In comparison to the mean absolute food group intakes by adolescents residing in large cities in the 2002 NNHS, boys in the present study were found to have lower intakes of cereals, vegetables, fish and shrimps, eggs, soybean products and nuts; higher intakes of fruit, meat and dairy products. Girls had lower intakes of most food

groups except for fruit and dairy products (Table 2).

The percentages of participants reaching the Chinese food pagoda 2007 are presented in Table 3. The majority of adolescents consumed vegetables, fruit, and soybean products and nuts much less than the required minimum recommendations. Only 9.2%, 14.1% and 6.4% of adolescents reached the minimum daily recommended intake levels for vegetables, fruit, and soybean products and nuts. Nearly 70% of the sample consumed dairy less than the recommended daily intake. More than 20% adolescents reached the recommended amounts for cereals and eggs. The percentages of meeting cereals, eggs, meat, fruit, vegetables, fish and shrimps, soybean products and nuts recommendations were 25.2%, 20.8%, 18.3%, 10.5%, 7.6%, 6.9%, and 4.3%, respectively. More than one-third (35.6%) of adolescents did not meet any food group recommendations. And no adolescents reached all eight food groups recommendations.

As shown in Table 4, the mean energy intake was 2,267 and 1,772 kcal/day for boys and girls, respectively. The mean intakes for percent energy from carbohydrate and fat were within the Chinese recommended nutrient intake (RNI) range (55-65% of energy for carbohydrate and 25-30% of energy for fat, respectively). On average, carbohydrate contributed to 57.0% of total energy intake. With respect to fat, the mean percentage of energy intake from fat was 25.4%. Nearly 80% of adolescents were not within the recommended range, with 52.5% and 23.8% beneath or exceeding this range, respectively. A low consumption of calcium and zinc was observed in the studied adolescents. It is important to underline the high percentage of girls that may be at risk of iron and calcium deficiency. Only 28.2% and 16.6% of the girls' were observed to have iron and calcium intakes reached the

Table 1. Characteristics of the study subjects

	Boys	Girls	Total
n (%)	1,018 (46.2)	1,186 (53.8)	2,204
Age (years) †	15.1±1.9	15.1±2.0	15.1±1.9
Body weight (kg) †	55.0±11.2	47.0±7.2	50.7±10.1
Body height (cm) †	168±8.4	158±5.8	163±8.6
BMI (kg/m ²) †	19.4±3.1	18.8±2.5	19.1±2.8
Overweight (n, %)	79 (7.8)	36 (3.0)	115 (5.2)
Obesity (n, %)	37 (3.6)	16 (1.3)	53 (2.4)

† Data presented as mean ± SD

Table 2. Average daily intakes of food groups among Chinese adolescents in Guangzhou city

	Food group intakes based on FFQ (Mean ± SD)			Mean intake by adolescents in large cities (2002 NNHS)	
	Boys (n=1,018)	Girls (n=1,186)	Total (n=2,204)	Boys	Girls
Cereals (g)	268±114	177±71.2	219±104	322	246
Vegetables (g)	172±116	157±103	164±109	236	212
Fruit (g)	106±131	108±118	107±124	59.5	84.6
Meat (g)	141±104	104±73.7	121±90.8	119	111
Fish and shrimps (g)	44.7±61.2	40.7±55.4	42.5±58.2	59.7	57
Eggs (g)	30.2±39.9	24.0±23.9	26.9±32.5	42.1	39.5
Dairy (g)	275±236	250±218	261±227	107	90.9
Soybean products and nuts (g)	13.4±17.0	10.2±9.6	11.7±13.6	19.6	13.0

† NNHS: Chinese National Nutrition and Health Survey

Table 3. Number and percentage of daily food group intakes among Chinese adolescents in Guangzhou city compared with the Chinese dietary guidelines

