

Original Article**Dietary patterns and nutrient intake of adult women in south-east China: a nutrition study in Zhejiang province**

Min Zhang MD, Colin W Binns MPH and Andy H Lee PhD

School of Public Health, Curtin University of Technology, Perth, Australia

This study documents the dietary patterns and nutrient intake of 652 adult women living in south-east China. Compared with data from previous national surveys and other nutrition studies in China, the results show different dietary patterns. The major differences include a greater consumption of vegetables, fruits and animal foods, but a lower consumption of cereal and tuber foods. The mean daily nutrient intakes of the urban women met the Chinese recommended dietary allowances. However, the situation was different in rural areas, where women had lower mean intakes of vitamins and minerals. There were also significant differences in dietary pattern and food consumption between these two groups of women. Further improvements in dietary intake for those residing in the south-east rural areas of China are needed.

Key words: Chinese women, cross-sectional study, dietary patterns, food consumption, nutrient intake, rural, urban, Zhejiang province.

Introduction

Nutrition is an important determinant of health. China is developing at a rapid pace and food consumption patterns are changing. It is useful to study dietary patterns in order to monitor the potential health impacts of these changes. In this paper we report on the food and dietary patterns of adult women from an area of China where rapid development is occurring. This group is increasing proportionally as the population ages and is at increased risk of diet-related chronic diseases such as cerebrovascular disease and cancer.

Knowledge of dietary patterns in adult women is important because they make up an increasing percentage of the population, as a result of increasing life expectancy.¹ The evidence linking diet with chronic, non-communicable diseases is recognized worldwide.^{2,3} The Chinese food supply has continued to increase in quantity and quality with the economic reform and “open door” policies in place since 1978. This has been the basis for the change in dietary patterns. For example, milk and egg products increased nearly four-fold, aquatic products more than doubled and staple food production increased more than 30% during the 1990s.⁴ The results of food and nutrition studies in China showed that the problem of basic food needs has been resolved since the mid-1980s, but the consumption of animal foods is still relatively low when compared to Western countries.⁵ A nutrition study of Jiangshu provincial residents in 1989–90 documented the change in food patterns and an imbalance in the intake of some nutrients.⁴ The national nutrition survey in 1992 indicated there had been a change in food patterns and improvement in nutrient intakes in China during the previous 10 years. However, the average consumption of vitamin A (retinol equivalents), riboflavin, calcium, thiamine, zinc and

selenium was lower than the recommended dietary allowance (RDA).⁶

There have been three national nutrition surveys in China, conducted in 1959, 1982 and 1992. The results of the first national nutrition survey were not published because China suffered from serious crop failures at that time and results were considered anomalous.⁷ The methodology used in the 1982 nutrition survey was a group (household) 5-day weighed diet record. The dietary records were checked every day by interviewers. The 1982 national survey included a total of 238 134 participants using a stratified random sample of the whole country.⁷ The 1992 national survey was based on a household 3-day weighed diet record plus three consecutive days’ 24-h dieting recall interviews for every individual in the family. A total of 27 000 families encompassing 99 749 subjects were selected using a four-step, stratified, random-sampling process that included all provinces.⁶

In 1990 the Chinese Academy of Preventive Medicine and the State Statistics Bureau of China piloted the National Food and Nutrition Surveillance System (FNSS), and the system was formally established in 1997. This national surveillance network collected a household weighed diet record using stratified random sampling of 40 sites (26 rural and 14 urban sites) from 26 provinces.⁸ Wang *et al.* reported on

Correspondence address: Professor Colin W Binns, School of Public Health, Curtin University of Technology, GPO Box U1987, Perth, WA 6845, Australia.

