The Difference in Nutrient Intakes between Chinese and Mediterranean, Japanese and American Diets

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Abstract: Across countries, the predominant diets are clearly different and highly related with human health. Therefore, it is necessary to evaluate dietary nutrients between them. This study aimed to evaluate dietary nutrients in China and compare those between Chinese and Mediterranean (Italian), Japanese and American diets. Dietary intakes of 2659 subjects in south-east China, Zhejiang province, from 2010 to 2012, were estimated by three consecutive 24-h dietary recalls. The contribution of carbohydrate to total energy in Chinese subjects was lower than that in Japanese and American subjects, but higher than that in Italian subjects. However, the energy contribution from fat in Chinese subjects was higher than that in Japanese and American subjects, and similar to that in Italian subjects. Moreover, the Chinese diet had lower daily intakes of fiber, calcium, phosphorus, potassium, selenium, vitamin A, vitamin B₁, vitamin B₂ and vitamin C, compared with the Japanese, American and Italian diets. Nevertheless, intakes of sodium, iron, copper and
vitamin E were higher among Chinese people relative to the people of other three countries. The present study demonstrated that the structure of the Chinese diet has been shifting away from the traditional diet toward high-fat, low-carbohydrate and low-fiber diets, and nutrients intakes in Chinese people have been changing even worse than those in American people.

Keywords: Chinese diet; Mediterranean diet; Japanese diet; American diet; nutrient intake; macronutrients; micronutrients

1. Introduction

Over the past decade, along with rapid economic growth and social changes, Chinese people have experienced remarkable shifts in its traditional diet and disease patterns [1,2]. As the classic eating pattern shifts, grain intake has significantly decreased; fat intake has dramatically increased; daily intake of salt has been much greater than that recommended; but intake of fruit and vegetables is insufficient [3]. These shifts in the composition of diet have been the basis for the change in nutrient intakes. An imbalanced nutrient intake is associated with increased morbidity and mortality from diseases, including diabetes, hypertension, dyslipidemia, cardiovascular diseases, certain cancers, etc. [4,5]. Moreover, assessing intake of nutrient is necessary to monitor nutritional status. It allows us to identify people nutritionally at risk due to inadequate or excessive intake of specific nutrients, to plan and evaluate nutrition intervention projects, and to establish dietary recommendations and food regulations [6,7].

Nowadays, there are predominant types of diets in each country. Some predominant diets are described as healthy diets while others are generally qualified as unhealthy. Both the Mediterranean and Japanese diets are known to be healthy. People in the Mediterranean countries have a low risk of cardiovascular disease, while the Japanese people are famous for their longevity/healthy life expectancy [8]. The Mediterranean diet has long been reported to be the optimal diet for preventing non-communicable diseases and preserving good health [9]. It is characterized by a high intake of cereals, nuts, fruit and vegetables, fish and olive oil, a low intake of dairy products, red meat, processed meats and sweets, and a moderate intake of wine during meals [9,10]. The Japanese diet also covers large amounts of rice, fruit and vegetables, soy-derived proteins and fish, but there is much lower intake of energy and oils/fats [11]. However, the Western diet is characterized by a high consumption of red and processed meats, high-fat dairy products, refined grains, and high-sugar drinks and desserts besides alcoholic beverages, and relatively low intakes of fruit, vegetables, whole-grain foods, fish and poultry [12]. This diet may have negative effects on health, specifically on the risk for obesity, metabolic syndrome, type 2 diabetes, cardiovascular disease as well as cancer [13].

There have been four national nutrition surveys in China, conducted in 1959, 1982, 1992 and 2002. With rapid economic development and urbanization, the pace of nutrition transition has dramatically accelerated in China [2,14]. It is difficult to reflect the nutritional and healthy problems of residents timely for the national nutrition survey carried out once every 10 years. Therefore, the way of national nutrition survey has changed to one cycle every 5 years since 2010 (three years for the first time). Our
study was based on the data of the fifth national nutrition survey in south-east China, Zhejiang province, from 2010 to 2012. Although the nutrition survey in Zhejiang province cannot completely reflect the nutritional status all over China, it can indicate the nutritional status in eastern-coast developed provinces and in urbanized provinces. So far, there has been no report which compared the nutrient intakes between Chinese and other types of diets in males and females for different age groups. Therefore, this study aimed to evaluate energy, macro- and micro-nutrients intakes in south-east Chinese diet and compare those between Chinese and Mediterranean (Italian), Japanese and Western (American) diets in males and females for different age groups.

2. Methods

2.1. Study Design and Subjects

All data of Chinese population in this study were derived from part of the fifth national nutrition survey, China National Nutrition and Health Monitoring Survey, from 2010 to 2012. For Zhejiang province, large cities of Jianggan District in Hangzhou and Jiangdong District in Ningbo were selected in 2010; small-medium cities of Jindong District in Jinhua and Tongxiang County in Jiaxing in 2011; Songyang County in Lishui and Anji County in Huzhou in 2012. We randomly selected six communities in each city, district or county using a randomized probability-proportional-to-size sampling scheme. 25 households in each community constituted a cluster by geography of house address. We randomly selected three clusters, totally 75 households, in each community. Dietary data of 30 households, which were constituted from 25 households in the first cluster and the first five households in second cluster, were collected using three consecutive 24-h dietary recalls. The rest 20 households in second cluster and 25 households in the third cluster were investigated, using instant food questionnaire and food frequency questionnaire to obtain dietary data. The survey was conducted from August to October in each calendar year.

In the present study, we only used dietary data from three consecutive 24-h dietary recalls to compare nutrient intakes between Chinese and other types of diets. That was because 24-h dietary recalls obtained extensive and complete data on all foods and beverages consumed, and then it provided a more precise assessment of intake of nutrients than food frequency methods [15,16]. Overall, 8175 subjects (3908 males and 4267 females) were recruited in this nutrition survey. Among them, 2659 individuals (1274 males and 1385 females) aged 2.0–89.2 years, participating in 24-h dietary recalls, were selected in the present study. The protocol of this survey was approved by the Medical Ethical Committee of Zhejiang Provincial Center of Disease Control and Prevention (CDC), and written informed consent was obtained from all participants.

2.2. Dietary Assessment

In this study, dietary intakes at the individual level for all household members aged ≥2 years were collected by well-trained CDC workers, using three consecutive 24-h dietary recalls (two weekdays and one weekend day) [2,17]. For the younger children aged below 12 years, their parents or primary caregivers were asked to recall the child's food consumption. The investigated information included the type and amount of all food items and consumption place by the aid of food models and pictures.
Additionally, home cooking oil and condiment consumption in each household were collected with a household food inventory weighing method on the same 3 days. The percentage of the oil and condiments of each family member was calculated by the ratio of his or her energy intake to the energy intake of all family members [18]. The daily intake of energy and nutrients was averaged over 3 days to assess usual dietary intake. The main nutrients of interest were total energy, carbohydrate, protein, fat, fiber and cholesterol, and intake of vitamins and minerals. Nutrient intakes for each food item consumed were calculated by multiplying the nutrient content listed in the Chinese Food Composition Table (FCT) [19]. Total dietary intake of each nutrient was calculated by adding the intake of that nutrient from each food item consumed.

2.3. Anthropometric and Demographic Variables Assessment

Anthropometric measurement (only for subjects aged ≥6 years) and demographic variables were collected from each individual. Body weight and height were respectively measured to the nearest 0.1 kg and 0.1 cm when the subjects wore light clothing and no shoes. Body mass index (BMI) was calculated as weight (kg)/height squared (m²). Waist circumference was measured to the nearest 0.1 cm at the midpoint between the top of the iliac crest and the lower margin of the last palpable rib in the mid axillary line using a tape measure. A questionnaire was used to collect information on demographic variables, including age, sex, educational level, marital status, occupation, annual family income, smoking and alcohol consumption and history of diseases.

2.4. Data of Mediterranean, Japanese and Western Diets

To compare nutrient intakes between Chinese diet and Mediterranean, Japanese, and Western diets, the data of the third National Food Consumption Survey (INRAN-SCAI 2005–06) in Italy [7], the National Health and Nutrition Survey (2007) in Japan provided by National Institute of Health and Nutrition [20], and the National Health and Nutrition Examination Survey (NHANES 2009–2010) in America from CDC [21] were obtained from corresponding website, respectively.

2.5. Statistical Analysis

The data of energy and nutrient intakes were presented as mean ± SD by sex and age. Due to different age categories across countries, age categories were grouped as 1–6 years, 7–14 years, 15–19 years, 20–29 years, 30–39 years, 40–49 years, 50–59 years, 60–69 years, and 70 years and above in data of Japanese and American diets, while age categorized in children (3–9 years), teenagers (10–17 years), younger adults (18–64 years) and older adults (65 years and above) in data of Italian diets. When nutrient intakes were compared between Chinese and other country population, the age categories in Chinese population were grouped according to corresponding age categorization. Food energy was expressed as kilocalories (kcal). Vitamin A was expressed in retinol equivalents (REs). The distributions of variables between male and female subjects were tested using Student’s t-test for the continuous variables and Pearson’s χ² test for the categorical variables. Comparison of daily intake of nutrients adjusted for energy by age in Chinese was tested using one-way analysis of variance. Moreover, one-sample t-test was used to compare nutrient intakes between Chinese and Japanese,
Italian diets, and two-independent-sample \( t \)-test was used to compare nutrient intakes between Chinese and American diets. All statistical tests were two-tailed. We used the false discovery rate (FDR) to control the false rate of multiple testing [22], and \( p \) value less than 0.04 was considered statistically significant after FDR adjustment. All analyses were performed using Statistical Analysis System software version 9.2 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1. Characteristics of the Study Population in Chinese

The anthropometric and socio-demographic characteristics of the Chinese subjects by sex are presented in Table 1. Of 2659 participants, 47.91% were males. Mean ages of males and females were 49.43 and 47.80 years, respectively. Distributions of BMI, annual family income and history of diseases (hypertension, diabetes, dyslipidemia and stroke) were comparable between males and females. However, males were more likely to be married, higher educational level, longer waist circumference, and more tobacco smoking and alcohol drinking than females. In general, intake of energy and nutrients in males were significantly higher than those in females (Supplementary Table S1). Mean energy intakes were 2194.78 kcal and 1766.14 kcal for males and females, respectively. Compared with females, males consumed more cholesterol (323.10 mg \textit{versus} 289.91 mg), fat (89.06 g \textit{versus} 72.73 g), protein (73.01 g \textit{versus} 61.89 g) and carbohydrate (261.47 g \textit{versus} 219.11 g) except fiber (10.67 g \textit{versus} 10.21 g). However, the mean energy contributions from fat, protein and carbohydrate in males were 36.46%, 13.62% and 48.06%, respectively, which were mildly lower than those in females (37.03%, 14.27% and 49.44%, respectively) with no significant difference in fat. In addition, males consumed more calcium, phosphorus, potassium, sodium, iron, zinc, copper, selenium, manganese, vitamin A, vitamin B\(_1\), vitamin B\(_2\) and vitamin E (all \( p < 0.05 \)) except vitamin C (\( p > 0.05 \)). Besides, we also presented the details of energy and nutrient intakes in Chinese by age and sex in Tables 2–6.