Food groups	Recommendations† (g/day)	Boys (n, %)	Girls (n, %)	Total (n, %)
Cereals	<250	474 (46.6)	1,041 (87.8)	1,515 (68.7)
	250-400	426 (41.8)	129 (10.9)	555 (25.2)
	>400	118 (11.6)	16 (1.3)	134 (6.1)
Vegetables	<300	909 (89.3)	1,091 (92.0)	2,000 (90.7)
	300-500	88 (8.6)	80 (6.7)	168 (7.6)
	>500	21 (2.1)	15 (1.3)	36 (1.6)
Fruit	<200	886 (87.0)	1,007 (84.9)	1,893 (85.9)
	200-400	92 (9.0)	139 (11.7)	231 (10.5)
	>400	40 (4.0)	40 (3.4)	80 (3.6)
Meat	<50	123 (12.1)	237 (20.0)	360 (16.3)
	50-75	160 (15.7)	243 (20.5)	403 (18.3)
	>75	735 (72.2)	706 (59.5)	1,441 (65.4)
Fish and shrimps	<50	819 (80.5)	985 (83.1)	1,804 (81.8)
	50-100	70 (6.9)	82 (6.9)	152 (6.9)
	>100	129 (12.6)	119 (10.0)	248 (11.3)
Eggs	<25	606 (59.5)	802 (67.6)	1,408 (63.9)
	25-50	232 (22.8)	227 (19.2)	459 (20.8)
	>50	180 (17.7)	157 (13.2)	337 (15.3)
Dairy	<300	642 (63.1)	844 (71.2)	1,486 (67.4)
	>300	376 (36.9)	342 (28.8)	718 (32.6)
Soybean products and nuts	<30	924 (90.8)	1,138 (96.0)	2,062 (93.6)
	30-50	59 (5.8)	36 (3.0)	95 (4.3)
	>50	35 (3.4)	12 (1.0)	47 (2.1)

† Data recommended by Chinese dietary guidelines and Chinese food pagoda for a balanced diet 2007

Table 4. Number and percentage of inadequate intakes of selected nutrients among Chinese adolescents in Guangzhou city compared with the Chinese dietary reference intakes

Nutrients	Boys (Mean ± SD)	Girls (Mean ± SD)	DRIs (RNI/AI) †		Boys (n, %)	Girls (n, %)	Total (n, %)
			Boys (12~13y/ 14~17 y)	Girls (12~13y/ 14~17 y)			
Energy (kcal)	2,267±683	1,772±494	2,400/2,900	2,200/2,400	816(80.2)	1,025(86.4)	1,841(83.5)
Vitamin A (µg RE)	811±693	685±534	>700/>800	>700/>700	624(61.3)	795(67.0)	1419(64.4)
Vitamin C (mg)	116±74.9	104±63.6	>90/>100	>90/>100	512(50.3)	652(55.0)	1,164(52.8)
Iron (mg)	24.7±9.5	19.1±7.1	>16/>20	>18/>25	264(25.9)	851(71.8)	1,115(50.6)
Zinc (mg)	17.1±6.8	13.2±5.4	>18.0/>19.0	>15.0/>15.5	681(66.9)	849(71.6)	1,530(69.4)
Calcium (mg)	836±328	781±303	>1,000/>1,000	>1,000/>1,000	602(59.1)	989(83.4)	1,591(72.2)

† DRI: Dietary reference intake; RNI: recommended nutrient intake; AI: Adequate intake

level of adequate intakes.

DISCUSSION

This cross-sectional study showed that the majority of Chinese adolescents living in Guangzhou city consumed vegetables, fruit, and soybean products and nuts less than the required minimum recommendations. More than one-

third of the adolescents did not meet any food group recommendations. No adolescents met all eight food group recommendations.

Vegetables and fruit are essential components of a healthy diet and are a significant source of vitamins, minerals and other bioactive substances. Among various food groups, vegetables and fruit are the most commonly stud-