Tel: +61 89266 7947; Fax: +61 89266 2958

Email: c.binns@curtin.edu.au

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food consumption and dietary patterns during the 1990–98 period, based on the results of FNSS together with data from the household surveys of the State Statistics Bureau conducted during 1990–95.⁹ Although the number of nutrition studies in China has been increasing, few reports of adult women in south-east China are available. The purpose of this cross-sectional study was to assess the habitual dietary patterns and nutrient intake of adult women living in south-east China.

Materials and methods

Recruitment of subjects

The aim of the recruitment strategy was to obtain a sample of adult women, representative of their peers in south-east China. Our cross-sectional study was conducted at the Women's Hospital, School of Medicine, Zhejiang University, which is a public teaching hospital with 500 beds. The hospital is located in Hangzhou, the capital city of Zhejiang province (Fig. 1). It receives patients from all over the Zhejiang province. There were about 12 000 inpatients and 450 000 outpatients in 1999, with 8000 operations performed (unpubl. data). In addition, the hospital is a place where the relatives and friends of the patients congregate. This hospital population source is representative of adult women in south-east China. Subjects were excluded if a previous diagnosis of malignant disease had been made, if their ages were outside the range of 20–75 years, or if they did not live in the province.

Recruitment took place between July 1999 and June 2000. During this period a total of 601 women were interviewed in the hospital and 51 women were recruited from the community. The hospital sample consisted of 340 healthy women (15 women declined to be interviewed, the non-response rate being 4.4%) and 261 outpatients (3 patients declined to participate in the study, with non-response rate 1.2%). The 340 healthy women were interviewed in the



Figure 1. Location of Hangzhou and Zhejiang province, south-east China.

hospital when they visited their relatives or friends having deliveries, when they came for their own family planning or when they came for a routine medical examination. All the recruited outpatients were interviewed after they had consulted their doctors. The 51 community women (non-response rate 7.8%) were interviewed at their homes, community areas near their homes, or their work places.

To control for selection bias, consulting rooms for outpatients and ward numbers for healthy women were chosen randomly using a random numbers table. The subjects were recruited if they met the selection criteria and agreed to participate. If no suitable subjects were found in the chosen room/ward, the adjacent room/ward would be used instead. This systematic selection process was adopted during the entire recruitment period. To control for hospital bias, a reasonable sample of community women was selected from nine different district communities of Hangzhou.

Preliminary testing

To assess the feasibility of the questionnaire it was pre-tested on 51 Chinese women who recently migrated to Perth, Australia. The subjects in this pilot trial were recruited by quota and snowball strategies. Essentially the same questionnaire was administered in both Australia and China, although feedback from the pre-test had led to some minor modifications of the initial questionnaire.

Interview using food frequency questionnaire

Data were collected by face-to-face interview using a structured food frequency questionnaire (FFQ) after the subjects had given their consent. All interviews were conducted in the native Hangzhou dialect by the first author. The interviews usually took between 40 and 50 min. During each interview, information on demographic and lifestyle characteristics, the consumption of 120 different foods and 8 vitamin and mineral supplements, as well as methods of cooking, and the reasons for coming to the hospital, were sought. All the participants were classified as either an urban or a rural resident. If the subject had not changed her address for five years, her current address was used, otherwise her previous residence(s) became the main criterion for assignment.

The FFQ used to collect the food consumption variables had been modified from a diet questionnaire for studying oesophagus, pancreas and stomach cancers in Shanghai, in order to ensure cultural relevance to the Zhejiang province.^{10–12} The Hawaii Cancer Research Survey,¹³ Australian Health Survey 1995¹⁴ and a 1992 USA food survey¹⁵ provided additional guidelines. The questionnaire was translated into Chinese and checked (back translated) by three professional Chinese translators.