Table 1. The distributions of socio-demographic characteristics of study subjects by sex in the Chinese group (\( N = 2659 \)).

| Variables                   | Males (\( N = 1274 \)) | Females (\( N = 1385 \)) | \( p \) value |
|-----------------------------|------------------------|---------------------------|---------------|
| Mean ± SD                   |                        |                           |               |
| Age, year                   | 49.43 ± 18.77          | 47.80 ± 18.21             | 0.0229 *      |
| Height, cm                  | 165.15 ± 9.37          | 154.93 ± 7.22             | <0.0001       |
| Weight, kg                  | 63.37 ± 12.59          | 55.33 ± 10.17             | <0.0001       |
| Body mass index, kg/m\(^2\) | 23.06 ± 3.54           | 22.95 ± 3.55              | 0.4271        |
| Waist circumference, cm     | 82.55 ± 11.11          | 78.65 ± 10.50             | <0.0001       |

| Education                   |                        |                           | \( p \) value |
|-----------------------------|------------------------|---------------------------|---------------|
| Primary school or below     | 549 (43.09)            | 714 (51.55)               | \( <0.0001 \) |
| Junior or senior high school| 636 (49.92)            | 586 (42.31)               |               |
| College or above            | 89 (6.99)              | 85 (6.14)                 |               |
| Missing                     | --                     | --                        |               |
Table 1. Cont.

| Marital status      | 0.0008 |
|---------------------|--------|
| No                  | 205 (16.09) | 293 (21.16) |
| Yes                 | 1069 (83.91) | 1092 (78.84) |
| Missing             | --      | --         |

| Occupation          | <0.0001 |
|---------------------|---------|
| Student             | 98 (7.69) | 113 (8.16) |
| Mental worker       | 120 (9.42) | 79 (5.70) |
| Manual worker       | 553 (43.41) | 508 (36.68) |
| Retiree             | 203 (15.93) | 265 (19.13) |
| Other               | 300 (23.55) | 420 (30.32) |
| Missing             | --      | --         |

| Income, yuan/year   | 0.7306 |
|---------------------|--------|
| <10,000             | 252 (21.25) | 291 (22.45) |
| 10,000–30,000       | 759 (64.00) | 811 (62.58) |
| >30,000             | 175 (14.76) | 194 (14.97) |
| Missing             | 88      | 89         |

| Tobacco smoking     | <0.0001 |
|---------------------|---------|
| No                  | 558 (47.57) | 1254 (98.51) |
| Yes                 | 615 (52.43) | 19 (1.49)    |
| Missing             | 101     | 112        |

| Alcohol drinking    | <0.0001 |
|---------------------|---------|
| No                  | 529 (45.1) | 991 (77.79) |
| Yes                 | 644 (54.9) | 283 (22.21) |
| Missing             | 101     | 111        |

| Hypertension        | 0.2011  |
|---------------------|---------|
| No                  | 899 (78.38) | 960 (76.19) |
| Yes                 | 248 (21.62) | 300 (23.81) |
| Missing             | 127     | 125        |

| Diabetes            | 0.3341  |
|---------------------|---------|
| No                  | 591 (88.08) | 672 (86.38) |
| Yes                 | 80 (11.92)  | 106 (13.62) |
| Missing             | 603     | 607        |

| Dyslipidemia        | 0.8895  |
|---------------------|---------|
| No                  | 492 (85.86) | 582 (85.59) |
| Yes                 | 81 (14.14)  | 98 (14.41)  |
| Missing             | 701     | 705        |

| Stroke              | 0.1418  |
|---------------------|---------|
| No                  | 1153 (98.29) | 1262 (98.98) |
| Yes                 | 20 (1.71)   | 13 (1.02)    |
| Missing             | 101     | 110        |

* Bold represents statistical significance.
Table 2. Comparison of daily intake of energy and macronutrients by age and sex in the Chinese, Japanese and American groups.

| Energy, Macronutrients and Age | Males (N = 1274) | Females (N = 1385) |
|-------------------------------|-------------------|--------------------|
|                               | Chinese           | Japanese           | American           |
|                               | N        | Mean ± SD | N        | Mean ± SD | N        | Mean ± SD |
| Total energy, kcal            |         |           |         |           |         |           |
| 1–6                           | 37      | 1287 ± 610 | 243     | 1389      | 552     | 1522 ± 463 *| 33      | 1027 ± 366 | 245     | 1270 *    | 539     | 1441 ± 439 *|
| 7–14                          | 63      | 1777 ± 702 | 392     | 2103 *    | 622     | 1997 ± 617 *| 75      | 1524 ± 494 | 403     | 1871 *    | 594     | 1830 ± 551 *|
| 15–19                         | 23      | 1951 ± 687 | 201     | 2440 *    | 360     | 2505 ± 923 *| 29      | 1579 ± 568 | 192     | 1873 *    | 316     | 1806 ± 653 |
| 20–29                         | 61      | 2229 ± 771 | 304     | 2183      | 363     | 2553 ± 959 *| 84      | 1959 ± 1242| 361     | 1684      | 446     | 1877 ± 645 |
| 30–39                         | 147     | 2270 ± 901 | 540     | 2208      | 394     | 2672 ± 966 *| 185     | 1802 ± 587 | 661     | 1725      | 442     | 1835 ± 587 |
| 40–49                         | 267     | 2423 ± 842 | 537     | 2153 *    | 407     | 2601 ± 929 *| 292     | 1898 ± 610 | 570     | 1719 *    | 508     | 1759 ± 573 *|
| 50–59                         | 259     | 2339 ± 855 | 587     | 2214 *    | 407     | 2387 ± 914  | 301     | 1858 ± 692 | 681     | 1774 *    | 384     | 1715 ± 576 *|
| 60–69                         | 255     | 2150 ± 846 | 664     | 2195      | 399     | 2071 ± 724  | 263     | 1696 ± 765 | 762     | 1759      | 401     | 1633 ± 563 *|
| ≥70                           | 162     | 1982 ± 769 | 696     | 1982      | 417     | 1884 ± 587  | 123     | 1583 ± 589 | 846     | 1613      | 469     | 1509 ± 515 |
| Carbohydrate, g               |         |           |         |           |         |           |
| 1–6                           | 37      | 161.2 ± 97.9| 243     | 195.9 *   | 552     | 207.1 ± 68.4 *| 33      | 115.1 ± 47.0| 245     | 174.7 *   | 539     | 195.3 ± 64.1 *|
| 7–14                          | 63      | 207.9 ± 89.9| 392     | 268.1 *   | 622     | 265.9 ± 85.8 *| 75      | 182.3 ± 79.0| 403     | 251.6 *   | 594     | 247.3 ± 77.4 *|
| 15–19                         | 23      | 250.5 ± 102.2| 201    | 333.6 *   | 360     | 323.4 ± 125.4 *| 29      | 184.2 ± 78.9| 192     | 245.4 *   | 316     | 237.5 ± 90.1 *|
| 20–29                         | 61      | 254.0 ± 114.1| 304    | 300.2 *   | 363     | 319.4 ± 126.4 *| 84      | 238.2 ± 231.3| 361     | 223.2      | 446     | 244.6 ± 89.1 |
| 30–39                         | 147     | 269.0 ± 142.3| 540    | 299.3 *   | 394     | 322.3 ± 129.7 *| 185     | 212.0 ± 91.8 | 661     | 235.4 *   | 442     | 232.2 ± 82.0 *|
| 40–49                         | 267     | 279.8 ± 111.1| 537    | 290.4     | 407     | 314.4 ± 120.5 *| 292     | 233.8 ± 91.2 | 570     | 233.1      | 508     | 226.3 ± 82.8 |
| 50–59                         | 259     | 275.1 ± 115.3| 587    | 296.8 *   | 407     | 282.6 ± 114.7 | 301     | 234.4 ± 102.9| 681     | 248.2 *   | 384     | 217.6 ± 82.8 *|
| 60–69                         | 255     | 266.0 ± 129.2| 664    | 306.7 *   | 399     | 247.9 ± 91.6  | 263     | 215.4 ± 116.5| 762     | 256.7 *   | 401     | 203.5 ± 74.8 |
| ≥70                           | 162     | 243.6 ± 102.1| 696    | 289.1 *   | 417     | 230.5 ± 78.3  | 123     | 211.0 ± 91.0 | 846     | 244.1 *   | 469     | 194.1 ± 70.9 |
### Table 2. Cont.

| Protein, g | 1–6 | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70  |
|------------|-----|------|-------|-------|-------|-------|-------|-------|------|
|            |     |      |       |       |       |       |       |       |      |
|            | 37  | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162  |
|            | 41.8 ± 20.0 | 60.3 ± 26.4 | 69.0 ± 28.9 | 77.3 ± 27.8 | 77.1 ± 32.6 | 76.7 ± 29.5 | 76.3 ± 28.7 | 73.0 ± 33.4 | 69.0 ± 29.3 |
|            | 243 | 392  | 201   | 304   | 540   | 537   | 587   | 664   | 696   |
|            | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 | 53.2 ± 28.2 |
|            | 48.8 * | 75.3 * | 87.5 * | 76.7 | 76.6 | 75.8 | 80.5 * | 80.9 | 74.8 * |
|            | 552 | 622  | 360   | 363   | 394   | 407   | 407   | 399   | 617   |
|            | 56.6 ± 19.0 * | 73.7 ± 26.6 * | 96.2 ± 42.2 * | 99.4 ± 40.4 * | 104.4 ± 39.1 * | 102.1 ± 37.9 * | 95.8 ± 39.0 * | 84.6 ± 34.1 * | 74.4 ± 25.6 * |
|            | 245 | 403  | 192   | 84    | 185   | 292   | 301   | 263   | 123   |
|            | 44.7 * | 67.7 * | 68.3 * | 69.9 ± 38.3 | 63.2 ± 21.6 | 63.4 ± 23.3 | 66.1 ± 31.6 | 62.4 ± 32.5 | 53.9 ± 23.4 |
|            | 559 | 594  |      | 646   |       | 687   |       | 442   |       |
|            | 53.9 ± 18.9 * | 66.3 ± 22.8 * |      | 68.7 ± 24.6 * |       | 72.0 ± 25.2 * |       | 67.1 ± 24.0 |       |
|            |      |      |      |       |       | 69.0 ± 23.2 |       | 69.0 ± 23.2 |       |
|            |      |      |      |       |       | 69.1 ± 24.9 * |       | 67.1 ± 24.0 |       |
|            |      |      |      |       |       | 60.0 ± 23.0 |       |       |       |

