Changes in food, nutrient and energy intake in People's Republic of China samples of urban and rural north and south adults surveyed in 1983-84 and resurveyed in 1987-88

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Dietary patterns were assessed in a prospective study of cardiovascular disease (CVD) risk factors in four Chinese populations: Beijing urban (BJ-U) and rural (BJ-R), Guangzhou urban (GZ-U) and rural (GZ-R). A total of 10,076 men and women 35-54 years old were surveyed in 1983-84 and resurveyed in 1987-88. Dietary data were obtained in a subsample of about 10% (n=169 BJ-U, 178 BJ-R, 198 GZ-U, 230 GZ-R). Three 24-hr recalls were collected on each participant in each survey. Comparison of mean intakes in the two periods showed increases in meat, poultry, fish (except GZ-R), eggs (rural only), milk (except BJ-R) and alcoholic beverages. The largest shifts were in meat intake (29%-39%), alcoholic beverages (71%-104%) and fats in the urban samples (33%-35%). These changes are reflected in increased mean intakes of animal protein, fat, saturated fatty acids (SFA) and higher Keys scores. Mean total fat intake now exceeds the PRC recommended range of 20-25% of energy in three of the four samples.

During this period BMI increased in all samples especially among men (3% - 6%). These surveys, conducted during a period of rapid economic development in China, show that such changes promote shifts in dietary patterns and energy balance towards increased risk of cardiovascular disease.

Key words: dietary survey, China, nutrient intake, cardiovascular

Introduction

Coronary heart disease (CHD) is uncommon in the People's Republic of China (PRC). Its relatively rare occurrence has been attributed to particularly low serum total cholesterol related in turn to low saturated fatty acids (SFA) and cholesterol in the traditional Chinese diet. Economic reforms implemented in the early 1980s have significantly increased income levels in many segments of the Chinese population. It is a reasonable hypothesis that these changes, coupled with increased access to Western products are having an impact on the traditional diet and other lifestyle characteristics known to influence population serum lipids and other major cardiovascular risk factors, including blood pressure.

The Peoples Republic of China-United States (PRC-USA) Collaborative Study of Cardiovascular and Cardiopulmonary Epidemiology initiated in 1981 under the PRC-USA Governmental Cooperation in Science and Technology provides an opportunity to test the foregoing hypothesis about dietary trends during this period of rapid economic change in four areas of China. This joint research study has carried out three surveys -- 1983-84, 1987-88, and 1993-94 -- on eight cohorts of adult men and women identified from urban and rural populations in, or close to, Beijing in the north and Guangzhou in the south of China. At each survey, three 24-hour dietary recalls were done on each of 775 men and women ages 35-54 years at baseline in 1983-84. Nutrient analyses have been completed from surveys 1 and 2. This report gives changes in food and nutrient intake from 1983-84 to 1987-88 -- by sex, site (north, south), and setting (urban, rural) -- related to the foregoing general hypothesis and its specific aspects.

Subjects and methods

Study populations: Four cohorts of at least 2000 men and women 35 to 54 years old were selected for the study. The

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Beijing population included workers from the Capital Iron and Steel Complex (CISC) in Beijing. This large complex encompassed 16 separate factories employing about 80,000 people at the time screening was initiated in 1981. All age-eligible workers in five factories were asked to participate. Due to the small number of female workers at CISC, additional women in a specified residential district, most of them wives of CISC workers, as well as women working in other nearby factories were also surveyed. The Beijing rural population included all age-eligible men in all 11 farm brigades and all age-eligible women in 9 of 11 farm brigades in Shijingshan agricultural district at the time of the 1981 census. The Guangzhou urban population comprised mainly employed male and female manual workers, plus some engineers, technicians, cadres (party members), physicians, and retired workers from the Guangzhou Shipyard Company. The request to participate was made to age-eligible persons in eight of the 25 company workshops. The Guangzhou rural population comprised age-eligible men and women working in 14 of 21 agricultural villages near Guangzhou, in the Dashi township of Panyu County at the time of the 1981 census. Approximately 10% of those screened were invited to participate in a more intensive data collection, which included assessment of dietary intake and urinary electrolytes. In Beijing, the urban subsample was selected on a day when employees of a given factory appeared for the general examination. From the first 50 general examinees, 20 were selected and studied for three consecutive days; additional 20/50 samples were sequentially selected. The rural subsample was selected in a similar way. These were "convenience" subsamples, since potential participants were excluded if they 1) lived far away, 2) worked outside the village or industrial complex, 3) appeared unreliable, or 4) were unavailable for three consecutive days of data collection.

In Guangzhou, a 10% subsample was randomly selected from attendees at the general survey. Every 10th person was included, unless the person refused or was judged to be potentially unreliable, in which case the 11th person was selected.

Data in this report are based on the cohorts of participants who provided at least two reliable dietary recalls both in the fall of 1983-84 and again in the fall of 1987-88. Sample sizes for participants who completed both surveys were 169 (Beijing urban), 178 (Beijing rural), 198 (Guangzhou urban), and 230 (Guangzhou rural). Three individuals were excluded from the baseline analysis because they did not return for subsequent surveys.

Dietary assessment: Dietary data were collected according to a standardised 24-hour dietary recall procedure over three consecutive days. The dietary assessment was carried out by physicians trained according to a common protocol. Standard utensils such as bowls and spoons, samples of real food, scales, and graduated cylinders were used to quantify amounts of foods reported. For the Guangzhou rural area, dietary interviews were usually conducted in the home. Otherwise, participants were interviewed at screening sites. Quality control procedures for the interview and data processing consisted of standardised training, standard procedure manuals, and random observation and inspection of forms by supervisors.