Data management

All data were reviewed by the principal researcher at the end of each interview. However, 20 women could not provide personal information on quantities for certain food items that were consumed by all family members. Two outpatients did not complete the interview. In such cases, the nutrient intake

means for all other women were substituted for such missing values. However, when tabulating the overall food consumption, their contribution was ignored. All frequency variables (coded as never or hardly ever, once a month, 2–3 times a month, once a week, 2–3 times a week, 4–6 times a week, once a day and ≥ 2 times a day) and quantity variables (based on the Chinese standard measure *liang*, which is equivalent to 50 g) were inputted into a spreadsheet. The data were subsequently converted into the amount of foods consumed in kg/year. Seasonal factors and cooking methods were also considered. The market availability of some seasonal food items was taken from a previous Hangzhou colorectal cancer study.¹⁶ The nutrient compositions of 119 food items were obtained from the Chinese Table of Food Composition,¹⁷ as were the levels of 6 vitamins in staple foods, animal foods and vegetables after cooking. The average level of vitamins in a food or beverage item was adopted if different values were reported for different cooking methods.¹⁸ Coffee was not listed in the Chinese data, therefore American compositional data were substituted.¹⁹ Following the local drinking habits in Hangzhou, the frequency of tea drinking was calculated based on the number of cups brewed from each new batch of tea. Each new batch of tea or coffee was estimated at 4 g. Alcoholic and other beverages (soft drinks, fruit juices) were measured by the quantity actually consumed. For dietary supplements, the nutrient content was obtained from appropriate sources, such as manufacturers' data sheets, labels and reference books. Finally, quantities and nutrient data were verified and double-checked using an ACCESS program.

The national recommended dietary allowances (RDA) were used for comparison.²⁰ The RDA reference values for adult women are reproduced in Table 1. When applying the RDA, moderate physical activity is assumed for women aged 18–59 years and light physical exercise is assumed for the

60–79 year age group. The nutrient intake was considered to be sufficient when the estimate was within 80–120% of the corresponding RDA.^{21,22}

Statistical analysis

The mean food consumption and the mean daily nutrient intake were tabulated separately for urban and rural groups. The distributions of energy, protein and fat sources were also obtained. Two sample *t*-tests and ANOVA were used to compare the means. The chi-squared test of association was also performed on selected categorical variables. All statistical analyses were undertaken using SPSS version 10.²³

Results

Demographic profile

Table 2 profiles the age distribution, anthropometric and demographic characteristics of the sample. Of the 652 participants, 354 (54.3%) came from urban areas and 298 (45.7%) lived in rural areas. The average age was 48 years (SD = 10.2).

Food consumption

All food items were first classified by origin into plant and animal based foods. The resulting composition of food groups is given in the Appendix. The average food consumption (kg/year) by women in this study, together with gender-mixed data from other nutrition surveys, are tabulated in Table 3. Rural women consumed more cereals, and tubers, but their urban counterparts consumed more in all other categories.

Nutrient intake

The mean daily nutrient intake by urban women met the RDA. Most mean intakes of vitamins and minerals by rural

Table 1. Recommended dietary allowances for Chinese women[†]

Nutrient (unit/day)	Age (years)			
	18–44	45–59	60–69	70–79
Energy (kcal)	2700	2400	1900	1800
Protein (g)	80	75	65	60
Fat energy ratio (%)	20–25	20–25	20–25	20–25
Minerals				
Calcium (mg)	800	800	800	800
Iron (mg)	18	12	12	12
Zinc (mg)	15	15	15	15
Selenium (μ g)	50	50	50	50
Vitamins				
Vitamin A (μ g)	800	800	800	800
Vitamin B ₁	1.4	1.3	1.3	1.3
Vitamin B ₂	1.4	1.3	1.3	1.3
Niacin (mg)	14	13	13	13
Vitamin C (mg)	60	60	60	60
Vitamin D (μ g)	5	5	10	10
Vitamin E (mg)	10	12	12	12

[†] From Institute of Nutrition and Food Hygiene, Chinese Academy of Preventive Medicine,²⁰ with moderate physical activity assumed for women 18–59 years of age and light physical exercise assumed for women 60–79 years of age. The reference ranges for common elements are: magnesium, 300 mg; copper, 2.0–3.0 mg; manganese, 2.5–5.0 mg; sodium, 1100–3300 mg; potassium, 1875–5625 mg.²⁰

women were below RDA levels, but their average intake of macronutrients (energy, carbohydrate, protein and fat) was found to be adequate. Table 4 reports the mean nutrient intakes of the two groups and the combined sample.