| Fat, g     | 1–6 | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70  |
|------------|-----|------|-------|-------|-------|-------|-------|-------|------|
|            |     |      |       |       |       |       |       |       |      |
|            | 37  | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162  |
|            | 53.2 ± 28.2 | 80.4 ± 45.4 | 77.1 ± 36.7 | 77.1 ± 36.7 | 73.0 ± 33.4 | 76.7 ± 29.5 | 76.3 ± 28.7 | 73.0 ± 33.4 | 69.0 ± 29.3 |
|            | 243 | 392  | 201   | 304   | 540   | 537   | 587   | 664   | 696   |
|            | 43.8 | 69.6 | 78.2 | 66.3 | 80.9 | 65.1 | 80.5 | 80.9 | 74.8 |
|            | 552 | 622  | 360   | 363   | 394   | 394   | 407   | 399   | 617   |
|            | 54.0 ± 19.8 | 73.2 ± 27.9 | 91.6 ± 40.2 | 89.0 ± 40.8 * | 84.6 ± 34.1 * | 96.1 ± 43.4 | 95.8 ± 39.0 * | 84.6 ± 34.1 * | 74.4 ± 25.6 * |
|            | 245 | 403  | 292   | 84    | 263   | 185   | 301   | 263   | 123   |
|            | 44.7 | 67.7 | 68.9 | 63.2 | 69.1 | 79.3 | 66.1 | 69.1 | 53.9 |
|            | 594 | 508  | 570   | 361   | 446   | 442   | 384   | 442   | 469   |
|            | 51.4 ± 19.2 | 66.4 ± 25.6 | 67.7 ± 30.5 * | 67.5 ± 29.7 * | 68.1 ± 29.0 * | 54.4 * | 67.5 ± 29.7 * | 68.1 ± 29.0 * | 60.0 ± 23.0 |
|            |      |      |       |       |       |       |       |       |      |
|            |      |      |       |       |       |       |       |       |      |
|            |      |      |       |       |       |       |       |       |      |
|            |      |      |       |       |       |       |       |       |      |
|            |      |      |       |       |       |       |       |       |      |
## Table 2. Cont.

| Fiber, g | 1–6 | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70 |
|----------|-----|------|-------|-------|-------|-------|-------|-------|-----|
| 1–6      | 37  | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162 |
| 7–14     | 63  | 7.5±5.5 | 13.3±6.0 | 75  | 7.0±4.9 | 75  | 7.0±4.9 | 75  | 7.0±4.9 |
| 15–19    | 23  | 8.6±5.5 | 13.2±6.0 | 75  | 7.0±4.9 | 75  | 7.0±4.9 | 75  | 7.0±4.9 |
| 20–29    | 61  | 9.8±7.7 | 12.6±6.0 | 84  | 10.0±6.7 | 84  | 10.0±6.7 | 84  | 10.0±6.7 |
| 30–39    | 147 | 10.3±6.7 | 12.9±6.0 | 185 | 9.9±6.1 | 185 | 9.9±6.1 | 185 | 9.9±6.1 |
| 40–49    | 267 | 10.4±6.3 | 13.2±6.0 | 292 | 10.2±9.2 | 292 | 10.2±9.2 | 292 | 10.2±9.2 |
| 50–59    | 259 | 11.5±8.6 | 14.7±6.0 | 301 | 11.9±9.4 | 301 | 11.9±9.4 | 301 | 11.9±9.4 |
| 60–69    | 255 | 12.2±8.5 | 16.9±6.0 | 263 | 10.5±6.6 | 263 | 10.5±6.6 | 263 | 10.5±6.6 |
| ≥70      | 162 | 11.0±7.9 | 16.5±6.0 | 123 | 10.0±7.5 | 123 | 10.0±7.5 | 123 | 10.0±7.5 |

| Cholesterol, mg | 1–6 | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70 |
|-----------------|-----|------|-------|-------|-------|-------|-------|-------|-----|
| 1–6             | 37  | 262±169 | 243  | 244  | 552  | 185.3±118.1 | 33  | 297±240 | 245 |
| 7–14            | 63  | 308±217 | 392  | 352  | 622  | 229.8±128.0 | 75  | 236±160 | 403 |
| 15–19           | 23  | 321±190 | 201  | 467±6.0 | 360  | 299.1±181.4 | 29  | 373±282 | 192 |
| 20–29           | 61  | 360±212 | 304  | 369  | 363  | 330.8±189.8 | 84  | 362±247 | 361 |
| 30–39           | 147 | 353±230 | 540  | 365  | 394  | 345.5±197.0 | 185 | 309±184 | 661 |
| 40–49           | 267 | 329±256 | 537  | 351  | 407  | 354.5±206.2 | 292 | 295±239 | 570 |
| 50–59           | 259 | 344±241 | 587  | 369  | 407  | 343.3±234.1 | 301 | 297±229 | 681 |
| 60–69           | 253 | 315±256 | 664  | 353±6.0 | 399  | 304.3±180.5 | 260 | 285±234 | 762 |
| ≥70             | 161 | 271±183 | 696  | 317±6.0 | 417  | 273.4±163.6 | 122 | 206±182 | 846 |

*Significant difference compared to the reference group (1–6 g fiber)
Table 2. Cont.

% Total energy from Carbohydrate, %

|       | 1–6  | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70   |
|-------|------|------|-------|-------|-------|-------|-------|-------|-------|
|       |      |      |       |       |       |       |       |       |       |
| Carbohydrate, % | 37   | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162   |
|       | 48.7 ± 13.3 | 47.9 ± 13.1 | 52.0 ± 12.8 | 45.6 ± 11.4 | 46.6 ± 12.0 | 47.0 ± 12.7 | 47.7 ± 11.9 | 49.3 ± 11.9 | 50.1 ± 12.8 |
|       | 243  | 392  | 201   | 304   | 540   | 537   | 587   | 664   | 696   |
|       | 58.2 * | 56.1 * | 57.1   | 58.9 * | 59.8 * | 60.6 * | 60.9 * | 62.5 * | 63.4 |
|       | 552  | 622  | 360   | 363   | 394   | 407   | 407   | 399   | 417   |
|       | 54.4 ± 7.2 * | 53.5 ± 7.3 * | 51.9 ± 8.5 | 50.5 ± 8.9 * | 48.6 ± 10.2 | 48.8 ± 9.1 | 47.9 ± 9.9 | 48.5 ± 9.5 | 49.3 ± 8.9 |
|       | 33   | 75   | 29    | 84    | 185   | 292   | 301   | 263   | 123   |
|       | 45.6 ± 10.9 | 47.8 ± 12.4 | 46.9 ± 11.9 | 46.7 ± 11.6 | 46.6 ± 12.3 | 49.6 ± 12.9 | 50.3 ± 11.3 | 50.3 ± 12.0 | 53.9 ± 14.2 |
|       | 245  | 403  | 192   | 361   | 661   | 570   | 681   | 762   | 846   |
|       | 56.8 * | 55.2 * | 54.5 * | 55.9 * | 57.4 * | 57.3 * | 58.2 * | 60.1 * | 62.3 * |
|       | 539  | 594  | 316   | 446   | 442   | 508   | 384   | 401   | 469   |
|       | 54.3 ± 7.7 * | 54.3 ± 6.9 * | 52.8 ± 8.1 * | 52.5 ± 8.2 * | 51.0 ± 9.3 * | 51.5 ± 9.2 | 50.9 ± 9.9 | 50.3 ± 9.3 | 51.7 ± 8.5 * |

Protein, %

|       | 1–6  | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70   |
|-------|------|------|-------|-------|-------|-------|-------|-------|-------|
|       |      |      |       |       |       |       |       |       |       |
| Protein, % | 37   | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162   |
|       | 13.2 ± 3.2 | 13.7 ± 3.3 | 14.1 ± 3.2 | 14.0 ± 2.9 | 13.9 ± 3.5 | 13.0 ± 3.5 | 13.4 ± 3.4 | 13.8 ± 3.5 | 14.3 ± 3.9 |
|       | 243  | 392  | 201   | 304   | 540   | 537   | 587   | 664   | 696   |
|       | 14   | 14.4 | 14.5  | 14.2  | 14    | 14.3  | 14.6  | 14.9  | 15.1 |
|       | 552  | 622  | 360   | 363   | 394   | 407   | 407   | 399   | 417   |
|       | 15.0 ± 3.0 * | 14.9 ± 3.2 * | 15.6 ± 4.1 | 15.8 ± 3.9 | 16.1 ± 4.5 * | 16.0 ± 3.7 | 16.3 ± 3.9 * | 16.6 ± 4.1 * | 16.0 ± 3.8 |
|       | 33   | 75   | 29    | 84    | 185   | 292   | 301   | 263   | 123   |
|       | 14.3 ± 3.2 | 13.8 ± 3.2 | 14.1 ± 5.0 | 15.0 ± 4.6 | 14.5 ± 3.8 | 13.7 ± 3.9 | 14.3 ± 3.8 | 14.8 ± 4.0 | 13.7 ± 3.4 |
|       | 245  | 403  | 192   | 361   | 661   | 570   | 681   | 762   | 846   |
|       | 14   | 15   | 14.7  | 14.7  | 14.7  | 14.7  | 14.8  | 15.8  | 15.4 |
|       | 539  | 594  | 316   | 446   | 442   | 508   | 384   | 401   | 469   |
|       | 15.1 ± 3.3 | 14.6 ± 3.1 | 14.6 ± 3.7 | 14.9 ± 3.5 | 15.9 ± 3.7 | 15.9 ± 3.7 | 16.0 ± 4.0 | 16.5 ± 4.6 | 16.2 ± 4.2 |
Table 2. Cont.

| Fat, % | Chinese Males (N = 1274) | | | | Chinese Females (N = 1385) | | | |
|---|---|---|---|---|---|---|---|---|
| 1–6 | 37 | 38.2 ± 12.7 | 243 | 27.8 * | 552 | 31.8 ± 5.7 * | 33 | 40.6 ± 9.3 | 245 | 29.2 * | 539 | 31.8 ± 5.8 * |
| 7–14 | 63 | 39.4 ± 12.1 | 392 | 29.5 * | 622 | 32.7 ± 5.8 * | 75 | 39.4 ± 11.3 | 403 | 30.2 * | 594 | 32.2 ± 5.8 * |
| 15–19 | 23 | 35.0 ± 11.4 | 201 | 28.4 * | 360 | 32.6 ± 6.6 | 29 | 40.3 ± 11.3 | 192 | 30.8 * | 316 | 33.3 ± 6.7 * |
| 20–29 | 61 | 41.0 ± 11.0 | 304 | 26.9 * | 363 | 30.9 ± 6.6 * | 84 | 39.0 ± 10.6 | 361 | 29.1 * | 446 | 31.9 ± 6.7 * |
| 30–39 | 147 | 38.2 ± 10.8 | 540 | 26.2 * | 394 | 32.1 ± 7.7 * | 185 | 39.7 ± 11.0 | 661 | 27.9 * | 442 | 32.9 ± 7.3 * |
| 40–49 | 267 | 37.2 ± 10.9 | 537 | 25.1 * | 407 | 32.9 ± 7.6 * | 292 | 37.4 ± 11.7 | 570 | 27.9 * | 508 | 32.1 ± 7.0 * |
| 50–59 | 259 | 36.3 ± 10.9 | 587 | 24.5 * | 407 | 33.1 ± 7.6 * | 301 | 36.0 ± 10.9 | 681 | 26.4 * | 384 | 32.7 ± 7.8 * |
| 60–69 | 255 | 34.9 ± 11.0 | 664 | 22.6 * | 399 | 33.1 ± 7.6 * | 263 | 35.5 ± 10.9 | 762 | 24.1 * | 401 | 33.2 ± 7.9 * |
| ≥70 | 162 | 33.2 ± 10.7 | 696 | 21.5 * | 417 | 33.7 ± 6.9 | 123 | 33.5 ± 12.7 | 846 | 22.3 * | 469 | 32.8 ± 6.7 |

* p < 0.04 after FDR adjustment versus Chinese.