ied food groups among adolescents. One study¹⁸ conducted in a Czech population showed that boys aged 11-14 years consumed 123 g of vegetables and 161g of fruits per day. The corresponding mean consumption was 101 g and 162 g in girls aged 11-14 years, respectively. Sathannoppakao *et al*¹⁹ reported that mean vegetables intake was 1.77 servings (approximately 141.6 g/day) for boys and 1.78 servings (approximately 142.4 g/day) for girls in Thailand. And mean fruit intake was 1.37 servings (approximately 110 g/day) for boys and 1.55 servings (approximately 124 g/day) for girls. Mean vegetables and fruit intake ranged from 143-265 g/day was observed in a survey focused on 11-year-old children from nine European countries.²⁰ The average daily consumption of vegetables and fruit were 186±74 g and 107±100 g in Italian secondary school students aged 17 years.²¹ In the current study, the mean vegetables and fruit intakes of 164 and 107 g/day were comparable to the results in other countries. However, compared to the Chinese food pagoda 2007 (300-500 g/day for vegetables, 200-400 g/day for fruits), the surveyed adolescents consumed an insufficient amount of vegetables and fruit. Only 9.2% and 14.1% of the adolescents consumed vegetables and fruit meeting or exceeding the minimum recommended intakes. In view of the substantial health benefits of vegetables and fruit, there is an urgent need to encourage Chinese adolescents to increase consumption of vegetables and fruits.

Consumption of cereals, meat, dairy and soybean products and nuts among adolescents has previously been reported in a few studies. The average daily consumption of cereals, meat, dairy and soy was 310, 136, 211 and 16 g in 17 year old Italian secondary school students.²¹ This consumption level was comparable to that observed in our study (cereals 219 g, meat 121 g, dairy 261 g, and soy food and nuts 12 g). However, consumption of dairy was higher (402 g) in German adolescents aged 14-18 years²² than the values obtained in our survey. Compared with the Chinese food pagoda, 93.6% of the studied adolescents did not meet the minimum recommended intake for soybean products and nuts. The percentages of adolescents meeting the recommended amounts for cereals and meat were 25.2% and 18.3%, respectively.

In terms of nutrients, as observed in the current study, an inadequate consumption of calcium and iron among adolescents was also found in studies conducted in Italy,²¹ Greece,²³ Turkey⁹ and other European countries.²⁴ Of total energy intake, median energy intake for percent energy from fat was 33% in male adolescents of Canada.³ In the United States, the percent of energy from fat was about 31%-39% among adolescents.^{25,26} In Greece adolescents, 41% for boys and 43% for girls was derived from fat.²³ Unlike these studies, the mean percentage of energy intake from fat was 25.4% in the current study. It is valuable to note that slightly more than one half (52.5%) of the adolescents did not reach the recommended fat intake (25-30% of total energy). The relatively higher percentage of fat intake below the recommended range maybe the result of the fact that information on the consumption of edible oil (vegetable oils and animal fats) was not collected in this study. Therefore, energy provide

by edible oil was not included in the calculation of the total energy intake.

In the current study, no adolescents met all eight food group recommendations in comparison with the recommended amounts depicted in the Chinese food pagoda 2007. More than one-third of the adolescents did not meet any food group recommendations. Enns and colleagues²⁷ reported that for any given Food Guide Pyramid group, less than one half of adolescents consumed the recommended number of servings. Another study also conducted in United States showed that compared with recommendations, most children and adolescents did not meet any recommendations.²⁸ One study conducted in Australian showed that almost two thirds of the adolescents have food intakes that fall short of the recommendations outlined in the Australian Guide to Healthy Eating.²⁹ All these studies showed that most adolescents failed to meet the recommendations for food group intake. Nutritional needs increase sharply during adolescence because of the increased growth rate and changes in body composition. A healthy diet that includes a variety of different foods is important to maintain health and no single food can provide all the essential nutrients that the body needs to be healthy and function efficiently.

When interpreting the findings of this study, some methodological issues must be addressed. This cross-sectional survey was conducted in samples of adolescents from 26 high schools located in Guangzhou urban districts. We can not say that the results are representative for all Chinese adolescents. The generalization therefore must be made very cautiously. Another important methodological issue is that an 81-item FFQ was used to assess the quantity of foods consumed daily in this study. Dietary intake data collected via FFQs may be crude because FFQs are restricted to a short list of some 50-150 food items compared with the many thousands of foods in population food supplies. However, the validation study showed that the FFQ has satisfactory reproducibility and reasonable validity among Chinese women.⁸ Furthermore, although the validity of our FFQ was not assessed among the adolescents, the results of the reproducibility evaluated in adolescents indicated that our FFQ gave reproducible estimates of nutrient and food group intake. Thirdly, accurate reporting of dietary intake for young people is also of concern. There may be errors in assessing the frequency of consumption of foods and differences in perceptions of portion size. Under- and over-reporting of food intake may occur, particularly in this age group. However, this problem has been tackled by excluding individuals with energy intake/BMR under or above a certain cut-off point. Therefore, the problem of under- and over-reporting will not influence the results seriously, if it exists.