Nutrient database: Energy and nutrient intakes were calculated from a specially constructed nutrient database, which is a subset of the Chinese national tables of food composition[1], supplemented by international data, chemical assays, and calculated recipes. When published nutrient composition data were unavailable, nutrients were imputed according to standard procedures[2]. Many fatty acid values and most carbohydrate fractions were imputed.

Nutrients in the database were selected for their putative role in cardiovascular risk factor development and include total fat, saturated (SFA), monounsaturated (MFA), and polyunsaturated (PFA) fatty acids, cholesterol, protein (total, animal, vegetable), total carbohydrate, starch, refined sugar, alcohol, sodium, potassium, and calcium.

Composition of foods in the database is generally based on the state of the food when purchased. Hence, composition of commodity foods (eg, meats and vegetables), is for raw foods, and for processed foods (such as commercial biscuits), it is for the cooked product. Recipe items were usually calculated from raw ingredients. No factors were applied to account for alterations in nutrients during cooking. Leaching of sodium and potassium into the cooking medium was not considered to be a major source of error since most meats and vegetables were prepared either stir-fried or as soups and the cooking medium was consumed.

Development of the nutrient database was a collaborative project involving Chinese investigators; the National Heart, Lung, and Blood Institute; the U.S. Department of Agriculture; and the University of Minnesota Nutrition Coordinating Center (NCC). Before utilising the nutrient database for calculation of recalls, it was subjected to a series of logic and consistency checks. Unusual values were flagged and verified or corrected. The nutrient database is maintained in the United States at the NCC and in China at Fu Wai Hospital in Beijing and at Guangdong Provincial Cardiovascular Institute in Guangzhou. Data in this report are based on version 1 of the nutrient database[2].

Body size and energy expenditure: Height was measured to the nearest centimetre (cm) with use of a standard right-angle device. Each participant was measured without shoes and in a standing position. Weight was measured to the nearest kilogram (kg) with use of a spring balance. Each participant was measured wearing usual indoor clothing and no shoes.

Body mass index (BMI) was calculated as: weight (kg)/ height $(m)^2$. Energy expenditure was calculated as kilocalories per kg body weight.

Statistical methods: To assess changes in reported nutrient and food intake, means, and standard deviations are reported for each of the two surveys and differences between them calculated.

Results

Changes in food intake

Food is a complex mixture of nutrients and other compounds, the balance of which can have beneficial or detrimental effects on serum lipids and blood pressure. Changes in food intake from 1983-84 to 1987-88 by location and site are displayed in Figures 1-5, and for men and women separately in Tables 1-4.

Figure 1. Mean consumption of meat, fish, and poultry in 1983-84 survey and 1987-88 re-survey in Beijing and Guangzhou.

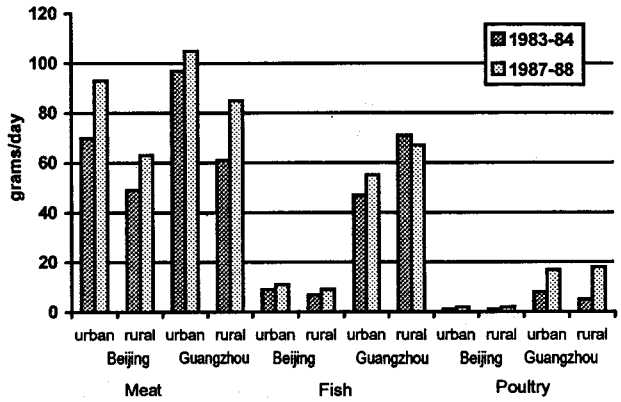


Figure 2. Mean consumption of eggs, milk and added fats in 1983-84 survey and 1987-88 re-survey in Beijing and Guangzhou.

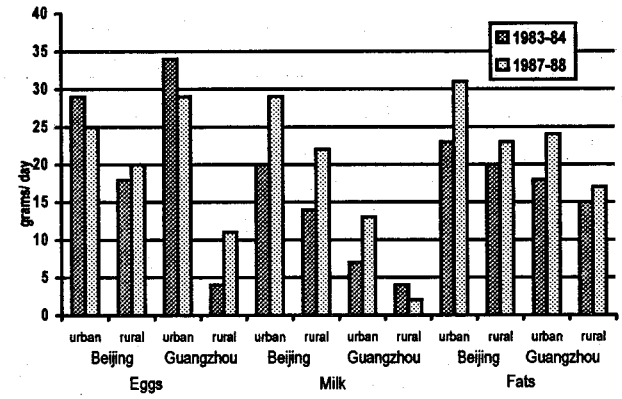
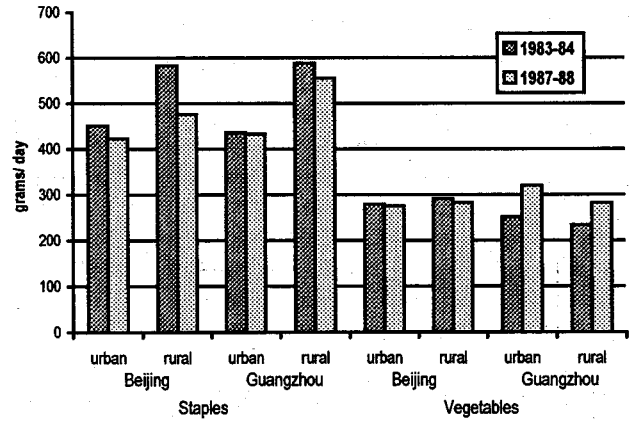


Figure 3. Mean consumption of staple foods and fresh vegetables in 1983-84 survey and 1987-88 re-survey in Beijing and Guangzhou.



