

• CLINICAL RESEARCH •

## Development of a semi-quantitative food frequency questionnaire for middle-aged inhabitants in the Chaoshan area, China

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### Abstract

**AIM:** This paper aims to develop a data-based semi-quantitative food frequency questionnaire (SQFFQ) covering both urban and rural areas in the Chaoshan region of Guangdong Province, China, for the investigation of relationships between food intake and lifestyle-related diseases among middle-aged Chinese.

**METHODS:** We recruited 417 subjects from the general population and performed an assessment of the diet, using a 3-d weighed dietary record survey. We employed contribution analysis (CA) and multiple regression analysis (MRA) to select food items covering up to a 90% contribution and a 0.90  $R^2$ , respectively. The total number of food items consumed was 523 (443 in the urban and 417 in the rural population) and the intake of 29 nutrients was calculated according to the actual consumption by foods/recipes.

**RESULTS:** The CA selected 233, 194, and 183 foods/recipes for the combined, the urban and the rural areas, respectively, and then 196, 157, and 160 were chosen by the MRA. Finally, 125 foods/recipes were selected for the final questionnaire. The frequencies were classified into eight categories and standard portion sizes were also calculated.

**CONCLUSION:** For adoption of the area-specific SQFFQ, validity and reproducibility tests are now planned to determine how the combined SQFFQ performs in actual assessment of disease risk and benefit.

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**Key words:** Nutrients; Weighed diet records; Contribution analysis; Multiple regression analysis

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### INTRODUCTION

Lifestyle is the most important environmental factor related to chronic diseases such as cardiovascular diseases, diabetes and cancer<sup>[1-5]</sup>, now the major causes of death in the developed countries and also increasing their impact in the developing world<sup>[6]</sup>. While genetic factors are also of interest in terms of etiology, from the viewpoint of disease prevention, environmental factors are more important, because they are controllable and thus targetable for health promotion. Unlike smoking, which only does harm to health<sup>[7]</sup>, the diet has two profiles: appropriate intake is necessary for life, but excessive intake or imbalance may be deleterious. The investigation of reliable internal associations between food intake and health/diseases requires sufficient and accurate information on diet intake.

Increasing interest in relationships between long-term dietary intake and the occurrence of chronic disease has thus stimulated the development of evaluation methods to assess dietary factors among large groups of individuals. As a relatively new but efficient method, the semi-quantitative food frequency questionnaire (SQFFQ) has become widely used worldwide, especially in the US and European countries<sup>[8,9]</sup>. Compared with other approaches, the SQFFQ has the following advantages: (1) it is simple and convenient to implement; (2) it has the ability to provide food information over a relatively long time period; (3) it can be applied with focuses on specific age groups<sup>[10]</sup>. At present, the SQFFQ is therefore the best tool to obtain information for investigation of the relationship between the diet and health or disease.

Recently, the economic status in China has greatly

improved, but a nationwide survey of food and nutrient intake in the country has revealed that geographical variations between urban and rural areas still exist in most regions. This variation demands the development of an appropriate SQFFQ covering both urban and rural populations to investigate the association between dietary factors and cancer risk, cases naturally being recruited from both areas. To develop a feasible combined SQFFQ, we here conducted a survey of food and nutrient intake using a 3-d weighed dietary record method (WDR) in urban and rural areas of Chaoshan.

## MATERIALS AND METHODS

The Chaoshan region, including Shantou, Chaozhou and Jieyang cities, is located in the east of Guangdong Province of China, with a population of approximately 10 million. People here still retain their own language and traditional culture. We have demonstrated that Nan'ao county in Chaoshan has the highest incidence and mortality rates of esophageal cancer in all China<sup>[11]</sup>. We here selected Chaozhou and Jieyang areas, including Nan'ao county, as representative of the countryside, and Shantou as representative of the new city.

### Study subjects

We initially recruited 520 healthy residents aged 30-55 years for participation in our investigation, but only 417 (200 males and 217 females) completed the 3-d WDR survey (70 in Chaozhou, 247 in Shantou and 100 in Nan'ao). The remainder dropped out because of their busy schedules or difficulties in recording. The fraction of sampling for the whole region was 41 per million.