The results of this study indicated that most adolescents did not follow the food group recommendations, especially for vegetables, fruit and soy food group. There is an urgent need for nutrition education and intervention to encourage the consumption of a healthy diet.

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AUTHOR DISCLOSURES

We declare that we have no conflict of interest.

REFERENCES

1. Lytle LA. Nutritional issues for adolescents *J Am Diet Assoc.* 2002;102:S8-12.
2. Nicklas TA, Webber LS, Berenson GS. Studies of consistency of dietary intake during the first four years of life in a prospective analysis: Bogalusa Heart Study. *J Am Coll Nutr.* 1991;10:234-41.
3. Schenkel TC, Stockman NK, Brown JN, Duncan AM. Evaluation of energy, nutrient and dietary fiber intakes of adolescent males. *J Am Coll Nutr.* 2007;26:264-71.
4. Lytle LA, Kubik MY. Nutritional issues for adolescents. *Best Pract Res Clin Endocrinol Metab.* 2003;17:177-89.
5. Masu R, Sallis JF, Berry CC, Broyles SL, Elder JP, Nader PR. The relationship between health beliefs and behaviors and dietary intake in early adolescence. *J Am Diet Assoc.* 2002;102:421-4.
6. Shatenstein B, Ghadirian P. Nutrient patterns and nutritional adequacy among French-Canadian children in Montreal. *J Am Coll Nutr.* 1996;15:264-72.
7. Chinese Nutrition Society. Dietary guidelines for Chinese residents. Lasa: Tibet People's Press; 2009.
8. Zhang CX, Ho SC. Validity and reproducibility of a food frequency questionnaire among Chinese women in Guangdong province. *Asia Pac J Clin Nutr.* 2009;18: 240-50.
9. Garipagaoglu M, Oner N, Vatansever U, Inan M, Kucukugurluoglu Y, Turan C. Dietary intakes of adolescents living in Edirne, Turkey. *J Am Coll Nutr.* 2008;27:394-400.
10. Rockett HR, Wolf AM, Colditz GA. Development and reproducibility of a food frequency questionnaire to assess diets of older children and adolescents. *J Am Diet Assoc.* 1995;95:336-40.
11. Report of a Joint FAO/ WHO/UNU Expert Consultation, Energy and Protein Requirements (Estimates of energy and protein requirement of adults and children). Geneva: Technical Report Series 724, 1985.
12. Goldberg GR, Black AE, Jebb SA, Cole TJ, Murgatroyd PR, Coward WA et al. Critical evaluation of energy intake data using fundamental principles of energy physiology: 1. Derivation of cut-off limits to identify under-recording. *Eur J Clin Nutr.* 1991;45:569-81.
13. Ocké MC, Larrañaga N, Grioni S, van den Berg SW, Ferrari P, Salvini S et al. Energy intake and sources of energy intake in the European Prospective Investigation into Cancer and Nutrition. *Eur J Clin Nutr.* 2009;63:S3-15.
14. Group of China Obesity Task Force. Body mass index reference for screening overweight and obesity in Chinese school-age children. *Biomed Environ Sci.* 2005;18:390-400.
15. Yang YX, Wang GY, Pan XC. China Food Composition. Beijing: Peking University Medical Press, 2002.
16. Chinese Nutrition Society. Chinese Dietary reference intake. 1st ed. Beijing: China light industry press, 2000.
17. Jin SG, Zhai FY. Report of the Chinese National Nutrition and Health Survey-10: 2002. Data of the Nutrition and Health Status. Beijing, China: People's Medical Publishing House, 2008.
18. Jakubikova M, Dofkova M, Ruprich J. Fruit and vegetable intake in the Czech child population. *Public Health Nutr.* 2011;14:1047-54.
19. Satheanoppakao W, Aekplakorn W, Pradipasen M. Fruit and vegetable consumption and its recommended intake associated with sociodemographic factors: Thailand National Health Examination Survey III. *Public Health Nutr.* 2009; 12:2192-8.
20. Yngve A, Wolf A, Poortvliet E, Elmadfa I, Brug J, Ehrenblad B et al. Fruit and vegetable intake in a sample of 11-year-old children in 9 European countries: The Pro Children Cross-sectional Survey. *Ann Nutr Metab.* 2005; 49:236-45.
21. Leclercq C, Piccinelli R, Arcella D, Le Donne C. Food consumption and nutrient intake in a sample of Italian secondary school students: results from the INRAN-RM-2001 food survey. *Int J Food Sci Nutr.* 2004;55:265-77.
22. Alexy U, Sichert-Hellert W, Kersting M. Fifteen-year time trends in energy and macronutrient intake in German children and adolescents: results of the DONALD study. *Br J Nutr.* 2002;87:595-604.
23. Hassapidou MN, Fotiadou E. Dietary intakes and food habits of adolescents in northern Greece. *Int J Food Sci Nutr.* 2001;52:109-16.
24. Rolland-Cachera MF, Bellisle F, Deheeger M. Nutritional status and food intake in adolescents living in Western Europe. *Eur J Clin Nutr.* 2000;54:S41-6.
25. Cavadini C, Siega-Riz AM, Popkin BM. US adolescent food intake trends from 1965 to 1996. *West J Med.* 2000;173: 378-83.
26. Wang Y, Jahns L, Tussing-Humphreys L, Xie B, Rockett H, Liang H, Johnson L. Dietary intake patterns of low-income urban African-American adolescents. *J Am Diet Assoc.* 2010;110:1340-5.
27. Enns CW, Mickle SJ, Goldman JD. Trends in food and nutrient Intakes by adolescents in the United States. *Fam Econ Nutr Rev.* 2003;15:15-24.
28. Muñoz KA, Krebs-Smith SM, Ballard-Barbash R, Cleveland LE. Food intakes of US children and adolescents compared with recommendations. *Pediatrics.* 1997;100:323-9.
29. Savage GS, Ball K, Worsley A, Crawford D. Food intake patterns among Australian adolescents. *Asia Pac J Clin Nutr.* 2007;16:738-47.