Table 3. Comparison of daily intake of minerals by age and sex in the Chinese, Japanese and American groups.

| Minerals and Age | Males (N = 1274) | | | | | | Females (N = 1385) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chinese | Japanese | American | | Chinese | Japanese | American | | | | |
| Calcium, mg | | | | | | | | | | | |
| 1–6 | 37 | 277 ± 148 | 243 | 456 * | 552 | 1044 ± 425 * | 33 | 263 ± 128 | 245 | 421 * | 539 | 988 ± 444 * |
| 7–14 | 63 | 354 ± 193 | 392 | 711 * | 622 | 1134 ± 503 * | 75 | 344 ± 164 | 403 | 623 * | 594 | 980 ± 523 * |
| 15–19 | 23 | 388 ± 212 | 201 | 578 * | 360 | 1233 ± 572 * | 29 | 344 ± 163 | 192 | 493 * | 316 | 873 ± 507 * |
| 20–29 | 61 | 416 ± 188 | 304 | 475 * | 363 | 1189 ± 641 * | 84 | 439 ± 285 | 361 | 445 | 446 | 902 ± 441 * |
| 30–39 | 147 | 468 ± 253 | 540 | 451 | 394 | 1189 ± 640 * | 185 | 406 ± 190 | 661 | 474 * | 442 | 934 ± 421 * |
| 40–49 | 267 | 453 ± 226 | 537 | 472 | 407 | 1107 ± 568 * | 292 | 389 ± 213 | 570 | 466 * | 508 | 865 ± 403 * |
| 50–59 | 259 | 466 ± 248 | 587 | 517 * | 407 | 1053 ± 565 * | 301 | 433 ± 264 | 681 | 542 * | 384 | 868 ± 431 * |
| 60–69 | 255 | 458 ± 241 | 664 | 589 * | 399 | 940 ± 558 * | 263 | 430 ± 256 | 762 | 580 * | 401 | 815 ± 433 * |
| ≥70 | 162 | 473 ± 267 | 696 | 587 * | 417 | 880 ± 429 * | 123 | 388 ± 236 | 846 | 553 * | 469 | 806 ± 412 * |
Table 3. Cont.

| Phosphorus, mg   | 1–6  | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70  |
|------------------|------|------|-------|-------|-------|-------|-------|-------|------|
|                  |      |      |       |       |       |       |       |       |      |
|                  | 37   | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162  |
| Phosphorus, mg   | 595 ± 282 | 812 ± 328 | 925 ± 364 | 1025 ± 347 | 1054 ± 440 | 1040 ± 373 | 1045 ± 379 | 1014 ± 438 | 1049 ± 465 |
|                  | 243  | 392  | 201   | 304   | 540   | 537   | 587   | 664   | 969   |
|                  | 744 * | 1140 * | 1192 * | 1030 | 1042 | 1046 | 1115 * | 1158 * | 1078 * |
|                  | 552  | 622  | 360   | 363   | 394   | 407   | 407   | 399   | 417   |
|                  | 1135 ± 370 * | 1364 ± 484 * | 1613 ± 627 * | 1640 ± 655 * | 1740 ± 658 * | 1683 ± 624 * | 1567 ± 618 * | 1396 ± 564 * | 1261 ± 434 * |
|                  | 33   | 75   | 29    | 84    | 185   | 292   | 301   | 263   | 123   |
|                  | 511 ± 198 | 707 ± 214 | 739 ± 269 | 940 ± 532 | 862 ± 274 | 864 ± 300 | 915 ± 413 | 874 ± 433 | 773 ± 329 |
|                  | 245  | 403  | 192   | 361   | 661   | 570   | 681   | 762   | 846   |
|                  | 683 * | 1033 * | 955 * | 875   | 895   | 898   | 984   | 1010 | 925 * |
|                  | 539  | 594  | 316   | 446   | 442   | 508   | 384   | 401   | 469   |
|                  | 1071 ± 376 * | 1208 ± 405 * | 1132 ± 475 * | 1192 ± 436 * | 1257 ± 441 * | 1181 ± 403 * | 1157 ± 418 * | 1128 ± 423 * | 1052 ± 398 * |

| Potassium, mg    | 1–6  | 7–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | ≥70  |
|------------------|------|------|-------|-------|-------|-------|-------|-------|------|
|                  |      |      |       |       |       |       |       |       |      |
|                  | 37   | 63   | 23    | 61    | 147   | 267   | 259   | 255   | 162  |
| Potassium, mg    | 950 ± 465 | 1375 ± 746 | 1661 ± 878 | 1704 ± 763 | 1808 ± 785 | 1771 ± 715 | 1827 ± 841 | 1800 ± 850 | 1733 ± 911 |
|                  | 243  | 392  | 201   | 304   | 304   | 537   | 587   | 664   | 696   |
|                  | 1571 * | 2356 * | 2329 * | 2181 * | 2204 * | 2266 * | 2518 * | 2742 * | 1078 * |
|                  | 552  | 622  | 360   | 363   | 363   | 407   | 407   | 399   | 417   |
|                  | 2108 ± 670 * | 2272 ± 797 * | 2761 ± 1177 * | 2860 ± 1195 * | 3132 ± 1216 * | 3180 ± 1343 * | 3082 ± 1164 * | 2906 ± 1133 * | 1261 ± 434 * |
|                  | 33   | 75   | 29    | 84    | 185   | 292   | 301   | 263   | 123   |
|                  | 924 ± 449 | 1231 ± 470 | 1389 ± 639 | 1672 ± 998 | 1577 ± 614 | 1564 ± 704 | 1693 ± 846 | 1603 ± 834 | 1463 ± 789 |
|                  | 245  | 403  | 192   | 681   | 661   | 570   | 681   | 762   | 846   |
|                  | 1455 * | 2145 * | 2052 * | 1913 * | 2018 * | 2088 * | 2425 * | 2613 * | 2401 * |
|                  | 539  | 594  | 316   | 446   | 442   | 508   | 384   | 401   | 469   |
|                  | 1995 ± 649 * | 2134 ± 773 * | 1968 ± 782 * | 2195 ± 863 * | 2431 ± 890 * | 2392 ± 851 * | 2450 ± 888 * | 2390 ± 891 * | 2323 ± 857 * |
### Table 3. Cont.

| Sodium, mg | 1–6 | 37   | 3719 ± 3757 | 243 | 2559 | 552  | 2242 ± 816 * | 33   | 2749 ± 1813 | 245 | 2323 | 539 | 2146 ± 788 |
|           | 7–14 | 63   | 4374 ± 2242 | 392 | 3858 | 622  | 3247 ± 1212 * | 75   | 4371 ± 2501 | 403 | 3543 * | 594 | 2953 ± 1004 * |
|           | 15–19 | 23   | 4228 ± 1807 | 201 | 4606 | 360  | 4135 ± 1689 | 29   | 3637 ± 2015 | 192 | 3740 | 316 | 2932 ± 1195 |
|           | 20–29 | 61   | 4711 ± 2125 | 304 | 4488 | 363  | 4248 ± 1729 | 84   | 5112 ± 3326 | 361 | 3701 * | 446 | 3116 ± 1107 * |
|           | 30–39 | 147  | 6081 ± 4251 | 540 | 4449 * | 394  | 4428 ± 1713 * | 185  | 5112 ± 3393 | 661 | 3776 * | 442 | 3061 ± 1063 * |
|           | 40–49 | 267  | 6664 ± 6882 | 537 | 4606 * | 407  | 4346 ± 1768 * | 292  | 6121 ± 10810 | 570 | 3898 * | 508 | 2905 ± 1032 * |
|           | 50–59 | 259  | 7344 ± 6507 | 587 | 4961 * | 407  | 3955 ± 1636 * | 301  | 5703 ± 4413 | 681 | 4252 * | 384 | 2791 ± 1037 * |
|           | 60–69 | 255  | 6061 ± 5731 | 664 | 4961 * | 399  | 3575 ± 1404 * | 263  | 5307 ± 5011 | 762 | 4291 * | 401 | 2775 ± 1071 * |
|           | ≥70   | 162  | 5540 ± 3385 | 696 | 4685 * | 417  | 3210 ± 1061 * | 123  | 5148 ± 4228 | 846 | 4094 * | 469 | 2553 ± 968 * |

| Magnesium, mg | 1–6 | 37   | 148 ± 72 | 243 | 158 | 552  | 209 ± 69 * | 33   | 141 ± 61 | 245 | 144 | 539 | 196 ± 65 * |
|               | 7–14 | 63   | 212 ± 101 | 392 | 238 | 622  | 244 ± 89 * | 75   | 198 ± 66 | 403 | 216 * | 594 | 227 ± 81 * |
|               | 15–19 | 23   | 241 ± 96 | 201 | 248 | 360  | 300 ± 122 * | 29   | 202 ± 68 | 192 | 216 | 316 | 217 ± 84 |
|               | 20–29 | 61   | 276 ± 110 | 304 | 241 * | 363  | 326 ± 137 * | 84   | 261 ± 168 | 361 | 204 * | 446 | 245 ± 95 |
|               | 30–39 | 147  | 295 ± 131 | 540 | 250 * | 394  | 358 ± 139 * | 185  | 248 ± 88 | 661 | 219 * | 442 | 272 ± 106 * |
|               | 40–49 | 267  | 299 ± 113 | 537 | 257 * | 407  | 357 ± 149 * | 292  | 254 ± 111 | 570 | 224 * | 508 | 265 ± 100 |
|               | 50–59 | 259  | 299 ± 116 | 587 | 279 * | 407  | 336 ± 127 * | 301  | 270 ± 123 | 681 | 256 * | 384 | 271 ± 102 |
|               | 60–69 | 255  | 300 ± 127 | 664 | 301 | 399  | 309 ± 125 | 263  | 262 ± 130 | 762 | 274 | 401 | 258 ± 95 |
|               | ≥70   | 162  | 284 ± 127 | 696 | 284 | 417  | 283 ± 125 | 123  | 231 ± 99 | 846 | 248 | 469 | 241 ± 94 |
Table 3. Cont.