Part juniors in the Chaozhou Normal College, staff of the Shantou Disease Preventive and Control Center, the Director General of the Nan'ao Board of Health and some doctors of Nan'ao Hospitals joined in our research team and were responsible for making contact with the subjects. Supervisors examined the completeness and accuracy of the information from the survey.

### Dietary assessment

A 3-d WDR (2 weekdays and 1 weekend day) was performed from December 2002 to August 2003, with a 24-h recall method also used as a supplement. Foods/recipes were individually weighed and recorded for their raw weights before cooking, except with cooked foods bought from markets. The completeness and accuracy of information were also reviewed by the research nutritionists.

### Nutrients of interest

The nutrients of interest comprised 29 items: energy, protein, fat, carbohydrates, crude fiber, retinol, carotene, vitamin C, vitamin E, folic acid, sodium, potassium, magnesium, calcium, iron, zinc, copper, selenium, phosphorus, saturated fatty acids (SFA), mono-unsaturated fatty acids (MUFA), poly-unsaturated fatty acids (PUFA), oleic acid, linoleic acid, arachidonic acid, linolenic acid, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and cholesterol.

### Selection of foods/recipes

Nutrient intake was calculated by multiplying the food intake

(grams) by the nutrient content per gram of food listed in the China Food Composition 2002, compiled by the Institute of Nutrition and Food Safety, China CDC<sup>[12]</sup>. Where necessary we also used data from the Japanese Standard Tables of Food Composition, 5<sup>th</sup> revised edition<sup>[13]</sup> for the nutrient content of foods which were not listed in the China Food Composition.

The selection of food items for developing the SQFFQ was performed using the same procedure as adopted by Tokudome and his colleagues<sup>[14]</sup>. At first, contribution analysis (CA) was performed for all nutrients of interest<sup>[14-16]</sup>, and each food item was listed according to the intake amount of nutrient. We selected food/recipe items with up to a 90% cumulative contribution. Then, multiple regression analysis (MRA) was carried out by adopting the total intake of specific nutrient as the dependent variable and overall amounts of this nutrient from the selected food/recipe items by CA as the independent variables for 417 individuals and secondly choosing foods/recipes with up to a 0.90 cumulative square of the multiple correlation coefficient<sup>[14,16]</sup>. Finally, we determined food items for the SQFFQ both by CA and MRA. Some food items with up to 0.90  $R^2$  but very small % contribution were excluded, because they may be marginal for total nutrient intake. The foods contributing less than three nutrients, with relatively small % contributions, were also excluded. The statistical package SPSS for Windows 10.0 (SPSS Inc., Chicago, IL, USA) was employed for the data analysis.

### Intake frequency

The food intake frequencies in SQFFQ were classified into seven categories: almost never; 1-3 times per month; 1-2 times per week; 3-4 times per week; 5-6 times per week; 1-2 times per day; and 3 times per day or more.

### Portion size

The standard portion size of each food item per meal was determined using the mean amount, typical/standard value or the natural unit. Portion size in SQFFQ was divided into six categories: none, 0.5, 0.75, 1.0, 1.5, 2.0 or more. As estimation of condiment and oil consumption per meal was difficult, four categories were employed: none, less than normal, normal and more than normal. The normal intake was determined as the mean amount in the 3-d WDR, and allocation to less or more than normal was estimated with reference to the standard deviation. We also took pictures of the most representative foods with a standard portion size and made a food model booklet for standardization of the intake amount.

## RESULTS

### Characteristics of the subjects studied

Table 1 shows the characteristics of the investigated subjects. The mean age was slightly older for the rural than the urban subjects in both genders. Although the mean height was not different, the mean weight and BMI in urban males were larger than those in their rural counterparts, with statistical significance. This was not the case for females.