Meat consumption rose in all four areas but the increase was greater in the GZ rural sample where it rose 39%. By 1987-88, reported mean consumption of meat ranged from 63 g/d in BJ rural to 105 g/d in GZ urban samples. The increase in meat consumption was similar in men and women in Beijing and urban Guangzhou. The most striking increase occurred in Guangzhou rural men where meat consumption nearly doubled. By 1987-88, meat contributed on average 13% of energy, an increase of 4%.

Figure 4. Mean consumption of legumes and fruits in 1983-84 survey and 1987-88 re-survey in Beijing and Guangzhou.

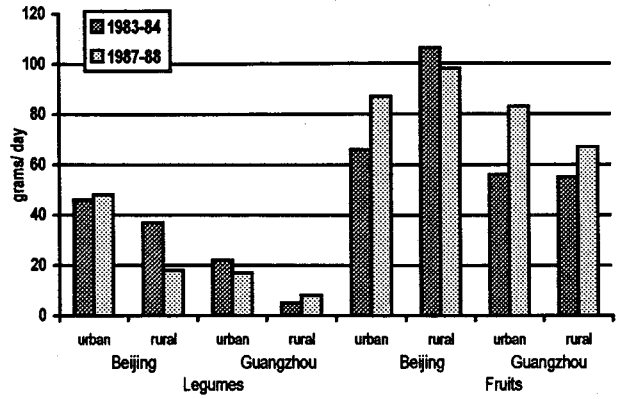
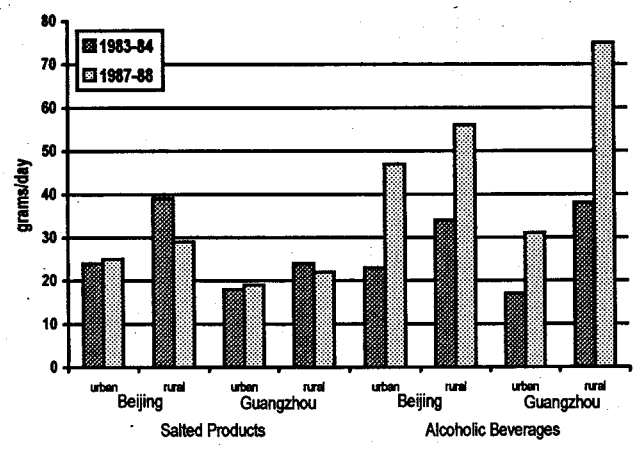


Figure 5. Mean consumption of salted products and alcoholic beverages in 1983-84 survey and 1987-88 re-survey in Beijing and Guangzhou.



Fish consumption decreased slightly in GZ rural samples and increased in GZ urban women and Beijing urban and rural samples. Fish consumption was considerably lower in Beijing, averaging about 10 g/d compared to nearly 60 g/d in Guangzhou in 1987-88. There were modest changes in fish and poultry consumption. Poultry was rarely consumed in Beijing. In Guangzhou mean consumption more than doubled in the urban sample and the increase was even larger in the rural sample. Changes were similar in men and women.

Egg consumption decreased slightly in both urban samples. Rural women had a larger increase than men. Mean egg consumption was much lower in the GZ rural sample, 11 g/d vs 25 g/d in the other samples. There was a small increase in milk consumption (except GZ rural); however the mean was still very low, ranging from 3 g/d in GZ rural men to 33 g/d in BJ urban women.

Overall total consumption of animal products increased by 25 to 30% except in the Guangzhou urban sample where it increased only 13%. In 1987-88 consumption of animal products ranged from 116 g/d in BJ rural sample to 219 g/d in GZ urban sample. On average animal products contributed 18% of energy in 1987-88.

Table 1. Mean grams of food and percent of energy for Beijing urban men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

Foods	V1			V2			V2-V1		V1			V2			V2-V1	
	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%
	Men (n = 75)								Women (n = 94)							
Meat	90	74.4	14.2	124	96.6	17.7	34	38	52	43.6	11.7	64	51.7	14.8	12	23
Poultry	1	6.4	0.1	2	7.2	0.1	1	100	--[2]	--	--	1	3.2	0.1	--	--
Fish	10	26.0	0.4	14	29.7	0.5	4	40	8	20.3	0.5	8	14.9	0.5	0	0
Eggs	30	32.0	1.7	28	33.6	1.6	-2	-7	27	26.6	2.3	23	26.3	1.9	-4	-15
Milk	22	58.1	0.6	25	68.1	0.7	3	14	19	56.4	0.7	33	80.3	1.2	14	74
Fats	29	16.8	9.0	37	22.7	11.1	8	28	18	9.9	7.9	25	16.6	11.1	7	39
Staples	508	113.3	53.0	481	126.1	50.8	-27	5	400	106.0	60.7	367	98.7	56.0	-33	8
Legumes	61	78.9	3.0	69	80.9	3.2	8	13	32	60.4	2.3	28	59.1	2.1	-4	-12.5
Fresh Veg	288	126.7	2.7	284	131.1	2.7	-4	-1	271	160.2	3.5	266	154.9	3.3	-5	-2
Fruits	58	63.9	1.0	86	106.2	1.6	28	48	74	82.2	1.8	88	97.4	2.1	14	19
Nuts	11	23.0	1.9	13	24.5	2.4	2	18	3	11.2	0.8	4	10.2	1.0	1	33
Salted Veg[1]	29	14.9	0.8	33	16.1	0.7	4	14	20	10.4	0.7	17	9.5	0.5	3	15
Dried Veg	4	11.5	0.3	4	7.7	<0.1	0	0	1	2.9	0.1	3	7.9	0.1	2	200
Sweets	55	57.1	8.2	23	35.3	3.0	-32	-58	32	34.1	7.1	26	30.8	5.0	-6	-19
Alcoholic Bev	47	90.8	3.2	95	214.8	4.0	48	102	2	16.0	0.1	1	6.3	0.2	-1	-50