| Iron, mg | 1–6 | 11.3 ± 5.1 | 243 | 4.9 * | 552 | 11.7 ± 5.1 | 33 | 11.3 ± 6.7 | 245 | 4.5 * | 539 | 11.1 ± 5.1 |
|---------|-----|------------|-----|-------|-----|------------|---|------------|-----|-------|-----|------------|
|         | 7–14| 17.3 ± 8.9 | 392 | 7.3 * | 622 | 15.5 ± 6.8 | 75 | 14.6 ± 5.7 | 403 | 6.6 * | 594 | 14.2 ± 6.1 |
|         | 15–19| 18.0 ± 7.6 | 201 | 8.4 * | 360 | 18.5 ± 9.6 | 29 | 15.0 ± 5.5 | 192 | 7.2 * | 316 | 12.6 ± 6.1 |
|         | 20–29| 21.5 ± 8.8 | 304 | 7.8 * | 363 | 18.0 ± 9.2 *| 84 | 18.7 ± 11.1| 361 | 7.1 * | 446 | 14.0 ± 7.2 *|
|         | 30–39| 22.5 ± 10.5| 540 | 8 * | 394 | 18.8 ± 9.2 *| 185 | 18.9 ± 7.0 | 661 | 7.5 * | 442 | 14.0 ± 6.1 *|
|         | 40–49| 23.1 ± 9.7 | 537 | 8 * | 407 | 18.5 ± 8.2 *| 292 | 19.9 ± 18.8| 570 | 7.1 * | 508 | 12.7 ± 5.3 *|
|         | 50–59| 23.7 ± 11.8| 587 | 8.7 *| 407 | 17.0 ± 8.4 *| 301 | 21.4 ± 17.3| 681 | 8.3 * | 384 | 12.9 ± 6.1 *|
|         | 60–69| 22.9 ± 12.3| 664 | 9.4 *| 399 | 15.8 ± 8.1 *| 263 | 19.9 ± 12.0| 762 | 9 * | 401 | 12.3 ± 5.8 *|
| ≥70     | 162 | 20.4 ± 9.0 | 696 | 9 * | 417 | 16.0 ± 7.3 *| 123 | 17.5 ± 12.1| 846 | 8.1 * | 469 | 12.4 ± 6.0 *|

| Zinc, mg | 1–6 | 6.3 ± 3.0 | 243 | 5.8 | 552 | 8.7 ± 3.5 *| 33 | 5.5 ± 2.4 | 245 | 5.4 | 539 | 8.3 ± 3.5 *|
|---------|-----|------------|-----|-----|-----|------------|---|----------|-----|-----|-----|------------|
|         | 7–14| 9.2 ± 3.6 | 392 | 9.3 | 622 | 11.5 ± 6.3 *| 75 | 7.8 ± 2.3 | 403 | 8.2 | 594 | 9.9 ± 4.2 *|
|         | 15–19| 10.6 ± 3.9| 201 | 11 | 360 | 13.9 ± 12.5 *| 29 | 8.1 ± 2.7 | 192 | 8.2 | 316 | 8.9 ± 4.3 |
|         | 20–29| 11.5 ± 3.8| 304 | 9.4 *| 363 | 13.7 ± 6.7 *| 84 | 10.5 ± 7.2 | 361 | 7.5 * | 446 | 9.6 ± 4.6 |
|         | 30–39| 12.0 ± 5.0 | 540 | 9.4 *| 394 | 14.6 ± 6.2 *| 185 | 9.6 ± 3.0 | 661 | 7.4 * | 442 | 10.2 ± 6.4 |
|         | 40–49| 12.4 ± 4.4 | 537 | 9.1 *| 407 | 14.3 ± 6.2 *| 292 | 10.0 ± 3.5 | 570 | 7.3 * | 508 | 9.7 ± 5.0 |
|         | 50–59| 12.1 ± 4.3 | 587 | 9.2 *| 407 | 13.6 ± 8.3 *| 301 | 10.3 ± 4.7 | 681 | 7.7 * | 384 | 9.9 ± 7.2 |
|         | 60–69| 11.6 ± 5.2 | 664 | 9.3 *| 399 | 11.9 ± 6.1 | 263 | 9.7 ± 5.0 | 762 | 7.8 * | 401 | 9.2 ± 4.5 |
| ≥70     | 162 | 10.6 ± 4.0 | 696 | 8.6 *| 417 | 11.7 ± 6.1 *| 123 | 8.4 ± 3.3 | 846 | 7.2 * | 469 | 9.2 ± 4.9 |
Table 3. Cont.

| Selenium, ug | 1–6  | 26.9 ± 14.2 | 243 | 552 | 74.5 ± 26.9 * | 33 | 27.4 ± 17.7 | 245 | 539 | 71.6 ± 26.3 * |
| 7–14         | 63   | 42.8 ± 31.4 | 392 | 622 | 101.5 ± 39.2 * | 75 | 31.8 ± 14.3 | 403 | 594 | 92.1 ± 34.8 * |
| 15–19        | 23   | 41.8 ± 22.0 | 201 | 360 | 130.1 ± 59.6 * | 29 | 36.4 ± 21.7 | 192 | 316 | 87.6 ± 35.2 * |
| 20–29        | 61   | 50.8 ± 24.9 | 304 | 363 | 138.5 ± 62.1 * | 84 | 48.7 ± 37.7 | 361 | 446 | 95.8 ± 35.8 * |
| 30–39        | 147  | 51.4 ± 28.7 | 540 | 394 | 142.7 ± 58.2 * | 185 | 44.8 ± 23.9 | 661 | 442 | 99.6 ± 37.6 * |
| 40–49        | 267  | 50.7 ± 33.3 | 537 | 407 | 140.4 ± 54.1 * | 292 | 39.4 ± 21.8 | 570 | 508 | 94.6 ± 36.3 * |
| 50–59        | 259  | 52.1 ± 29.7 | 587 | 407 | 129.0 ± 56.4 * | 301 | 45.8 ± 37.0 | 681 | 384 | 91.0 ± 35.3 * |
| 60–69        | 255  | 48.6 ± 32.6 | 664 | 399 | 117.2 ± 47.7 * | 263 | 46.3 ± 34.9 | 762 | 401 | 91.1 ± 38.0 * |
| ≥70          | 162  | 46.0 ± 26.7 | 696 | 417 | 103.0 ± 37.1 * | 123 | 35.9 ± 23.9 | 846 | 469 | 81.3 ± 34.5 * |

| Copper, mg   | 1–6  | 1.2 ± 0.9 | 243 | 0.75 * | 552 | 0.8 ± 0.3 * | 33 | 1.0 ± 0.6 | 245 | 0.67 * | 539 | 0.8 ± 0.4 |
| 7–14         | 63   | 2.0 ± 1.4 | 392 | 1.13 * | 622 | 1.0 ± 0.5 * | 75 | 1.4 ± 0.5 | 403 | 1.03 * | 594 | 1.0 ± 0.4 * |
| 15–19        | 23   | 1.9 ± 1.1 | 201 | 1.32 * | 360 | 1.3 ± 0.9 * | 29 | 1.6 ± 1.0 | 192 | 1.03 * | 316 | 0.9 ± 0.4 * |
| 20–29        | 61   | 2.2 ± 1.4 | 304 | 1.23 * | 363 | 1.4 ± 0.7 * | 84 | 2.0 ± 1.5 | 361 | 1.00 * | 446 | 1.1 ± 0.6 * |
| 30–39        | 147  | 2.1 ± 1.2 | 540 | 1.24 * | 394 | 1.5 ± 0.7 * | 185 | 1.8 ± 0.8 | 661 | 1.02 * | 442 | 1.2 ± 0.7 * |
| 40–49        | 267  | 2.2 ± 1.0 | 537 | 1.25 * | 407 | 1.5 ± 0.7 * | 292 | 1.9 ± 1.0 | 570 | 1.02 * | 508 | 1.2 ± 0.9 * |
| 50–59        | 259  | 2.2 ± 1.2 | 587 | 1.32 * | 407 | 1.4 ± 0.7 * | 301 | 2.1 ± 1.6 | 681 | 1.16 * | 384 | 1.2 ± 0.8 * |
| 60–69        | 255  | 2.2 ± 1.2 | 664 | 1.4 * | 399 | 1.3 ± 0.6 * | 263 | 1.8 ± 1.2 | 762 | 1.23 * | 401 | 1.2 ± 1.1 * |
| ≥70          | 162  | 2.0 ± 1.2 | 696 | 1.33 * | 417 | 1.3 ± 1.5 * | 123 | 1.8 ± 1.1 | 846 | 1.15 * | 469 | 1.1 ± 0.7 * |

* p < 0.04 after FDR adjustment, versus Chinese.
Table 4. Comparison of daily intake of vitamins by age and sex in the Chinese, Japanese and American groups.