### Intake of energy and selected nutrients

Table 2 shows mean intake and standard deviations for energy,

**Table 1** Characteristics of the investigated subjects

	Males		<i>P</i>	Females		<i>P</i>
	Rural <i>n</i> = 115	Urban <i>n</i> = 102		Rural <i>n</i> = 102	Urban <i>n</i> = 98	
Age (yr)	43.1±6.9	42.4±7.1	0.803	42.9±6.8	41.3±7.7	0.245
Height (cm)	169.7±6.0	170.3±3.7	0.496	158.6±4.2	158.6±4.4	0.417
Weight (kg)	62.0±6.4	65.9±6.8	0.004	53.5±6.3	53.8±6.9	0.175
BMI	21.8±2.2	22.6±2.3	0.003	20.9±2.4	21.5±2.4	0.072

**Table 2** Intake of nutrients by the urban and rural subjects

	Males		<i>P</i>	Females		<i>P</i>
	Rural <i>n</i> = 115	Urban <i>n</i> = 102		Rural <i>n</i> = 102	Urban <i>n</i> = 98	
Energy (kcal)	2 268±539	2 237±520	0.447	2 560±661	2 449±635	0.084
Protein (g)	83.5±26.7	85.5±23.8	0.375	85.0±27.4	91.8±27.3	0.244
Fat (g)	84.7±28.2	90.8±41.8	0.196	103.9±26.9	104.3±40.5	0.121
Carbohydrate (g)	295.1±106.8	271.9±101.1	0.320	327.2±129.8	301.3±111.8	0.758
Crude fiber (g)	10.2±4.7	10.0±3.7	0.707	9.5±3.6	12.0±9.8	0.017
Cholesterol (mg)	389.1±221.0	352.7±165.2	0.174	344.7±249.8	441.3±217.7	0.004
Carotene (μg)	2 576.7±2 105.7	2 693.8±2 009.1	0.675	2566.5±2132.6	3 487.0±1 872.2	0.001
Retinol (μg)	118.0±84.0	116.6±118.8	0.92	90.4±78.6	137.1±86.5	0.000
Folic acid (mg)	395.6±219.9	357.6±129.9	0.128	375.5±155.0	452.6±172.3	0.001
Vitamin C (mg)	88.4±52.3	80.4±39.6	0.205	96.2±61.0	102.2±38.8	0.416
Vitamin E (mg)	22.7±10.8	27.0±11.7	0.005	24.2±10.9	28.9±11.1	0.003
Calcium (mg)	525.6±191.7	446.8±190.2	0.412	406.9±187.4	505.0±155.1	0.000
Phosphorus (mg)	963.9±311.0	937.2±216.8	0.468	1 042.0±390.2	1 099.8±222.0	0.202
Potassium (mg)	1 718.0±575.5	1 745.0±459.3	0.705	1 808.9±666.6	2 006.6±453.2	0.015
Sodium (mg)	4 584.7±1 856.1	4 460.9±2 297.6	0.66	6 091.1±2 436.2	4 733.4±1 590.2	0.000
Magnesium (mg)	298.8±93.4	280.2±63.2	0.09	311.4±104.2	326.7±64.4	0.215
Iron (mg)	23.3± 8.8	22.9± 7.3	0.744	22.7±8.2	25.5±6.8	0.009
Zinc (mg)	12.73± 4.78	11.53±2.80	0.028	13.25±5.42	13.99±3.54	0.256
Selenium (μg)	64.92± 29.60	69.40±37.20	0.322	77.81±42.63	72.55±38.14	0.36
Copper (mg)	2.46±1.53	2.24±1.02	0.227	2.30±1.19	2.38±0.68	0.589
SFA (g)	21.14±7.51	22.83±7.92	0.107	24.12±10.56	25.84±8.78	0.215
MUFA (g)	32.05±10.68	35.83±10.47	0.009	36.53±15.36	42.34±10.26	0.002
PUFA (g)	18.62±8.27	23.01±9.70	0.000	21.90±15.58	26.41±8.92	0.013
Oleic acid (g)	29.40±9.79	33.12±9.76	0.005	33.50±13.74	38.46±9.39	0.003
Linoleic acid (g)	16.76±7.41	20.89±8.76	0.000	18.93±8.63	23.92±8.12	0.000
Linolenic acid (g)	1.64±1.30	1.67±1.46	0.895	1.74±1.62	2.76±2.06	0.000
Arachidonic acid (g)	0.088±0.041	0.087±0.041	0.951	0.092±0.056	0.096±0.047	0.626
EPA (g)	0.038±0.046	0.039±0.036	0.900	0.050±0.041	0.034±0.032	0.004
DHA (g)	0.079±0.100	0.069±0.063	0.385	0.118±0.095	0.072±0.073	0.000