[1]includes salt and soya sauce; [2]negligible

Table 2. Mean grams of food and percent of energy for Beijing rural men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

Foods	V1			V2			V2-V1		V1			V2			V2-V1	
	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%
	Men (n = 107)								Women (n = 76)							
Meat	55	64.1	8.9	74	68.9	12.2	19	35	44	42.1	9.3	56	57.9	12.8	12	27
Poultry	--	--	--[1]	2	5.6	0.1	--	+	1	3.5	--	3	11.5	0.2	2	100
Fish	8	33.8	0.3	10	29.0	0.4	2	25	7	22.3	9	8	24.6	0.5	1	14
Eggs	20	25.2	1.0	20	36.2	1.1	0	0	17	22.2	1.3	21	25.4	1.7	4	23
Milk	21	83.7	0.7	27	87.6	0.7	6	29	7	37.7	0.2	19	59.5	0.7	12	171
Fats	23	15.0	6.3	26	16.1	7.7	3	13	17	12.6	6.5	21	12.6	8.7	4	24
Staples	667	226.7	63.8	552	184.0	57.9	-115	-17	552	184.0	57.9	419	148.6	59.9	133	24
Legumes	46	71.9	2.1	19	41.2	0.9	-27	-59	28	50.4	1.8	17	42.3	1.1	11	39
Fresh Veg	299	147.3	3.1	295	148.7	2.8	-4	-1	283	157.0	3.1	275	138.4	3.6	-8	-3
Fruits	94	96.7	1.6	70	113.2	1.3	-24	-26	118	128.6	2.7	119	126.2	3.0	1	1
Nuts	10	24.4	1.7	15	43.8	2.4	5	50	3	9.8	0.8	6	18.4	1.6	3	100
Salted Veg[2]	46	25.6	1.0	36	17.9	0.8	10	22	32	18.7	1.0	24	12.8	0.8	8	25
Dried Veg	--	--	--	3	4.9	0.1	--	--	2	4.3	--	2	4.7	--	0	0
Sweets	39	67.6	5.2	50	71.9	5.3	11	28	35	49.6	6.4	32	54.6	4.6	-3	-9
Alcoholic Bev	71	198.3	4.2	111	199.0	6.4	40	56	1	2.1	--	15	69.8	0.8	14	140

[1]negligible; [2]includes salt and soya sauce

Table 3. Mean grams of food and percent energy for Guangzhou urban men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2)

Foods	V1			V2			V2-V1		V1			V2			V2-V1	
	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%
	Men (n = 91)								Women (n = 123)							
Meat	111	59.7	13.6	118	67.3	14.4	7	6	87	57.6	12.9	94	53.1	14.0	7	8
Poultry	9	16.5	0.6	19	25.3	1.0	10	111	7	13.8	0.5	16	20.5	1.1	9	128
Fish	51	36.7	2.2	50	37.3	2.0	-1	-2	44	34.5	2.4	58	38.7	2.8	14	32
Eggs	35	20.9	2.1	31	27.8	1.9	-4	-11	33	22.8	2.5	27	21.6	2.0	-6	-18
Milk	5	19.9	0.2	13	45.4	0.2	8	160	8	27.2	0.5	14	51.5	0.5	6	75
Fats	18	9.5	5.8	24	11.5	7.7	6	33	18	8.7	7.2	23	10.8	8.8	5	28
Staples	500	102.6	61.0	490	133.3	58.3	10	2	386	92.6	59.0	385	91.3	57.1	1	0
Legumes	26	44.1	1.4	17	23.9	1.2	-9	-35	19	31.3	1.7	16	29.5	1.1	-3	-16
Fresh Veg	273	118.8	2.2	339	141.2	2.7	66	24	233	97.6	2.5	304	115	2.9	71	30
Fruits	37	50.7	0.8	64	65.2	1.5	27	73	70	81.7	2.0	100	100.7	2.7	30	43
Nuts	9	16.6	1.5	8	16.3	1.3	-1	-11	11	18.4	1.9	11	16.9	1.8	0	0
Salted Veg[1]	19	13.9	0.4	22	15.0	0.4	3	16	17	13.4	0.5	17	11.7	0.4	0	0
Dried Veg	4	7.9	0.1	8	15.2	0.3	4	100	3	8.5	0.1	8	11.2	0.6	5	167
Sweets	60	66.2	5.8	45	65.4	3.7	-15	-25	40	33.8	6.2	28	30.3	3.9	-12	-30
Alcoholic Bev	34	63.9	2.3	64	116.7	3.3	30	88	5	21.9	0.2	4	18.1	0.1	-1	-20

[1]includes salt and soya sauce

Table 4. Mean grams of food and percent of energy for Guangzhou rural men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