| Vitamins and Age | Males (N = 1274) | | | Females (N = 1385) | | |
|------------------|------------------|-------|------------------|-------|-------|-------|
|                  | Chinese          | Japanese | American         | Chinese | Japanese | American |
|                  | N               | Mean ± SD | N               | Mean ± SD | N               | Mean ± SD |
| Vitamin A, μg REs & | | | | | | |
| 1–6              | 37              | 277 ± 397 | 243              | 419 * | 552              | 589 ± 263 * |
|                  | 539             | 570 ± 288 * |
| 7–14             | 63              | 377 ± 395 | 392              | 618 * | 622              | 641 ± 369 * |
|                  | 594             | 569 ± 307 * |
| 15–19            | 23              | 364 ± 237 | 201              | 805 * | 360              | 640 ± 390 * |
|                  | 316             | 469 ± 338 |
| 20–29            | 61              | 482 ± 630 | 304              | 603 * | 363              | 617 ± 469 |
|                  | 446             | 550 ± 463 * |
| 30–39            | 147             | 577 ± 1020 | 540              | 592 * | 394              | 669 ± 522 |
|                  | 661             | 529 ± 442 |
| 40–49            | 267             | 444 ± 498 | 537              | 630 * | 407              | 650 ± 461 * |
|                  | 508             | 569 ± 398 * |
| 50–59            | 259             | 554 ± 969 | 587              | 601 * | 407              | 650 ± 451 |
|                  | 681             | 612 ± 442 |
| 60–69            | 255             | 453 ± 466 | 664              | 674 * | 399              | 628 ± 463 |
|                  | 594             | 569 ± 307 * |
| ≥70              | 162             | 445 ± 444 | 696              | 750 * | 417              | 772 ± 949 * |
|                  | 539             | 651 ± 468 * |
| Vitamin B₁, mg   | | | | | | |
| 1–6              | 37              | 0.51 ± 0.28 | 243              | 0.61 * | 552              | 1.30 ± 0.52 * |
|                  | 539             | 1.22 ± 0.46 * |
| 7–14             | 63              | 0.72 ± 0.38 | 392              | 1.28 * | 622              | 1.72 ± 0.68 * |
|                  | 594             | 1.54 ± 0.60 * |
| 15–19            | 23              | 0.80 ± 0.31 | 201              | 1.42 * | 360              | 1.97 ± 0.90 * |
|                  | 316             | 1.33 ± 0.58 * |
| 20–29            | 61              | 0.98 ± 0.47 | 304              | 1.39 * | 363              | 1.97 ± 0.97 * |
|                  | 446             | 1.48 ± 0.67 * |
| 30–39            | 147             | 1.03 ± 0.52 | 540              | 1.23 * | 394              | 2.05 ± 1.06 * |
|                  | 442             | 1.48 ± 0.61 * |
| 40–49            | 267             | 1.14 ± 0.64 | 537              | 1.25 * | 407              | 2.01 ± 0.90 * |
|                  | 508             | 1.35 ± 0.54 * |
| 50–59            | 259             | 1.08 ± 0.61 | 587              | 1.42 * | 407              | 1.84 ± 0.83 * |
|                  | 384             | 1.36 ± 0.58 * |
| 60–69            | 255             | 0.91 ± 0.46 | 664              | 1.44 * | 399              | 1.70 ± 0.81 * |
|                  | 401             | 1.31 ± 0.57 * |
| ≥70              | 162             | 0.87 ± 0.48 | 696              | 1.71 * | 417              | 1.65 ± 0.68 * |
|                  | 469             | 1.31 ± 0.57 * |
Table 4. Cont.

| Vitamin B<sub>2</sub>, mg |       |       |       |       |       |       |       |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|
| 1–6                     | 37    | 0.55 ± 0.29 | 243  | 0.91 * | 552  | 1.91 ± 0.68 * | 33   | 0.48 ± 0.24 | 245  | 0.82 * | 539  | 1.81 ± 0.69 * |
| 7–14                    | 63    | 0.71 ± 0.33 | 392  | 1.38 * | 622  | 2.14 ± 0.84 * | 75   | 0.59 ± 0.21 | 403  | 1.33 * | 594  | 1.85 ± 0.71 * |
| 15–19                   | 23    | 0.81 ± 0.39 | 201  | 1.75 * | 360  | 2.32 ± 1.17 * | 29   | 0.66 ± 0.25 | 192  | 1.27 * | 316  | 1.59 ± 0.84 * |
| 20–29                   | 61    | 0.85 ± 0.36 | 304  | 1.43 * | 363  | 2.33 ± 1.42 * | 84   | 0.81 ± 0.44 | 361  | 1.39 * | 446  | 1.77 ± 1.01 * |
| 30–39                   | 147   | 0.91 ± 0.50 | 540  | 1.34 * | 394  | 2.54 ± 1.37 * | 185  | 0.73 ± 0.29 | 661  | 1.41 * | 442  | 1.87 ± 0.80 * |
| 40–49                   | 267   | 0.90 ± 0.46 | 537  | 1.39 * | 407  | 2.44 ± 1.13 * | 292  | 0.73 ± 0.35 | 570  | 1.28 * | 508  | 1.79 ± 0.80 * |
| 50–59                   | 259   | 0.89 ± 0.40 | 587  | 1.62 * | 407  | 2.37 ± 1.23 * | 301  | 0.78 ± 0.44 | 681  | 1.56 * | 384  | 1.83 ± 0.83 * |
| 60–69                   | 255   | 0.85 ± 0.46 | 664  | 1.57 * | 399  | 2.16 ± 1.11 * | 263  | 0.75 ± 0.48 | 762  | 1.57 * | 401  | 1.75 ± 0.84 * |
| ≥70                     | 162   | 0.78 ± 0.37 | 696  | 1.5 *  | 417  | 2.17 ± 0.91 * | 123  | 0.61 ± 0.31 | 846  | 1.76 * | 469  | 1.74 ± 0.77 * |

| Niacin, mg              |       |       |       |       |       |       |       |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|
| 1–6                     | 37    | 8.2 ± 4.0   | 243  | 8.3    | 552  | 16.2 ± 6.5 * | 33   | 7.3 ± 3.6   | 245  | 7.6    | 539  | 15.2 ± 6.2 * |
| 7–14                    | 63    | 12.9 ± 5.8  | 392  | 12.9   | 622  | 23.1 ± 8.9 * | 75   | 10.4 ± 3.6  | 403  | 11.5   | 594  | 20.7 ± 7.8 * |
| 15–19                   | 23    | 15.8 ± 7.6  | 201  | 16.5   | 360  | 30.2 ± 14.7 *| 29   | 11.6 ± 5.2  | 192  | 13.3   | 316  | 19.7 ± 8.3 * |
| 20–29                   | 61    | 17.1 ± 6.0  | 304  | 16.9   | 363  | 31.9 ± 15.5 *| 84   | 14.7 ± 9.1  | 361  | 13.2   | 446  | 22.2 ± 9.5 * |
| 30–39                   | 147   | 17.5 ± 8.3  | 540  | 17.6   | 394  | 33.4 ± 14.0 *| 185  | 13.5 ± 4.7  | 661  | 13.3   | 442  | 22.0 ± 8.2 * |
| 40–49                   | 267   | 18.3 ± 8.0  | 537  | 17.5   | 407  | 31.8 ± 13.3 *| 292  | 13.9 ± 5.6  | 570  | 14.1   | 508  | 20.8 ± 8.1 * |
| 50–59                   | 259   | 18.1 ± 8.0  | 587  | 18.9   | 407  | 29.0 ± 13.1 *| 301  | 14.6 ± 7.6  | 681  | 15.2   | 384  | 20.5 ± 8.3 * |
| 60–69                   | 255   | 16.6 ± 7.6  | 664  | 18.7 * | 399  | 25.7 ± 11.1 *| 263  | 13.9 ± 7.5  | 762  | 15.4   | 401  | 19.6 ± 8.1 * |
| ≥70                     | 162   | 15.0 ± 7.2  | 696  | 16.2 * | 417  | 24.4 ± 10.5 *| 123  | 11.0 ± 4.5  | 846  | 13.5   | 469  | 18.5 ± 8.1 * |
Table 4. Cont.

| Vitamin C, mg |     |        |     |     |        |        |     |        |     |
|--------------|-----|--------|-----|-----|--------|--------|-----|--------|-----|
| 1–6          | 37  | 24.8 ± 20.5 | 243 | 55 * | 552    | 83 ± 55 * | 33  | 32.8 ± 22.6 | 245 |
| 7–14         | 63  | 44.7 ± 45.6  | 392 | 83 * | 622    | 77 ± 58 * | 75  | 43.0 ± 37.1  | 403 |
| 15–19        | 23  | 109.9 ± 156.0 | 201 | 108 | 360    | 101 ± 92 | 29  | 57.2 ± 44.3  | 192 |
| 20–29        | 61  | 62.4 ± 143.2 | 304 | 92  | 363    | 92 ± 96  | 84  | 58.9 ± 40.3  | 361 |
| 30–39        | 147 | 66.7 ± 45.2  | 540 | 85 * | 394    | 91 ± 79  | 185 | 62.3 ± 40.9  | 661 |
| 40–49        | 266 | 62.1 ± 43.2  | 537 | 87 * | 407    | 94 ± 92  | 292 | 60.5 ± 40.5  | 570 |
| 50–59        | 259 | 61.5 ± 44.0  | 587 | 115 *| 407    | 93 ± 86  | 301 | 67.9 ± 50.7  | 681 |
| 60–69        | 255 | 68.5 ± 49.3  | 664 | 135 *| 399    | 90 ± 88  | 263 | 72.9 ± 60.5  | 762 |
| ≥70          | 162 | 71.6 ± 52.1  | 696 | 131 *| 417    | 89 ± 74  | 123 | 59.8 ± 40.7  | 846 |

| Vitamin E, mg |     |        |     |     |        |        |     |        |     |
|---------------|-----|--------|-----|-----|--------|--------|-----|--------|-----|
| 1–6           | 37  | 17 ± 11 | 243 | 4.9 *| 552    | 4.8 ± 2.6 *| 33  | 17 ± 9  | 245 |
| 7–14          | 63  | 23 ± 17 | 392 | 6.7 *| 622    | 6.1 ± 3.1 *| 75  | 24 ± 15 | 403 |
| 15–19         | 23  | 22 ± 11 | 201 | 9.3 *| 360    | 7.7 ± 4.5 *| 29  | 26 ± 15 | 192 |
| 20–29         | 61  | 35 ± 20 | 360 | 9.3 *| 363    | 8.1 ± 5.6 *| 84  | 30 ± 19 | 361 |
| 30–39         | 147 | 32 ± 18 | 540 | 7.4 *| 394    | 8.7 ± 4.9 *| 185 | 29 ± 17 | 661 |
| 40–49         | 267 | 35 ± 24 | 537 | 8.1 *| 407    | 8.7 ± 5.5 *| 292 | 29 ± 17 | 570 |
| 50–59         | 259 | 33 ± 22 | 587 | 9.5 *| 407    | 8.1 ± 5.1 *| 301 | 27 ± 15 | 681 |
| 60–69         | 255 | 30 ± 17 | 664 | 9.1 *| 399    | 7.4 ± 4.3 *| 263 | 25 ± 13 | 762 |
| ≥70           | 162 | 27 ± 16 | 696 | 9.9 *| 417    | 7.7 ± 4.9 *| 123 | 24 ± 14 | 846 |

* RES: Retinol equivalents; * p < 0.04 after FDR adjustment, versus Chinese.
Table 5. Comparison of daily intake of energy and nutrients \(^a\) by age in children \(^^\wedge\) and males in the Chinese and Italian groups.