SFA: saturated fatty acid; MUFA: mono-unsaturated fatty acid; PUFA: poly-unsaturated fatty acid; EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid.

protein, fat, carbohydrate and other nutrients. Geographical variation of energy and major nutrient intake was not apparent in either sex, except for greater intake of crude fiber in urban males. Urban males and females consumed more vitamin E, MUFA, PUFA, oleic acid, and linoleic acid than rural subjects. In males, urban subjects consumed more cholesterol, carotene, retinol, folic acid, calcium, potassium and linolenic acid, whereas rural subjects had greater intakes of sodium, DHA and EPA. In females, rural subjects took more zinc and manganese.

We compared the consumption of each nutrient with the Recommended Nutrient Intake (RNI) for the first and second degree of work in China<sup>[17]</sup>. The energy consumption in our urban and rural males was similar to RNI, but with females the values were high. The consumption of protein and fat in both genders of urban and rural areas was higher than the RNI, especially for fat, but that for carbohydrate was relatively low.

### Selection of food items

The total number of food/recipe items consumed by all subjects over 3 d was 523 (443 and 417 in the urban and rural cases, respectively). The numbers of food items with up to 90% cumulative contribution for 29 nutrients were 233, 194, and 183 in the combined, urban and rural areas, and those for up to 0.9 cumulative *R*<sup>2</sup> were 196, 157, and 160, respectively. Then, we combined several food items with similar nutrient contents. Finally, we selected 125 food items for a combined SQFFQ. Alcohol beverages were not included in them, because the number of regular drinkers was very small. However, liquor and beer were intentionally added in this SQFFQ, because they are important dietary factors involved in the risk of diabetes and cancer<sup>[4,5]</sup>.

The number of food items selected for each nutrient by CA and MRA are listed in Table 3. The mean numbers by CA were 58, 46, and 48 for the combined, the urban and

**Table 3** Numbers of foods contributing to 29 nutrients with up to 90 cumulative % and 0.9 cumulative  $r^2$ 

	Cumulative %			Cumulative $r^2$		
	Rural	Urban	Combined	Rural	Urban	Combined
Energy	49	51	60	33	22	37
Protein	79	85	94	51	26	55
Fat	23	23	25	150	11	17
Carbohydrate	26	29	33	3	8	77
Crude fiber	65	61	74	74	13	21
Cholesterol	31	36	37	47	10	12
Carotene	23	21	38	47	12	8
Retinol	25	30	33	28	7	55
Folic acid	53	49	59	40	13	19
Vitamin C	38	27	44	52	17	70
Vitamin E	48	45	54	116	5	16
Calcium	94	93	104	70	19	30
Phosphorus	85	91	102	41	28	51
Potassium	114	99	120	63	36	1
Sodium	13	16	16	145	4	3
Magnesium	86	98	109	41	31	58
Iron	84	94	104	45	22	35
Zinc	72	78	86	41	15	44
Selenium	73	88	96	82	8	22
Copper	76	75	88	91	9	31
SFA	22	22	36	100	10	14
MUFA	16	17	21	70	9	8
PUFA	18	16	23	138	5	113
Oleic acid	15	15	17	142	6	8
Linoleic acid	17	15	18	143	5	8
Linolenic acid	31	28	56	136	1	2
Arachidonic acid (g)	24	32	53	53	17	17
EPA	22	32	51	30	17	23
DHA	14	29	36	24	13	12
Mean	46	48	58	72	14	30

SFA: saturated fatty acid; MUFA: mono-unsaturated fatty acid; PUFA: poly-unsaturated fatty acid; EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid.

the rural cases, respectively, as compared with 30, 14, and 72 with the MRA.