The prevalence of inadequate nutrient intake was then computed, based on the RDA reference values. From Table 5, 19% of women reported excess energy intake while 27% were below the acceptable RDA energy range. Protein intake was inadequate in 27% of the participants, but excess fat

intake was evident in 14% of the participants. Inadequate intakes of calcium, zinc, selenium, vitamins A, B₁, B₂ and niacin were prevalent in the combined sample, whereas intakes of iron, and vitamins C and E were found to be sufficient. In terms of rural–urban comparison, a significantly higher proportion of rural women were deficient in protein, calcium, selenium, vitamins A, B₁, B₂, C and niacin. The proportions of inadequate energy and zinc intakes were similar between the two groups.

Table 2. Age distribution, anthropometric and lifestyle characteristics of the sample

	All	Urban	Rural	Difference between urban and rural
Number of participants	652	354 (54.3%)	298 (45.7%)	NS
Age in years (mean ± SD)	48.0 ± 10.2	48.5 ± 11.3	47.4 ± 8.6	NS
Height in cm (mean ± SD)	158.3 ± 4.6	158.9 ± 4.4	157.5 ± 4.7	**
Weight in kg (mean ± SD)	57.6 ± 8.5	60.0 ± 8.3	57.1 ± 8.6	NS
BMI (weight/height ²)	23.0 ± 3.1	22.9 ± 3.1	23.0 ± 3.2	NS
% Overweight (BMI ≥ 25) (%)	23.8	22.3	25.5	NS
Marital status (%)				
Never married	1.2	2.0	0.3	NS
Married	93.8	93.1	94.3	NS
Widowed, divorced, separated	5.0	4.8	5.3	NS
Education (%)				
No	20.4	6.8	36.6	**
Primary	33.1	21.2	47.3	**
Secondary	35.3	51.7	15.8	**
Tertiary	11.2	20.3	0.3	**
Income in 1998 (yuan/month) (%)				
≤ 1000	87.6	81.9	94.3	**
1001–2000	10.6	15.5	4.7	**
≥ 2001	1.8	2.5	1.0	**
Current smoking (%)	2.0	2.8	1.0	NS
Alcohol consumption (%)	35.6	41.2	28.9	**

** *P*-value < 0.01, * *P*-value < 0.05. BMI, body mass index; NS, not significant.

Table 3. Average food consumption (kg/year) of women from Zhejiang province, China, compared with gender-mixed data from national and other nutrition surveys

Food group	2000 ^a	1999–2000		1998 ^b		1995 ^c		1992 ^d		1982 ^e	
	Goal	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Cereals	150	130.4	167.5	125.8	245.4	142.4	250.4	147.9	177.3	167.8	193.8
Tubers	36	17.6	21.8	NA	7.8	7.8	3.4	23.0	37.6	24.1	83.2
Legumes and products	15	16.1	11.3	5.7	6.5	7.7	8.8	4.8	3.8	5.2	4.8
Vegetables	120	180.0	169.6	146.5	129.9	123.5	89.6	119.4	115.9	114.7	122.4
Fruits	18	100.8	59.8	73.1	20.8	73.3	29.1	29.2	11.7	24.9	8.9
Meat	24	27.8	21.6	37.9	15.6	36.8	18.5	34.4	12.7	22.6	8.2
Fish	9	22.3	11.7	16.7	3.4	21	9.9	16.1	7.0	7.9	2.4
Eggs	12	9.4	7.0	15.9	5.3	10.8	4.2	10.7	3.2	5.7	1.4
Milk	9	22.0	1.3	18.4	0.8	8.8	0.2	13.2	1.4	3.6	2.7
Vegetable oil	9	10.8	9.5	9.9	6.3	6.8	3.1	11.8	6.2	7.7	3.4
Animal oil	NA	0.5	2.3	0.5	1.1	0.4	1.1	1.6	3.1	1.7	2.0
Wine	NA	12.3	12.8	14.7	8.2	27.4	23.8	0.9	0.5	1.6	1.3