Foods	V1			V2			V2-V1		V1			V2			V2-V1	
	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%	Mean g	SD	Mean % en	Mean g	SD	Mean % en	g/d	%
	Men (n = 102)								Women (n = 107)							
Meat	79	55.8	9.8	114	60.0	12.8	35	44	45	45.8	6.2	62	43.4	9.1	17	38
Poultry	8	16.8	0.4	23	31.5	1.1	15	187	3	7.0	0.1	14	25.2	0.8	11	367
Fish	75	46.0	3.1	69	57.0	2.7	-6	-8	67	37.2	3.2	66	43.4	3.1	-1	-1
Eggs	5	14.2	0.3	10	16.9	0.6	5	100	4	9.6	0.3	12	20.8	0.8	8	200
Milk	3	5.8	0.3	3	18.1	0.1	0	0	4	4.3	0.5	1	6.1	0	-3	-75
Fats	19	9.7	5.5	19	12.1	5.6	0	0	12	8.2	4.2	15	10.1	5.1	3	25
Staples	603	178.4	66.4	542	185.5	58.3	-61	10	574	152.1	75.5	566	145.4	73.2	-8	1
Legumes	6	14.1	0.5	9	18.0	0.6	3	50	5	11.0	0.5	8	20.2	0.5	3	60
Fresh Veg	262	129.5	1.7	292	131.6	1.9	30	11	207	103.0	1.6	273	136.9	2.0	66	32
Fruits	46	93.0	0.7	60	140.0	1.1	14	30	63	96.0	1.3	73	116.8	1.9	10	16
Nuts	6	15.8	1.0	8	19.4	1.2	2	33	4	10.5	0.6	11	16.9	1.8	7	175
Salted Veg[1]	26	26.5	0.5	24	16.2	0.4	2	8	22	21.1	0.4	20	15.2	0.4	2	9
Dried Veg	3	11.9	0.2	4	8.7	0.3	1	33	3	11.3	0.1	8	11.2	0.6	5	167
Sweets	36	40.6	3.8	49	102.9	2.7	13	36	36	26.3	5.3	24	45.7	2.0	-12	-33
Alcoholic Bev	78	122.3	5.8	159	186.7	10.5	81	104	2	11.2	0.2	5	23.1	0.2	3	150

[1]includes salt and soya sauce

Fat added to food increased in all samples except GZ rural men. Increases were larger in urban samples, (33-34% vs 2-13%). Fat added to foods contributed on average 5-8% of energy by 1987-88.

Staple foods include grain products, sweet potato and taro and are the major sources of energy in Chinese diets. Average consumption dropped in the BJ rural sample by 17%. The declines in other area samples were smaller; in GZ women consumption remained unchanged over the two survey periods. Staple foods contributed 59% of energy in 1987-88, a drop of 4%.

Consumption of legume products was considerably higher in Beijing at both visits compared to Guangzhou. By 1987-88 average consumption declined from 48 g/d to 18 g/d in the BJ rural sample, a drop of 40%, whereas changes in legume consumption in Guangzhou were on the order of 3-9 g/d . Vegetable consumption increased in Guangzhou by about 30% except for GZ rural men (11%). In Beijing, vegetable consumption was similar in both surveys. Fruit consumption increased in GZ and BJ urban samples. Fruit and vegetable consumption ranged from 349 g/d in BJ rural to 403 g/d in GZ urban samples in 1987-88.

Salted products include soya sauce, salt preserved vegetables and other salt-fermented products. They are the major source of sodium in Chinese diets. Consumption of these products was higher in Beijing. Consumption declined in the rural samples and increased slightly in the urban samples (except GZ urban women).

Mean consumption of alcoholic beverages was higher in men (especially rural men) than women. It increased substantially (50-140%) by 1987-88, contributing on average 7% of energy. Consumption of alcoholic beverages increased in rural women but remained low (<1% en).

Changes in energy balance

Positive energy balance contributing to overweight influences both blood lipids and blood pressure. Changes in reported energy intake, expenditure and BMI are shown in Table 5. In BJ urban men, total reported energy intake was similar in both surveys. Energy expenditure (mJ/kg) declined and BMI increased. In BJ rural men, energy intake and expenditure declined and BMI increased. In BJ urban women, mean energy intake and energy expenditure dropped, and BMI showed little change.

Table 5. Changes in reported energy intake, energy expenditure, and BMI in samples of Beijing men and women surveyed in 1983-84 and re-surveyed in 1987-88.

	Men				Women			
	V1	V2	Δ	%	V1	V2	Δ	%
	Beijing							
Urban								
Energy, mJ	12.1	12.2	.1	0.6	8.5	8.4	-0.1	-1.0
Energy, mJ/kg	44	43	-1	-2.2	33	33	0	0
BMI	23.4	24.5	1.1	4.7	20.8	21.1	0.3	1.6
Rural								
Energy, mJ	13.7	12.6	-1.1	-8.0	9.8	8.9	-0.9	-9.3
Energy, mJ/kg	50	48	-2	-4.0	42	37	-5	-11.9
BMI	24.7	25.6	0.9	3.6	22.0	22.4	0.3	1.5
	Guangzhou							
Urban								
Energy, mJ	12.0	12.1	.1	0.4	9.4	9.7	.2	2.4
Energy, mJ/kg	51	50	1	-2.0	42	44	2	4.8
BMI	21.9	22.6	0.7	3.2	19.3	19.6	0.3	1.8
Rural								
Energy, mJ	12.7	13.1	.4	3.0	10.9	11.0	0.1	1.2
Energy, mJ/kg	57	60	3	5.2	55	57	2	3.6
BMI	23.3	23.8	1.5	6.5	19.6	20.0	0.4	2.1

In GZ urban men, reported mean energy intake was similar in both surveys, energy expenditure declined, and BMI increased. In GZ rural men, energy intake, expenditure, and BMI all increased. GZ urban and rural women showed small increases in energy intake. Energy expenditure increased and there was only a very small rise in BMI.

Changes in nutrients that affect blood lipids

Changes in nutrient intake are presented in Figures 6-9 by site and location and in Tables 6-9 for men and women. Nutrient intake is presented as percent of energy for macronutrients.