### List of food items

The percentage contributions of the top five foods/recipes for energy, protein, fat and carbohydrate for rural, urban

and combined areas are listed in Tables 4 and 5. Rice was the most important food source for energy, protein and carbohydrate intake, accounting for more than one-third of the energy, followed by peanut oil, pork, mixed oil, and lard, this being similar in both urban and rural areas. One-fourth of protein and more than two-thirds of carbohydrates

**Table 4** Percentage contributions of the top five foods for energy and protein

Energy						Protein					
Rural		Urban		Combined		Rural		Urban		Combined	
Rice	45.8	Rice	38.2	Rice	41.9	Rice	28.6	Rice	23.6	Rice	25.7
Pork	7.7	Peanut oil	8.9	Peanut oil	7.8	Pork	7.5	Pork	6.6	Pork	6.8
Peanut oil	6.9	Pork	6.9	Pork	7.1	Grass carp	3.4	Beef	4.0	Grass carp	3.6
Mixed oil	4.2	Mixed oil	6.4	Mixed oil	5.3	Egg	3.2	Grass carp	3.8	Egg	3.5
Lard	4.1	Lard	3.2	Lard	3.7	Fish	2.9	Egg	3.8	Beef	2.9

**Table 5** Percentage contribution of the top five foods for fat and carbohydrate

Fat						Carbohydrate					
Rural		Urban		Combined		Rural		Urban		Combined	
Peanut oil	21.7	Peanut oil	24.2	Peanut oil	22.9	Rice	70.4	Rice	67.5	Rice	70.4
Pork	20.2	Mixed oil	17.6	Pork	17.4	Noodle	3.2	Noodle	3.3	Noodle	3.2
Mixed oil	13.3	Pork	15.7	Mixed oil	15.6	Bread	2.3	Bread	3.0	Bread	2.3
Lard	13.1	Lard	11.0	Lard	11.0	Rice noodles	1.7	Rice noodles	2.1	Rice noodles	1.7
Pork chops	3.7	Pork chops	3.6	Pork chops	3.6	White sugar	1.6	White sugar	1.9	White sugar	1.6

were also contributed by rice. Peanut oil supplied more than one-fifth of fats, followed by pork, mixed oil, lard, pig chops and rice according to the CA. As for energy, the combined, urban and rural data also demonstrated almost have the same ranking for protein, fat and carbohydrate.

According to the category of the China Food Composition 2002, the 125 foods/recipes listed in the SQFFQ comprised: cereals (11 items), legumes (6), fresh legumes (3), vegetables (13), melons and nightshade (5), cauliflower (1), roots (7), fruits (11), meats (11), poultry (5), milk (2), eggs (3), pickles (4), marine products (16), mushrooms (5), nuts (2), cakes (3), condiments (6), oils (3) and beverages (8).

### Nutrition coverage in the SQFFQ

Table 6 shows the percentage coverage of 29 nutrients by the SQFFQ. The selected food items covered 17, 19, and 16 nutrients with up to 90% of the total intake for the rural, urban and combined SQFFQ, and the lowest coverage percentage of the combined SQFFQ was still 82.7%, for linolenic acid.

## DISCUSSION

The present study showed that variation in nutrient consumption between urban and rural subjects in the Chaoshan area was small, and the selected food items for the rural and urban SQFFQs were similar, covered all 29 nutrients with acceptable

percentage values. The present results thus revealed that development of a combined SQFFQ for rural and urban populations is feasible.

The nationwide survey of China held in 1992 showed the national average energy intake to be higher in urban than in rural areas, especially in those with middle and high incomes<sup>[18]</sup>. Recent economic improvement may have reduced the variation in diet between rural and urban populations, and increased the amount of nutrient intake in both, but especially in rural individuals. The total energy intake in males was 2.4% higher in the present urban area and 21.0% higher in the rural area than those in the representative urban and rural areas of the same province by nationwide survey. The mean intakes of major nutrients in the present study were 6.4% higher in the urban area and 25.9% higher in the rural area for protein; 15.6% higher and 70.6% higher for fat; 2.1% lower and 1.0% higher for carbohydrate; and 31.9% higher and 15.9% higher for crude fiber, compared with the respective figures from the nationwide survey. The present urban population took more unsaturated fatty acid from vegetables, and the rural population took more animal fat, although geographical variation in total fat intake was not apparent.