| Energy and Nutrients      | Children (3–9 Years) | Males (10–17 Years) | Males (18–64 Years) | Males (65 Years and Above) |
|---------------------------|----------------------|----------------------|----------------------|-----------------------------|
|                           | Chinese (N = 112)    | Italian (N = 193)    | Chinese (N = 53)     | Italian (N = 108)           |
| Total energy, kcal        | 1322.2 ± 560.9       | 1914 ± 488 *         | 2576 ± 744 *         | 2300 ± 865                  |
| Carbohydrate, g           | 157.4 ± 81.0         | 239.8 ± 69.8 *       | 326.7 ± 110.2 *      | 274.9 ± 123.8               |
| Protein, g                | 44.9 ± 20.2          | 74.1 ± 18.5 *        | 99.3 ± 26.2 *        | 76.9 ± 31.0                 |
| Fat, g                    | 57.9 ± 30.3          | 79.5 ± 22.8 *        | 105.4 ± 32.3 *       | 95.9 ± 46.4                 |
| Fiber, g                  | 5.5 ± 3.7            | 14.4 ± 5.2 *         | 18.1 ± 5.9 *         | 11.0 ± 7.6                  |
| Cholesterol, mg           | 275.1 ± 198.4        | 286 ± 118            | 301 ± 217            | 339 ± 247                   |
| % Total energy from        |                      |                      |                      |                             |
| Carbohydrate, %           | 47.5 ± 12.3          | 46.8 ± 5.8           | 50.3 ± 13.6          | 47.2 ± 5.6                  |
| Protein, %                | 13.8 ± 3.3           | 15.7 ± 2.3 *         | 13.5 ± 3.0           | 15.6 ± 1.9                  |
| Fat, %                    | 39.2 ± 11.1          | 37.4 ± 12.7          | 36.9 ± 4.9           | 37.0 ± 10.9                 |
| Minerals                  |                      |                      |                      |                             |
| Calcium, mg               | 292.1 ± 140.0        | 749 ± 252 *          | 381 ± 216            | 892 ± 344                   |
| Phosphorus, mg            | 619.1 ± 254.6        | 1180 ± 299 *         | 875 ± 339            | 1479 ± 396                  |
| Potassium, mg             | 1050.5 ± 473.0       | 2441 ± 633 *         | 1552 ± 883           | 3123 ± 879                  |
| Magnesium, mg             | 162.7 ± 70.4         | 230 ± 69 *           | 229 ± 99             | 286 ± 75                    |
| Zinc, mg                  | 6.7 ± 2.7            | 9.9 ± 2.9 *          | 9.9 ± 3.8            | 13.3 ± 3.9                  |
| Vitamins                  |                      |                      |                      |                             |
| Vitamin A, ug REs \(^a\) | 299.7 ± 346.8        | 740 ± 941 *          | 352 ± 316            | 802 ± 767                   |
| Vitamin B1, mg            | 0.5 ± 0.2            | 0.92 ± 0.3 *         | 0.78 ± 0.40          | 1.23 ± 0.46                 |
| Vitamin B2, mg            | 0.6 ± 0.3            | 1.43 ± 0.41 *        | 0.76 ± 0.38          | 1.69 ± 0.53                 |
| Vitamin C, mg             | 31.5 ± 27.4          | 107 ± 64 *           | 77 ± 114             | 136 ± 93                    |
| Vitamin E, mg             | 18.6 ± 10.7          | 10.4 ± 3.5 *         | 24.2 ± 17.7          | 13.9 ± 5 *                  |

\(^a\) Mean ± SD; \(^a\) REs: Retinol equivalents; \(^^\wedge\) Two infants (<3 years) were not included, with males and females grouped in the case of children; \(^*\) p < 0.04 after FDR adjustment, versus Chinese.
Table 6. Comparison of intake of energy and nutrients by age in females in the Chinese and Italian groups.

| Energy and Nutrients       | Females (10–17 Years) | Females (18–64 Years) | Females (65 Years and above) |
|---------------------------|-----------------------|------------------------|-----------------------------|
|                           | Chinese (N = 75)      | Italian (N = 139)      | Chinese (N = 1027)          | Italian (N = 1245)      | Chinese (N = 231)      | Italian (N = 316)      |
| Total energy, kcal        | 1549 ± 516            | 2091 ± 532 *           | 1845 ± 750                  | 1939 ± 526 *            | 1613 ± 558             | 1834 ± 486 *           |
| Carbohydrate, g           | 181.8 ± 82.5          | 263.1 ± 80.1 *         | 227.8 ± 118.8               | 236.5 ± 75.3 *          | 210.2 ± 89.3           | 233.7 ± 71.7 *         |
| Protein, g                | 53.1 ± 17.9           | 81.8 ± 20.1 *          | 64.5 ± 29.6                 | 76 ± 19.5 *             | 57.8 ± 23.5            | 71.4 ± 18.8 *          |
| Fat, g                    | 69.2 ± 30.2           | 86 ± 23.1 *            | 76.5 ± 38.5                 | 79.1 ± 23.4 *           | 61.7 ± 31.2            | 69.6 ± 22.2 *          |
| Fiber, g                  | 6.8 ± 4.6             | 16.4 ± 5.8 *           | 10.7 ± 8.3                  | 17.7 ± 6.3 *            | 10.0 ± 6.7             | 18.7 ± 6.7 *           |
| Cholesterol, mg           | 283 ± 205             | 311 ± 144              | 304 ± 230                   | 265 ± 125 *             | 239 ± 198              | 243 ± 106              |
| % Total energy from       |                      |                        |                            |                          |                        |                          |
| Carbohydrate, %           | 46.6 ± 12.3           | 46.8 ± 5.8             | 49.1 ± 12.3                 | 45.5 ± 6.3 *            | 52.2 ± 13.0            | 47.8 ± 7.3             |
| Protein, %                | 14.1 ± 4.0            | 15.8 ± 2.2 *           | 14.2 ± 3.9                  | 15.9 ± 2.3 *            | 14.5 ± 3.9             | 15.7 ± 2.4 *           |
| Fat, %                    | 40.2 ± 11.5           | 37.2 ± 5 *             | 37.3 ± 11.3                 | 36.8 ± 5.3              | 34.2 ± 11.7            | 34.1 ± 6.1             |
| Minerals                  |                       |                        |                             |                           |                        |                          |
| Calcium, mg               | 339 ± 166             | 770 ± 280 *            | 415 ± 241                   | 730 ± 277 *             | 409 ± 236              | 754 ± 290 *            |
| Phosphorus, mg            | 712 ± 214             | 1252 ± 333 *           | 886 ± 391                   | 1168 ± 312 *            | 818 ± 317              | 1117 ± 305 *           |
| Potassium, mg             | 1241 ± 494            | 2737 ± 796 *           | 1621 ± 800                  | 2861 ± 797 *            | 1515 ± 733             | 2822 ± 794 *           |
| Magnesium, mg             | 199 ± 67              | 251 ± 91               | 259 ± 122                   | 257 ± 74                | 245 ± 101              | 243 ± 66               |
| Zinc, mg                  | 7.9 ± 2.3             | 10.9 ± 3 *             | 10.0 ± 4.6                  | 10.6 ± 3 *              | 8.9 ± 3.2              | 9.9 ± 2.9 *            |
| Vitamins                  |                       |                        |                             |                          |                        |                          |
| Vitamin A, ug REs &       | 318 ± 221             | 751 ± 855 *            | 437 ± 471                   | 818 ± 885 *             | 418 ± 450              | 773 ± 466 *            |
| Vitamin B1, mg            | 0.64 ± 0.24           | 1 ± 0.32 *             | 0.79 ± 0.39                 | 0.95 ± 0.32 *           | 0.68 ± 0.32            | 0.86 ± 0.26 *          |
| Vitamin B2, mg            | 0.61 ± 0.22           | 1.42 ± 0.4 *           | 0.76 ± 0.42                 | 1.38 ± 0.43 *           | 0.66 ± 0.33            | 1.31 ± 0.39 *          |
| Vitamin C, mg             | 48 ± 40               | 128 ± 92 *             | 64 ± 47                     | 123 ± 74 *              | 67 ± 52                | 127 ± 84 *             |
| Vitamin E, mg             | 25.4 ± 16.2           | 11.8 ± 3.5 *           | 27.8 ± 16.3                 | 11.9 ± 3.8 *            | 23.6 ± 12.7            | 10.9 ± 3.7 *           |

* Mean ± SD; ** REs: Retinol equivalents; * p < 0.04 after FDR adjustment, versus Chinese.
3.2. Comparison of Age- and Sex-Specific Intake of Energy and Macronutrients between Chinese and Italian, Japanese and American Subjects

Tables 2, 5 and 6 show the comparison of intake of energy and macronutrients by age and sex. Compared with the subjects of other three countries, Chinese subjects consumed much less fiber in all age groups of both sexes (all p < 0.04). In general, compared with the Japanese subjects, young Chinese subjects consumed lower total energy, while adult Chinese subjects consumed higher total energy; compared with the American subjects, Chinese males and young Chinese females consumed lower total energy, while adult Chinese females consumed higher total energy. Carbohydrate and protein intakes in Chinese subjects were lower than those in Japanese and American subjects. Fat intake in Chinese subjects was higher than that in Japanese adults of both sexes and American females, while similar to that in American males (except 20–29 age group). In addition, Chinese, Japanese, American and Italian subjects consumed similar cholesterol, except American females. Furthermore, total energy and macronutrients in Chinese subjects were lower than those in Italian subjects in both sexes except for a similar intake of cholesterol.

The percent energy from carbohydrate in Chinese subjects ranged from 45.6% to 53.9%. It was lower than that in Japanese and American subjects, while higher than that in adult Italian subjects. However, the energy contribution from fat in Chinese subjects ranged between 33.2% and 41.0%. It was higher than that in Japanese and American subjects in both sexes (except ≥70 age group), while similar to that in Italian subjects. The contribution of protein to energy in Chinese subjects (13.0%–15.0%) was lower than that in Japanese, American and Italian subjects; nevertheless, there were no significant differences for Japanese subjects aged <40 years and American females aged <30 years.

3.3. Comparison of Age- and Sex-Specific Intake of Minerals between Chinese and Italian, Japanese and American Subjects

For macro-minerals, daily intakes of calcium, phosphorus and potassium in Chinese subjects were generally lower than those in Japanese, American and Italian subjects (Tables 3, 5 and 6). Nevertheless, Chinese subjects consumed a higher intake of sodium than Japanese and American subjects (Table 3). In addition, magnesium intake in Chinese subjects was higher than that in younger adult Japanese subjects, but lower than that in American males aged <60 years and females aged 1–14 and 30–39 years, and Italian children and males aged below 18 years.

For micro-minerals, intakes of iron and copper in both male and female age groups in Chinese subjects were higher than those in Japanese and American subjects, but selenium intake was lower than that in American subjects (Table 3). Zinc intake in Chinese subjects was higher than that in adult Japanese subjects, but lower than that in American males and Italian subjects (Tables 3, 5 and 6).
3.4. Comparison of Age- and Sex-Specific Intake of Vitamins between Chinese and Italian, Japanese and American Subjects

For vitamins, intakes of vitamin B₁ and vitamin B₂ were lower among Chinese subjects in all age groups of both sexes, compared with those in the people of the other three countries; but vitamin E intake was higher (all $p < 0.04$, Tables 4–6). Compared with the people of other three countries, Chinese subjects consumed a lower level of vitamin A and vitamin C in both sexes (Tables 4–6), with no significant differences across several age groups in Japanese and American subjects (Table 4). Although niacin intake by age and sex in Chinese subjects was lower than that in American subjects (all $p < 0.04$), these significant differences were only found in Japanese older adults and females aged 7–14 years (Table 4).