There was a general upward trend in macronutrients that tend to raise cholesterol and a downward trend in those that

Table 6. Mean values for selected nutrients for Beijing urban men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

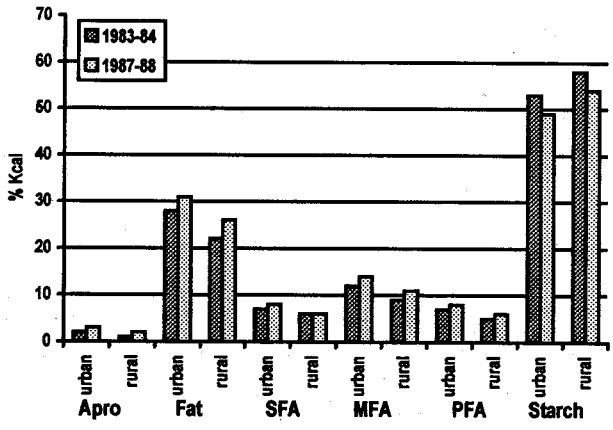
Nutrient	V1		V2		V2 - V1		V1		V2		V2 - V1	
	Mean	SD	Mean	SD	Amt	%	Mean	SD	Mean	SD	Amt	%
	Men (n = 75)						Women (n = 94)					
Protein % en	10.4	1.43	10.9	2.01	0.5	48	10.1	1.24	9.7	1.32	-0.5	-5
APRO % en	2.2	1.55	3.5	2.21	1.2	55	1.2	1.48	1.8	1.56	0.5	42
VPRO % en	8.2	1.44	7.4	1.49	-0.8	-10	8.9	1.26	7.9	1.38	-1.0	-11
Fat % en	29.4	7.76	33.3	6.61	3.9	13	20.8	7.5	24.7	8.98	3.8	18
SFA % en	7.6	2.62	9.0	2.47	1.4	18	5.1	2.80	6.3	3.09	1.1	22
MFA % en	13.2	4.25	14.8	3.7	1.6	12	8.8	3.4	10.7	4.5	1.9	22
PFA % en	7.2	1.89	8.1	2.45	0.8	11	5.0	1.59	6.2	2.70	1.2	24
Cholesterol mg	271	214	367	289	95	35	193	144	307	169	114	59
Carbohydrate % en	57.2	9.03	52.5	7.90	-4.7	-8	65.2	10.53	60.0	12.14	-5.2	-8
Starch % en	49.7	9.18	45.9	8.1	-3.8	-8	58.0	10.88	53.0	12.48	-4.9	-8
Sugar % en	2.5	2.77	1.4	1.88	-1.1	-44	1.1	1.68	1.67	2.37	0.5	45
Alcohol g	13	18.8	14	17.2	1	8	0	0.8	1	3.4	1	0
Potassium mg	2522	669	2621	958	99	4	2263	754	2160	791	-102	-5
mmol	64	16.8	66	24.1	2	3	50	16.1	50	17.8	0	0
Calcium mg	554	240	607	285	53	10	415	195	399	222	-16	-4
Sodium mg	5188	2093	5489	2279	298	6	3946	1533	3577	1471	-369	-9
mmol	225	90.7	238	98.8	13	6	143	61.1	131	51.9	-11	-8
Keys Score	23.3	9.53	28.7	9.7	5.3	23	16.5	10.67	19.1	10.81	2.55	15
Na/K	3.6	1.2	3.7	1.3	0.1	0	3.0	1.4	3	1.4	0.1	0

Abbreviations: en, energy; APRO, animal protein; VPRO, vegetable protein; SFA, saturated fatty acids; MFA, monounsaturated fatty acids; PFA, polyunsaturated fatty acids; Na/K, sodium potassium ratio

Keys Score: 1.35 (2S-P) * 1.5z where S = % SFA, PZ % kcal PFA and Z = Sqrt dietary cholesterol, mg/1000 kcal.

are associated with low cholesterol. In all groups there was an increase in intake of animal protein, fat, SFA (except BJ rural), MFA, PFA, dietary cholesterol (except BJ urban women) and the Keys Score. The Keys Score is an index of atherogenicity of the diet based on the formula 1.35 (2S-P) + 1.5 Z where S= %kcal SFA, P= %kcal PFA and Z=Sq Rt of cholesterol/1000 kcal[3]. Vegetable protein decreased in all samples except Beijing rural men. Total carbohydrate and starch intake declined in all samples.

Figure 6. Mean values of nutrients that influence serum lipids in 1983-84 survey and 1987-88 re-survey in Beijing.

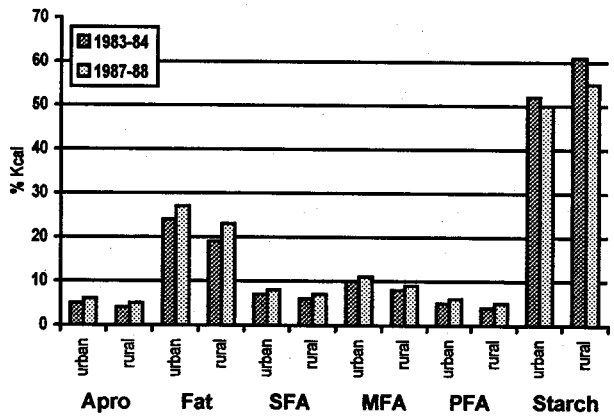


Changes in nutrients that affect blood pressure

Alcohol intake (Figure 10) increased in Beijing and Guangzhou. Alcohol intake in women in both surveys was minimal. In men, alcohol intake was higher in rural men in both surveys compared to urban men. Guangzhou rural men had the highest intake and the largest increase (85%) between 1983-84 and 1987-88.

Sodium and potassium increased in BJ urban men (Table 6), GZ men (Table 8) and GZ rural women (Table 9). In BJ women (Tables 6,7) and BJ rural men (Table 7), there was a decrease in sodium and potassium. However, sodium/potassium ratios did not change between the two surveys. BJ rural men had the highest ratio.