Here we chose the 3-d WDR method as the “gold standard” rather than others to develop a SQFFQ for Chaoshan area, because it is the most efficient method for collecting dietary information at present. To decrease the

**Table 6** Percentage coverage of nutrients by the SQFFQ

	% coverage		
	Rural	Urban	Combined
Energy	94.3	94.2	93.7
Protein	91.7	90.1	88.4
Fat	95.0	93.5	93.8
Carbohydrate	94.3	95.4	94.6
Crude fiber	86.5	87.3	87.5
Cholesterol	93.3	88.9	86.3
Carotene	88.7	93.9	90.3
Retinol	91.8	81.7	89.1
Folic acid	91.5	92.8	92.5
Vitamin C	86.3	94.6	91.2
Vitamin E	89.7	88.3	89.4
Calcium	87.3	87.3	88.6
Phosphorus	92.4	90.5	86.4
Potassium	86.8	90.5	88.2
Sodium	97.7	96.1	95.1
Magnesium	89.7	90.9	90.1
Iron	83.5	90.3	89.6
Zinc	90.9	91.9	91.6
Selenium	86.6	83.7	85.8
Copper	87.9	86.8	87.4
SFA	94.7	90.5	92.6
MUFA	96.2	95.6	88.4
PUFA	91.1	91.7	97.6
Oleic acid	96.5	95.7	90.2
Linoleic acid	94.2	92.1	97.6
Linolenic acid	91.2	92.2	82.7
Arachidonic acid (g)	90.3	88.5	92.7
EPA	82.4	80.2	87.6
DHA	88.4	81.9	82.9
Mean	90.7	90.2	90.0

SFA: saturated fatty acid; MUFA: mono-unsaturated fatty acid; PUFA: poly-unsaturated fatty acid; EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid.

influence of seasonal variation on food survey, we conducted the survey in three seasons of winter, spring and summer, because there is no major climatic difference between the fall and winter. Although the sample size was relatively small, the number of subjects appeared sufficient from previous studies to develop SQFFQs, including the ones conducted in China<sup>[14,19,20]</sup>.

We used the two contrasting methods of CA and MRA to select representative food items for stable food intake. Each method has its own particular advantages and disadvantages<sup>[13,14]</sup>. The former approach is based on the absolute food and nutrient intake and is especially suitable for investigation of the associations between absolute nutrient intake and disease risk. The latter, in contrast, is based on variance of nutrient intake, and is efficient for categorizing individuals. Therefore, the combination of the two methods for food selection should provide a more suitable SQFFQ for the assessment of food and nutrient intake.

We selected 125 food items, including alcoholic beverages, for the combined SQFFQ. Most were frequently consumed by the local inhabitants. Although the coverage rates of all 29 nutrients were over 80%, the potential for overestimation or underestimation does exist, because of

the incompleteness of the composition table, and the exclusion of food items, such as some marine products, in the selection for the SQFFQ.

We have already developed data-based SQFFQs in Jiangsu, in the central coastal region of China, and Chongqing, more than 1 000 km west inland from Jiangsu, using a standardized method developed in Japan<sup>[14]</sup>. We compared the top three food items of three SQFFQs developed in Jiangsu<sup>[19]</sup>, Chongqing<sup>[20]</sup> and the present study area, Chaoshan, more than 1 000 km south of Jiangsu, according to the percentage contribution for energy, protein, fat and carbohydrate by the urban and rural area (Table 7). Most items were shared in common, except for fat. These comparisons suggest the possibility to developing a common SQFFQ to assess and compare dietary factors impacting on cancer by the standardized method<sup>[21]</sup>.