^a The 2000 goal of ideal food consumption for the nation.²⁵ ^b Data from 1998 National Food and Nutrition Surveillance System.⁹ ^c Data from 1990 to 1995 survey of Beijing and 6 other provinces by the State Statistics Bureau.⁸ ^d Data from 1992 national nutrition survey.⁶ ^e Data from 1982 national nutrition survey.⁷ NA, not available.

Dietary patterns

The daily mean intake and distribution of energy (kcal/day), protein (g/day) and fat (g/day), according to plant and animal food sources, were calculated. Table 6 shows that the major sources of energy, protein and fat for the adult women in south-east China came from plant-based foods.

Discussion

The present research specifically targeted adult women in south-east China, unlike other published and typically gender-mixed findings in the literature. Information on usual food intake and other data were collected by individual, face-to-face interviews, using a food frequency questionnaire.

Table 4. Mean daily energy and nutrients intake of women from Zhejiang province, China

Intake per day (mean \pm SD)	All	Urban	Rural	Difference between urban and rural
Energy (kcal)	2344 \pm 600	2283 \pm 589	2418 \pm 606	**
Protein (g)	80.7 \pm 31.9	82.4 \pm 30.4	78.6 \pm 33.5	NS
Fat (g)	58.8 \pm 23.1	61.9 \pm 21.9	55.2 \pm 23.9	**
Fat energy ratio (%)	22.8 \pm 6.8	24.4 \pm 5.9	20.8 \pm 7.2	**
Carbohydrate (g)	379.3 \pm 108.3	354.1 \pm 97.8	409.3 \pm 112.7	**
Carbohydrate energy ratio (%) [†]	64.6 \pm 7.7	62.1 \pm 6.7	67.6 \pm 7.6	**
Dietary fibre (g)	13.2 \pm 5.5	13.4 \pm 5.1	13.0 \pm 5.9	NS
Cholesterol (mg)	239.2 \pm 178.6	282.8 \pm 178.8	187.4 \pm 164.1	**
Minerals				
Calcium (mg)	662.1 \pm 476.0	796.4 \pm 550.2	502.6 \pm 299.6	**
Iron (mg)	26.0 \pm 8.4	26.8 \pm 8.7	24.9 \pm 8.1	**
Zinc (mg)	12.8 \pm 3.8	12.8 \pm 3.8	12.8 \pm 3.8	NS
Selenium (μ g)	39.0 \pm 27.2	44.1 \pm 33.1	33.0 \pm 15.8	**
Phosphorus (mg)	1056 \pm 390	1113 \pm 411	987 \pm 353	**
Potassium (mg)	1864 \pm 895	2076 \pm 891	1613 \pm 834	**
Sodium (mg)	2781 \pm 1189	2478 \pm 862	3141 \pm 1406	**
Magnesium (mg)	331.3 \pm 109.6	340.8 \pm 109.9	319.9 \pm 108.2	*
Manganese (mg)	8.8 \pm 2.5	8.3 \pm 2.2	9.3 \pm 2.8	**
Copper (mg)	3.7 \pm 3.7	4.3 \pm 4.2	3.0 \pm 2.7	**
Vitamins				
Vitamin A (μ g)	823.0 \pm 1909	1046.3 \pm 2467	557.8 \pm 792.8	**
Vitamin B ₁	1.1 \pm 1.2	1.3 \pm 1.4	0.87 \pm 0.96	**
Vitamin B ₂	1.2 \pm 1.3	1.5 \pm 1.5	0.94 \pm 0.98	**
Niacin (mg)	12.0 \pm 6.2	13.3 \pm 6.6	10.4 \pm 5.3	**
Vitamin C (mg)	118.3 \pm 84.9	137.8 \pm 96.6	95.2 \pm 61.1	**
Vitamin E (mg)	38.1 \pm 35.4	46.1 \pm 44.9	28.6 \pm 13.6	**