Figure 7. Mean values of nutrients that influence serum lipids in 1983-84 survey and 1987-88 re-survey in Guangzhou.



Calcium intake increased in BJ urban men, the GZ urban sample, and GZ rural women and decreased in the other groups. Changes were small and mean intakes remained very low at both surveys. The highest intake was observed in BJ urban men (607 mg/d).

In summary, between 1983-84 and 1987-88 unfavourable increases in intakes of fat, SFA, cholesterol, Keys score, and alcohol and unfavourable decreases in carbohydrate were observed. Intakes of sodium remained high and intakes of calcium remained low. An increase in BMI was observed in all samples.

Table 7. Mean values of selected nutrients for Beijing rural men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

Nutrient	V1		V2		V2 - V1		V1		V2		V2 - V1	
	Mean	SD	Mean	SD	Amt	%	Mean	SD	Mean	SD	Amt	%
	Men (n = 107)						Women (n = 76)					
Protein % en	12.5	1.76	13.2	1.92	0.7	6	10.6	1.43	10.6	1.53	0	0
APRO % en	5.5	1.86	6.2	2.10	0.7	13	2.3	1.7	2.8	1.79	0.5	22
VPRO % en	7.0	0.87	7.0	0.87	0	0	8.3	1.20	7.8	1.5	-0.5	-6
Fat % en	26.8	5.36	28.0	6.97	3.2	12	25.9	6.78	29.7	8.44	3.8	15
SFA % en	7.2	1.99	8.1	2.39	0.9	13	6.9	2.48	7.5	3.22	0.7	10
MFA % en	10.5	2.71	11.8	3.35	1.3	12	11.1	3.66	13.4	4.33	2.3	21
PFA % en	5.6	1.23	6.5	1.60	0.9	16	6.3	1.79	7.3	2.45	1.0	16
Cholesterol mg	212	218	235	274	23	11	255	199	247	196	-8	-3
Carbohydrate % en	62.5	5.54	58	7.06	-3.9	-6	63.5	6.92	59.5	8.5	-3.9	-6
Starch % en	52.0	5.50	48.9	7.60	-3.1	-6	55.8	7.79	51.5	9.20	-4.5	-8
Sugar % en	8.0	4.01	3.8	2.84	-4.2	-53	1.8	2.08	2.0	0.0	-1.1	-61
Alcohol g	19	29	26	35	7	37	0	1	1	3	1	+
Potassium mg	2914	851	2558	772	-357	-12	1991	640	1976	706	-15	-7
mmol	73	21.4	64	19.5	-9	-12	57	19.0	54	19.9	-3	-5
Calcium mg	579	255	485	240	-94	-10	429	236	416	200	-13	-3
Sodium mg	5924	2471	5102	1809	-821	-14	3294	1411	3029	1199	-265	-8
mmol	257	107.1	221	78.4	-36	-14	171	66.4	155	63.7	-16	-9
Keys Score[1]	30.0	7.42	31.2	7.34	1.3	4	24.4	10.2	24.8	11.4	0.4	2
Na/K	3.5	1.2	3.5	1.3	0	0	2.9	0.9	2.7	0.9	0	0

Abbreviations: en, energy; APRO, animal protein; VPRO, vegetable protein; SFA, saturated fatty acids; MFA, monounsaturated fatty acids; PFA, polyunsaturated fatty acids; Na/K, sodium potassium ratio

[1]Keys Score: 1.35 (2S-P) * 1.5z where S = % SFA, PZ % kcal PFA and Z = Sqrt dietary cholesterol, mg/1000 kcal.

Table 8. Mean values of selected nutrients for Guangzhou urban men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

Nutrient	V1		V2		V2 - V1		V1		V2		V2 - V1	
	Mean	SD	Mean	SD	Amt	%	Mean	SD	Mean	SD	Amt	%
	Men (n = 91)						Women (n = 123)					
Protein % en	11.9	1.68	12.0	1.67	0	0	10.9	1.52	11.4	1.41	0.5	5
APRO % en	4.8	2.0	5.2	1.93	0.4	8	3.4	1.82	4.1	1.60	0.7	21
VPRO % en	7.2	1.18	6.9	1.09	-0.3	-4	7.5	0.66	7.3	0.70	-0.3	-4
Fat % en	24.2	5.58	26.0	5.72	1.8	7	17.4	4.77	21.5	5.99	4.1	24
SFA % en	7.5	2.2	7.7	2.0	0.3	4	5.2	1.65	6.2	2.10	1.0	19
MFA % en	10.4	2.74	11.0	2.87	0.7	7	6.9	2.32	8.8	2.90	1.9	28
PFA % en	5.1	1.19	5.7	1.26	0.7	14	4.2	1.10	5.1	1.30	0.9	21
Cholesterol mg	386	175	454	227	68	18	379	180	369	166	-9	-2
Carbohydrate % en	61.8	6.65	58.8	9.27	-3.0	-5	71.4	5.47	66.8	6.31	-4.6	-6
Starch % en	53.2	6.69	50.7	9.94	-2.6	-5	64.5	6.24	60.6	7.65	-8.3	-13
Sugar % en	7.6	4.29	4.8	3.74	-2.9	-38	4.6	3.55	3.0	3.59	-1.64	-36
Alcohol g	8	18	13	28	5	63	0	2	0	1	0	0
Potassium mg	2456	600	2672	770	216	9	2119	559	2440	602	322	15
mmol	62	15.1	67	19.4	5	8	53	14.1	61	15.2	8	15
Calcium mg	487	217	512	200	25	5	410	150	480	161	70	17
Sodium mg	4062	1742	4817	1738	755	19	3112	1585	4009	1370	896	29
mmol	176	75.5	209	75.3	33	19	135	68.7	174	59.4	39	29
Keys Score[1]	29.4	6.99	30.7	7.62	1.3	4	22.3	7.46	27.2	7.78	4.9	22
Na/K	2.9	1.6	3.1	1.1	0.2	7	2.5	1.4	2.9	1.0	0.4	16

Abbreviations: en, energy; APRO, animal protein; VPRO, vegetable protein; SFA, saturated fatty acids; MFA, monounsaturated fatty acids; PFA, polyunsaturated fatty acids; Na/K, sodium potassium ratio

[1]Keys Score: 1.35 (2S-P) * 1.5z where S = % SFA, PZ % kcal PFA and Z = Sqrt dietary cholesterol, mg/1000 kcal.