In summary, in the present investigation we clarified common intake of foods and 29 nutrients in urban and rural areas of Chaoshan, Guangdong Province, China, for adoption in an area-specific SQFFQ. Validity and reproducibility tests<sup>[22–24]</sup> are now planned to determine how the combined SQFFQ performs in the actual assessment of disease risk and benefit.

**Table 7** Comparison of percentage contributions of the top three foods for energy, protein, fat, and carbohydrates in urban and rural areas of Jiangsu, Chongqing and Chaoshan in China

Percentage contribution						
Energy						
Urban						
Jiangsu	Rice	36.9	Salad oil	6.9	Flour	5.9
Chongqing	Rice	30.1	Rape oil	10.2	Pork	6.2
Chaoshan	Rice	45.8	Pork	7.7	Peanut oil	6.9
Rural						
Jiangsu	Rice	39.5	Lard	14.2	Pork	5.3
Chongqing	Rice	32.1	Rape oil	12.2	Flour	7.7
Chaoshan	Rice	38.2	Peanut oil	8.9	Pork	6.9
Protein						
Urban						
Jiangsu	Rice	23.1	Pork	7.2	Egg	5.0
Chongqing	Rice	17.5	Horse bean	8.0	Pork	6.5
Chaoshan	Rice	28.6	Pork	7.5	Grass card	3.4
Rural						
Jiangsu	Rice	34.4	Pork	6.5	Egg	4.3
Chongqing	Rice	20.4	Pork	7.4	Flour	7.0
Chaoshan	Rice	23.6	Pork	6.6	Beef	4.0
Fat						
Urban						
Jiangsu	Salad oil	22.1	Soybean oil	17.1	Pork	9.5
Chongqing	Rape oil	30.0	Pork	15.3	Salad oil	1.5
Chaoshan	Peanut oil	21.7	Pork	20.2	Salad oil	13.3
Rural						
Jiangsu	Lard	45.8	Pork	16.4	Rape oil	11.7
Chongqing	Rape oil	32.3	Lard	13.5	Pork	12.2
Chaoshan	Peanut oil	24.2	Salad oil	17.6	Pork	15.7
Carbohydrate						
Urban						
Jiangsu	Rice	57.1	Flour	8.7	Noodle	2.9
Chongqing	Rice	55.1	Flour	10.3	Noodle	7.9
Chaoshan	Rice	73.7	Noodle	2.8	Bread	1.7
Rural						
Jiangsu	Rice	59.6	Noodle	5.8	Corn	5.7
Chongqing	Rice	60.1	Flour	16.6	Peas	2.8
Chaoshan	Rice	67.5	Noodle	3.3	Bread	3.0