[†] Recommended range 63–68%.⁴ ** *P*-value < 0.01, * *P*-value < 0.05. NS, not significant.

Table 5. Proportion of women from Zhejiang province, China, with excess or inadequate intake of energy and nutrients

Daily intake	Excess/ Inadequate	All (%) (<i>n</i> = 652)	Urban (%) (<i>n</i> = 354)	Rural (%) (<i>n</i> = 298)	Difference between urban and rural
Energy	Excess	19	17	21	NS
Energy	Inadequate	27	28	26	NS
Protein	Inadequate	27	22	33	**
Fat	Excess	14	17	10	*
Calcium	Inadequate	65	52	81	**
Iron	Inadequate	2	1	3	NS
Zinc	Inadequate	48	49	46	NS
Selenium	Inadequate	66	55	78	**
Vitamin A	Inadequate	72	65	80	**
Vitamin B ₁	Inadequate	78	71	87	**
Vitamin B ₂	Inadequate	72	62	85	**
Niacin	Inadequate	53	43	64	**
Vitamin C	Inadequate	12	7	18	**
Vitamin E	Inadequate	1	1	1	NS

* *P*-value < 0.05, ** *P*-value < 0.01. Excess, > 120% RDA; Inadequate, < 80% RDA; NS, not significant; RDA, recommended daily allowance.

Table 6. Mean intake and distribution of energy, protein and fat according to food sources for women from the Zhejiang province, China

Source	All		Urban		Rural		Difference between urban and rural
	Energy	%	Energy	%	Energy	%	
Energy (kcal/day)							
Plants	1951	84.6	1986	84.8	1909	84.5	NS
Cereals	1355	58.5	1397	59.5	1306	57.3	**
Legumes	98	4.2	99	4.1	97	4.3	NS
Meat	134	5.6	137	5.6	130	5.7	NS
Fish and shellfish	35	1.5	33	1.4	36	1.6	NS
Eggs and milk	78	3.0	70	2.7	87	3.4	NS
Overall†	2344		2283		2418		**
Protein (g/day)							
Plants	57.4	72.6	58.7	73.4	55.9	71.6	NS
Cereals	30.2	40.9	31.0	42.3	29.4	39.3	*
Legumes	9.1	11.0	9.1	10.8	9.0	11.4	NS
Meat	10.2	12.7	10.4	12.8	10.0	12.6	NS
Fish and shellfish	5.8	6.9	5.5	6.6	6.1	7.4	NS
Eggs and milk	4.6	5.2	4.2	4.6	5.1	5.8	NS
Overall†	80.7		82.4		78.6		NS
Fat (g/day)							
Plants	37.4	66.2	37.8	66.1	37.0	66.3	NS
Cereals	3.6	6.8	3.8	7.1	3.4	6.4	*
Legumes	4.0	6.9	4.1	6.9	3.9	7.0	NS
Meat	9.9	16.2	10.2	16.2	9.6	16.3	NS
Fish and shellfish	1.2	2.0	1.1	1.8	1.2	2.2	NS
Eggs and milk	4.5	6.6	4.0	5.8	5.0	7.4	NS
Overall†	58.8		61.9		55.2		**

† Includes other unclassifiable sources. ** P -value < 0.01, * P -value < 0.05. NS, not significant.

The study design and the recruitment procedure led to a large representative sample of 20–75-year-old women in Zhejiang province that could be compared to other Chinese studies.