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¹Guangdong Provincial Key Laboratory of Food, Nutrition and Health, Department of Medical Statistics and Epidemiology, School of Public Health, Sun Yat-sen University, Guangzhou, People's Republic of China
²Department of Nutrition, School of Public Health, Sun Yat-sen University, Guangzhou, People's Republic of China

廣州市青少年食物攝入情況：與中國居民膳食指南的比較

食物類別攝入情況與青少年健康密切相關，目前為止，尚無研究評估中國青少年的食物類別攝入情況。目的：瞭解居住在廣州市的青少年食物類別攝入情況，並評價其是否達到中國居民膳食指南和中國居民平衡膳食寶塔(2007)推薦的攝入量。方法：2006年10月到2007年4月期間，在廣州市開展了一項以學校為基礎的橫斷面研究。隨機調查了2977名年齡在12-17歲的青少年，採用自填式的半定量食物頻數問卷來估計青少年的食物攝入情況，並根據中國居民平衡膳食寶塔(2007)推薦的食物種類，將食物分為糧穀類、蔬菜、水果、畜禽肉類、魚蝦類、蛋類、奶製品、豆製品及堅果類八大類。結果：大部分青少年植物性食物如蔬菜、水果和豆製品的攝入量較低，僅有9%、14%和6%的青少年蔬菜、水果、豆製品和堅果類的攝入量達到推薦的最低攝入量。接近70%的青少年奶製品攝入量低於推薦攝入量，25.2%的青少年糧穀類和蛋類的攝入量達到推薦攝入量。35.6%的青少年沒有一種食物類別的攝入量達到推薦攝入量。沒有一個研究對象滿足所有八類食物的推薦攝入量。此外，鈣和鐵的攝入量不足也在青少年中常見。結論：本次研究調查的青少年，大部分食物類別未能達到中國居民膳食指南推薦的攝入量。

關鍵字：青少年、中國居民膳食指南、食物類別攝入量、營養素