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## REFERENCES

- 1 **Chen H**, Zhang S, Hernan M, Willett WC, Ascherio A. Dietary intakes of fat and risk of Parkinson's disease. *Am J Epidemiol* 2003; **157**: 1007-1014
- 2 **Blumenfeld A**, Fleshner N, Casselman B, Trachtenberg J. Nutritional aspects of prostate cancer: a review. *Can J Urol* 2000; **7**: 927-935
- 3 **Swinburn B**. Sustaining dietary changes for preventing obesity and diabetes: lessons learned from the successes of other epidemic control programs. *Asia Pac J Clin Nutr* 2002; **11** (Suppl 3): S598-606
- 4 **Wannamethee S**, Camargo C Jr, Manson J. Alcohol drinking patterns and risk of type 2 diabetes mellitus among younger women. *Arch Intern Med* 2003; **163**: 1329-1336
- 5 **Willett W**. Diet and cancer. *Oncologist* 2000; **5**: 393-404
- 6 **Kopczynski J**, Wojtyniak B, Gorynski P, Lewandowski Z. The future of chronic diseases. *Cent Eur J Public Health* 2001; **9**: 3-13
- 7 **Pride N**, Soriano J. Chronic obstructive pulmonary disease in the United Kingdom: trends in mortality, morbidity, and smoking. *Curr Opin Pulm Med* 2002; **8**: 95-101
- 8 **Bergmann M**, Bussas U, Boeing H. Follow-up procedures in EPIC-Germany-data quality aspects. European prospective investigation into cancer and nutrition. *Ann Nutr Metab* 1999; **43**: 225-234
- 9 **Key TJ**, Appleby PN, Davey GK, Allen NE, Spencer EA, Travis RC. Mortality in British vegetarians: review and preliminary results from EPIC-Oxford. *Am J Clin Nutr* 2003; **78** (3 Suppl): 533S-538
- 10 **Willett W**, Colditz G. Approaches for conducting large cohort studies. *Epidemiol Rev* 1998; **20**: 91-99
- 11 **Li K**. Mortality and incidence trends from esophagus cancer in selected geographic areas of China circa 1970-90. *Int J Cancer* 2002; **102**: 271-274
- 12 **Yang YX**, Wang GY, Pan XC. China Food Composition 2002. Beijing: *Peking University Medical Press* 2002: 21-338
- 13 Resources Council, Science and Technology Agency, Japan. Standard Tables of Food Composition in Japan, 5th revised ed. Tokyo: *Resource Council Science and Technology Agency* 2000: 29-303
- 14 **Tokudome S**, Ikeda M, Tocudome Y, Imaeda N, Kitagawa I, Fujiwara N. Development of a data-based semi-quantitative food Frequency questionnaire for dietary studies in middle-aged Japanese. *Jpn J Clin Oncol* 1998; **28**: 679-687
- 15 **Stiggelbout AM**, van der Giezen AM, Blauw YH, Blok E, van Staveren WA, West CE. Development and relative validity of a food frequency questionnaire for the estimation of intake of retinol and beta-carotene. *Nutr Cancer* 1989; **12**: 289-299
- 16 **Overvad K**, Tjonneland A, Haraldsdottir J, Ewertz M, Jensen OM. Development of a semiquantitative food frequency questionnaire to assess food, energy and nutrient intake in Denmark. *Int J Epidemiol* 1991; **20**: 900-905
- 17 Chinese Nutrition Society. Chinese Dietary Reference Intakes, DRIs. *Yingyang Xuebao* 2001; **3**: 193-196
- 18 **Ge KY**, Zhai FY, Yan HC, Cheng L, Wang Q, Jia FM. The dietary and nutritional status of chinese population in 1990s. *Yingyang Xuebao* 1995; **2**: 123-134
- 19 **Wang YM**, Mo BQ, Takezaki T, Imaeda N, Kimura M, Wang XR, Tajima K. Geographical variation in nutrient intake between urban and rural areas of Jiangsu province, China and development of a semi-quantitative food frequency questionnaire for middle-aged inhabitants. *J Epidemiol* 2003; **13**: 80-89
- 20 **Zhou Z**, Takezaki T, Mo B, Sun H, Wang W, Sun L, Liu S, Ao L, Cheng G, Wang Y, Cao J, Tajima K. Geographical variation in nutrient intake between urban and rural areas of Chongqing, China and development of a data-based semi-quantitative food frequency questionnaire for both populations. *Asia Pac J Clin Nutr* 2004; **13**: 273-283
- 21 **Aydemir G**. Research on nutrition and cancer: The importance of the standardized dietary assessments. *Asian Pac J Cancer Prev* 2002; **3**: 177-180
- 22 **Tokudome S**, Imaeda N, Tocudome Y, Fujiwara N, Nagaya T, Sato J, Kuriki K, Ikeda M, Maki S. Relative validity of a semi-quantitative food frequency questionnaire versus 28 d weighed diet records in Japanese female dietitians. *Eur J Nutr* 2001; **55**: 735-742
- 23 **Imaeda N**, Fujiwara N, Tokudome Y, Ikeda M, Kuriki K, Nagaya T, Sato J, Goto C, Maki S, Tokudome S. Reproducibility of a semi-quantitative food frequency questionnaire in Japanese female dietitians. *J Epidemiol* 2003; **12**: 45-53
- 24 **Kim J**, Kim DH, Ahn YO, Tokudome Y, Hamajima N, Inoue M, Tajima K. Reproducibility of a food frequency questionnaire in Koreans. *Asian Pac J Cancer Prev* 2003; **4**: 253-257

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