Comparison with other Chinese nutrition data

Given the obvious limitations and the different methodologies used for recording food intake data, direct comparisons between studies are difficult. Nevertheless, when compared with previous national surveys, our results show differences in dietary patterns and overall improvement in nutritional status for women in this part of China, and these are substantial enough to show trends. The intakes of cereals and tubers are lower, whereas the intakes of vegetables, fruits and animal foods such as meat, fish, egg and milk are higher than those observed in previous studies. These differences in dietary patterns suggest that, at least in the urban group, more women are now able to meet the RDA.

Food consumption and dietary patterns

The present study is unique in that, to our knowledge, it is the only research study in China that obtained usual food intakes using a FFQ instrument and was conducted via actual face-to-face interviews. The outcomes were consistent with previous surveys that indicated a general trend towards improving nutritional status.²⁴ Current Chinese dietary recommendations

encourage a traditional Chinese diet consisting of staple plant foods supplemented with certain animal foods. A guideline for ideal food consumption for the nation in the year 2000 had been proposed.²⁵ Our results revealed that the targeted population of adult women in south-east China performed reasonably well with respect to this goal, although some items are still of concern. In our sample, the intakes of energy, protein and fat were mostly from plant-based foods, with proportions as high as 85, 73 and 66%, respectively (Table 6).

Comparing rural and urban nutrient intakes

Different levels of nutritional intake between rural and urban women were evident in this study. The mean intake of women living in urban areas met the RDA for most nutrients (except zinc and selenium), but at the individual level the prevalence of inadequacy of energy or nutrient intake for some of these women was still of concern. The mean intake of most vitamins and minerals by rural women was substantially below the RDA, while their average intakes of energy, carbohydrate, protein and fat were adequate.

The prevalence of inadequate nutrient intake among the participants in the study was similar to that reported for the Jilin province in north-east China.²² Deficiencies were significantly more common for the rural women in Zhejiang when compared to their urban counterparts.

Nutrition is an important determinant of health.²⁶ The Statistical Yearbook of China 1999 cited the five leading causes of death for urban women as cerebrovascular disease (22.7%), malignant tumour (19.2%), heart trouble (18.7%), respiratory disease (14.7%) and trauma and intoxication (5.5%). This pattern of disease is not dissimilar to that found in developed countries. The top five causes of death for rural women were respiratory disease (24.7%), cerebrovascular disease (18.6%), heart trouble (14.4%), malignant tumour (13.9%) and trauma and intoxication (9.7%). This is more compatible with the pattern of disease in developing countries where infectious diseases are the major causes of death.^{27,28}

Improving nutritional status

This research has found significant differences in the mean nutrient intakes, and the prevalence of inadequate nutrient intakes, between urban and rural women in south-east China. Between 1978 and 1998 the relative index of per capita annual income for urban and rural households increased threefold and fourfold, respectively.²⁹ This study indicates that despite the dramatic increase in income, there is still a problem in achieving adequate nutrient intakes for women in rural areas. The limited nutritional improvement may be due to habitual dietary patterns and lack of nutrition knowledge by rural inhabitants. It is well established that Chinese women have played an important role in purchasing foods and in preparing and cooking meals. Their knowledge of nutrition is thus a vital determinant of the nutritional status of their families. One gender-mixed nutrition survey of a peasant population in south-east China found no significant difference in dietary patterns among rural residents. This study surveyed those living in buildings of formal and adequate construction compared with those living in huts, a proxy indicator of economic status.³⁰ Another study also suggested that the apparent differences between urban and rural residents were not linked to economic development and food resources, but were merely a reflection of their contrasting nutrition knowledge, dietary habits and real needs.⁴

Since the mean intake of most vitamins and minerals by the women of south-east China were below the RDA, especially by those in rural areas, action is required to improve the nutritional status of rural women. By contrast, a significant proportion of women had an excess consumption of energy and fat, confirming that dietary consumption patterns have changed considerably over the years. Nutrition education should also be a priority for these women.