3.5. Comparison of Age- and Sex-Specific Intake of Nutrients Adjusted for Energy between Chinese and Italian Subjects

As presented in Supplementary Tables S2 and S3, intakes of fiber, calcium, phosphorus, potassium, zinc, vitamin A, vitamin B₁, vitamin B₂ and vitamin C after energy adjusted in Chinese subjects were lower than those in Italian subjects, while intakes of cholesterol, iron, magnesium and vitamin E were higher among Chinese subjects relative to Italian subjects ($p < 0.04$). These results were quite similar before and after energy adjustment.

4. Discussion

The present study described intakes of energy and nutrients in south-east Chinese people and presented the comparison of those between Chinese and Italian, Japanese and American diets in males and females for different age groups. There were marked differences in nutrients consumption between Chinese subjects and those from the other three countries. Firstly, the contribution of carbohydrate to energy in Chinese subjects was lower than that in Japanese and American subjects, but higher than that in Italian subjects; however, the energy contribution from fat in Chinese subjects was higher than that in Japanese and American subjects, and similar to that in Italian subjects. Secondly, the Chinese diet had lower daily intakes of fiber, calcium, phosphorus, potassium, selenium, vitamin A, vitamin B₁, vitamin B₂ and vitamin C, compared with the Japanese, American and Italian diets; nevertheless, intakes of sodium, iron, copper and vitamin E were higher among Chinese subjects relative to the people of other three countries.

4.1. Nutrients Intakes in Chinese People Changing Even Worse than Those in American People

Across countries, the predominant diets are clearly different and highly related with human health. Both the Italian and Japanese diets are known to be healthy, while the American diet is generally qualified as unhealthy [11]. The traditional Chinese diet includes rice, wheat and wheat products and vegetables with low animal-source foods [23]. It has been considered as extremely healthy diet, like the Italian and Japanese diets [14]. However, China seems to be rapidly relinquishing its traditional diet with its rapid economic development. China has experienced remarkable shifts in its disease patterns from the decreasing prevalence of malnutrition and nutrition deficiencies to a high prevalence
of diet-related non-communicable diseases, such as obesity, diabetes, cardiovascular disease, and cancer [14]. In addition, China is also undergoing a remarkably fast, but undesirable shift towards a stage of nutrition transition dominated by a high intake of edible oils, processed foods and animal foods and a low intake of coarse grains, legumes and other healthy foods [2]. These shifts have been the basis for the change in nutrient intakes. The shifts of nutrient intakes accompanied by major cooking and eating behavior changes are leading to what might be characterized as an unhealthy Western diet. Therefore, we evaluated the dietary nutrients in south-east Chinese subjects and compared those to the healthy Italian, Japanese diets and unhealthy American diet. In the present study, 2659 participants aged 2.0–89.2 years were enrolled to evaluate the dietary nutrients in south-east Chinese subjects. We found that compared with the American subjects, Chinese subjects consumed lower intakes of fiber, carbohydrate and protein. Nevertheless, fat and cholesterol intakes in Chinese subjects were higher than those in American females, and similar to those in American males. Lower contribution of carbohydrate and protein and higher contribution of fat to energy in Chinese subjects than those in American subjects were also found. Therefore, macronutrients intakes of Chinese subjects had been close to those of American subjects, and many macronutrients were even worse than those of American subjects. Furthermore, the Chinese diet had lower daily intakes of calcium, phosphorus, potassium, selenium, vitamin A, vitamin B₁, vitamin B₂, vitamin C and niacin, and higher intakes of sodium, iron, copper and vitamin E, compared with the American diet. Therefore, these results demonstrated that nutrients intakes in Chinese people have been changing even worse than those in American people. The relative low prices of animal-source foods and oils partially explain these shifts and income increases are a second important cause [24,25]. In addition, another reason is that cooking and eating behaviors are changing rapidly, including the decrease in the percentage of food cooked in healthy ways (steamed, boiled, baked) and the increase in snacking, fried foods and away-from-home food consumption [26].

4.2. Nutritional Transition of the Chinese Diet from Traditional to Non-Traditional Diet

Compared with the 2002 China National Nutrition and Health Survey data [27], intakes of total energy, carbohydrate, fiber, phosphorus, potassium, sodium, iron, copper, vitamin A, vitamin B₁, vitamin B₂, vitamin C and vitamin E decreased, while intakes of fat, calcium and selenium increased, with stable intake of protein. In addition, in the nine provinces in the China Health and Nutrition Survey, there were rapid changes in the percent energy intake from carbohydrate and fat between 1991 and 2011 [2]. The energy contributions from carbohydrate were 66.0%, 59.8% and 54.3% in 1991, 2000 and 2011, respectively; while the proportions of energy derived from fat were 21.8%, 27.8% and 32.0% in 1991, 2000 and 2011, respectively. Moreover, our study found that the percent energy from carbohydrate and fat in Chinese subjects ranged from 45.6% to 53.9% and from 33.2% to 41.0% in different age groups, respectively. Furthermore, Zhou et al. [28] once compared nutrient intakes of middle-aged men and women, aged 40–59 years, in Chinese, Japanese and American subjects in the late 1990s (1997–1999). This study showed higher fiber intake and percent energy from carbohydrate and lower cholesterol intake and percentage of energy from fat in Chinese subjects than those in Japanese and American subjects; these findings were consistent with another study carried out in women aged 40–70 years in Shanghai (China), Japan and America, from 1997 to 2000 [26].
Nevertheless, in our study we found lower fiber intake and percent energy from carbohydrate and higher percentage of energy from fat in Chinese subjects than those in Japanese and American subjects, which were opposite to the results in the late 1990s. In summary, these results demonstrated that fat intake has increased but the intake of complex carbohydrates and fiber has decreased in Chinese people in the past two decades. Therefore, the structure of the Chinese diet has been shifting away from the traditional diet toward high-fat, low-carbohydrate and low-fiber diets. However, it is noted that the older adults tended to retain the traditional diet (Supplementary Table S4).

4.3. Trends of Minerals and Vitamins

The truly healthy trends for Chinese diet were the reduction in intakes of sodium and increases in intakes of calcium. High sodium and low potassium intakes are the key risk factors for hypertension [29–32]. Although sodium intake decreased, it remained double those recommended by the Institute of Medicine and the WHO; and potassium intake was below the recommended amount [33]. Our findings were consistent with other studies [28,33]. However, it should be noted that dietary method is an inadequate assessment of sodium, and 24-h urine sodium is the only way to estimate sodium intake [34]. Nowadays, the major source of dietary sodium remains added salt, followed by soy sauce, processed foods, and monosodium glutamate [33]. Therefore, replacing sodium with potassium in salt is an option with the potential to control and prevent hypertension and improve the health of the Chinese population [33]. In addition, calcium intake increased in the past decade. Nevertheless, it remained far below the recommended amount [35]. Deficient intake of calcium from cereals, vegetables, legumes and dairy mainly accounted for the low intake of calcium [36]. Iron intake in males was higher than that recommended by the Chinese Nutrition Society [35], while it was comparable for females. However, the main source of iron intake was from plant-based foods among this study population, which has low bioavailability [37]. So iron intake might not meet the needs of the body, especially in females. Besides, vitamin B2 intake was inadequate. Its deficiency has been shown to negatively affect iron absorption and utilization, which is associated with increased risk of anemia [38]. Consequently, a higher intake of fruit, vegetables, cereals, legumes, dairy and certain animal-source foods should be recommended.

Zhou et al. [28] also compared intakes of minerals and vitamins in Chinese, Japanese and American people in the late 1990s. The compared results of calcium, sodium, phosphorus, potassium, selenium, magnesium, vitamin A and vitamin C intakes in this study were consistent with our results. However, this study showed similar intake of iron (between Chinese and American people) and vitamin E (between Chinese and Japanese, American people), while we found higher intakes of iron and vitamin E in Chinese people than those in Japanese and American people. Nevertheless, Chen et al. [26] reported higher intakes of iron and vitamin E in Chinese people than those in Japanese and American people in the late 1990s, which were consistent with our study. Together, these findings demonstrated that excessive, especially inadequate intakes of a range of minerals and vitamins have been persistent in the past decade.
4.4. Strengths and Limitations

To the best of our knowledge, this was the first study to compare of nutrient intakes between Chinese and Italian, Japanese and American diets in males and females for different age groups. However, our research has several limitations. First, as expected, in some age and sex groups, and in particular in children and teenagers, the sample size might be not sufficient. Second, energy and nutrient intakes in present study were estimated by three consecutive 24-h dietary recalls, which is frequently used in dietary assessment. We could not avoid the possibility of recall bias and other unknown confounding factors, which might influence the precise assessment of nutrient intakes. However, the average intake over three days can offer a relatively valid estimate of usual nutrient intakes [39,40]. In addition, the diet data collected between August and October of each year may not reflect seasonal differences in nutrients consumption. Third, it is noted that our present results were without adjustment for sampling weight, which might limit the ability to generalize our findings to the general population. Finally, because of possible differences in sampling frame, dietary assessment methods (24-h dietary recall or dietary record) and data-processing methods, a detailed cross-country comparison of nutritional data would introduce bias. However, Kroes et al. [41] found a similar effect on estimating dietary intake between 24-h dietary recall and dietary record. Moreover, it was clear that the nutrient intakes of the Chinese people in this study were quite different from those found in the people of other three countries, regardless of nutrients adjusted for energy.

5. Conclusions

The present study demonstrated that the structure of the Chinese diet has been shifting away from the traditional diet toward high-fat, low-carbohydrate and low-fiber diets, and nutrients intakes in Chinese people have been changing even worse than those in American people. From a public health perspective, the present findings imply that a healthy diet should be advocated in the Chinese people.

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Authors Contributions

Yunxian Yu developed the initial idea and designed the study. Zhaopin Wang, Biao Zhou, Lijuan Wang, Lichun Huang, Shuying Jiang, Zeyu Liu and Jingxin Jiang were responsible for the data and sample collection. Ronghua Zhang and Biao Zhou was responsible for the quality control. Ying Fei and Shuangshuang Zheng conducted the statistical analysis. Ronghua Zhang and Zhaopin Wang wrote the manuscript. All authors contributed to the interpretation of the results and were involved in preparing the final manuscript.
Conflicts of Interest

The authors declare no conflict of interest.

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