The nutrition transition

The results described above indicate that the urban women have passed through the nutrition transition well ahead of their rural counterparts. Rapid changes in diets resulting from economic development and food supply improvement are having a significant impact on the nutritional status of populations in China. Despite the improved nutritional status, there have been negative consequences in terms of inappropriate dietary patterns, for example, increasing consumption of food that is

high in fat and low in carbohydrates. There has been a corresponding increase in nutritional and diet-related diseases, including obesity, diabetes, cardiovascular disease and various forms of cancer.^{31,32} The results of this nutrition study in south-east China have documented the nutrition transition.

Nutritional and diet-related diseases are significant causes of disability and premature death in both developing and newly developed countries. They are taking over from more traditional public health concerns like undernutrition and infectious disease, and placing additional burdens on over-taxed national health budgets.³³ Stookey *et al.* recently reported that urban residence was consistently and positively associated with energy from fat and protein intakes.³⁴ Some nutritionists are concerned with the imbalance of nutrition and warn that China is facing two challenges. The first is to increase food provision and improve diet quality to control undernutrition; the second is providing dietary guidelines and adjusting dietary patterns to prevent overnutrition. They considered the latter to be a long-term and arduous challenge.^{35,36}

Conclusion

The mean nutrient intakes by urban women in south-east China appear to achieve most of the recommended dietary allowances. However, the prevalence of inadequate nutrient intake is still high, particularly in the rural areas. High intakes of fat may increase the risk of chronic and other diseases, such as cardiovascular disease and cancer. The nutritional situation of rural women is obviously inferior to that of their urban counterparts. Further research and education are required. Changes in dietary patterns towards healthy food choices may help to minimise disease for this age group. Consequently, developing appropriate strategies to promote a healthy diet for adult women in south-east China should be a public health priority.

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Appendix I

Composition of food groups

Food group/item	Composition
Plants sources	
Cereals	Rice, rice noodles, noodles, instant noodles, steamed bun, pancake, porridge, tortilla, bread (white/brown/mixed grain), gluten wheat.
Tubers	Potato, sweet potato.
Legumes and products	Soybean, mung bean, red bean, other dried beans, pea pods, green peas, green beans, green broad beans, bean curd, fried bean curd, textured bean curd, fermented bean-curd, soybean milk, skin of soybean milk, peanuts.
Vegetables	Bok choy, spinach, cabbage, Chinese cabbage, cauliflower, celery, bean sprouts, eggplant, wild rice stem, lettuce, pumpkin, white gourd, cucumber, carrot, dried mushrooms, fresh mushrooms, sweet green/red peppers, tomato, bamboo shoot, lotus root, dishcloth gourd, Chinese wax gourd, white radish, taro, sweet corn, garlic, garlic stalks, Chinese chives, onion, spring onion, ginger, green/red fresh chili, kelp, sea weeds, salted mustard greens, salted vegetables, hot pickled mustard stem.
Fruits	Apple, pear, orange, tangerine, banana, grape, watermelon, peaches, pineapple, strawberries, plums, apricot, dates.
Vegetable oil	Rape seed oil, peanut oil, soybean oil, sesame oil.
Animal sources	
Meat	Pork chops, pork spareribs, pork feet, fresh pork (fat), fresh pork (lean), fresh pork (fat and lean), salted pork, pork liver, other organ meats, sausages, ham, beef and mutton, chicken, duck.
Fish and shellfish	Salt water fish (e.g., hair-tail, yellow croaker), fresh water fish (e.g., silver carp, golden carp), salted fish, eel, shrimp, crab, shellfish, spiral shell.
Eggs	Fresh poultry eggs, salted egg, preserved limed duck eggs.
Milk and products	Fresh milk, powdered milk, ice cream, yogurt, cheese.
Animal oil	Lard.