Discussion

China is experiencing the phenomenon observed in many other developing countries emerging from a largely agrarian economy and undergoing rapid industrialisation[4]. As affluence increases, dietary patterns typically change toward increased use of high prestige foods formerly rarely consumed and reserved primarily for ceremonial occasions. Increased world trade opens the market to a variety of processed foods and "fast food" commercial outlets. Foods from these sources are often high in fat, cholesterol, salt and sugar. Economic expansion brings with it increased social stratification with resulting areas of poverty and its nutritional consequences. Concomitantly, as improvements in hygiene, medical care and access to food diminish the impact of infectious diseases and malnutrition, life expectancy increases to the point where chronic diseases assume major importance as a cause of disability and premature death. This transition has been predicted in China from data obtained in cross sectional surveys[4]. The USA-PRC Collaboration provides an opportunity to observe this transition directly in four discrete communities. During the four years encompassed by these two surveys, there was a shift toward a more atherogenic dietary pattern as indicated by increases of 7 to 25% in Keys scores. During the same period, nutrients that are associated with unfavourable blood pressure levels either increased (alcohol) or persisted with

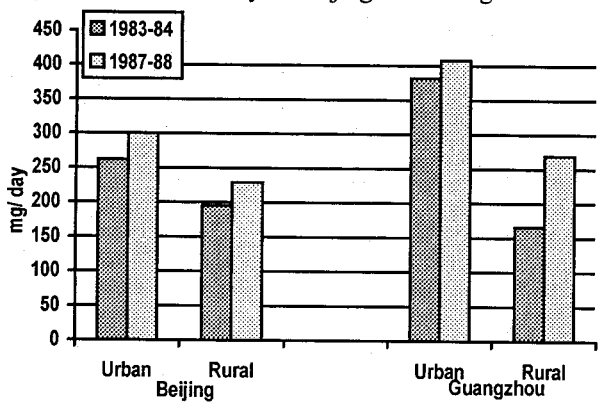
Table 9. Mean values of selected nutrients for Guangzhou rural men and women surveyed in 1983-84 (V1) and re-surveyed in 1987-88 (V2).

Nutrient	V1		V2		V2 - V1		V1		V2		V2 - V1	
	Mean	SD	Mean	SD	Amt	%	Mean	SD	Mean	SD	Amt	%
	Men (n = 102)						Women (n = 107)					
Protein % en	10.2	1.09	10.3	1.61	0.1	1	10.8	1.51	11.1	1.76	0.3	3
APRO % en	1.5	1.32	2.2	2.03	0.7	47	4.0	1.63	5.0	1.99	1.0	25
VPRO % en	8.8	1.14	8.1	1.48	-0.7	-8	6.8	1.14	6.1	1.24	-0.7	-10
Fat % en	22.8	7.45	26.2	9.08	3.4	15	20.9	5.88	24.4	6.53	3.5	17
SFA % en	5.7	2.48	6.5	3.38	0.9	16	6.4	2.32	7.4	2.50	1.0	16
MFA % en	9.4	3.75	11.5	4.91	2.1	22	8.7	2.98	10.4	3.21	1.7	20
PFA % en	5.5	1.87	6.3	2.11	0.8	15	4.6	1.10	5.2	1.07	0.6	13
Cholesterol mg	193	144	307	169	114	59	142	129	236	170	94	66
Carbohydrate % en	66.9	7.51	62.9	9.87	-4.0	-6	62.7	10.60	54.4	12.01	-8.3	-13
Starch % en	57.9	7.98	53.9	10.67	-4.9	-8	56.6	10.44	48.3	12.08	-8.3	-15
Sugar % en	1.8	2.56	1.7	2.43	-0.02	-1	4.4	4.01	3.2	3.46	-1.2	-28
Alcohol g	25	41	47	61	22	85	0	3	1	3	1	+
Potassium mg	2574	631	2613	736	39	1	2253	568	2357	583	104	5
mmol	65	15.9	66	18.5	1	1	57	14.3	59	14.7	3	5
Calcium mg	515	198	502	213	-13	-3	438	147	448	156	10	2
Sodium mg	3809	2135	4031	1378	222	6	3325	1502	3538	1560	213	6
mmol	165	92.5	175	59.7	10	6	144	65.1	154	67.6	9	6
Keys Score[1]	16.6	10.67	19.1	10.81	2.5	15	22.3	7.46	27.2	7.78	4.5	20
Na/K	2.6	1.4	2.7	1.0	0.1	4	2.6	1.2	2.6	1.3	0	0

Abbreviations: en, energy; APRO, animal protein; VPRO, vegetable protein; SFA, saturated fatty acids; MFA, monounsaturated fatty acids; PFA, polyunsaturated fatty acids; Na/K, sodium potassium ratio. [1]Keys Score: 1.35 (2S-P) * 1.5z where S = % SFA, PZ % kcal PFA and Z = Sqrt dietary cholesterol, mg/1000 kcal.

unfavourable values. This shift was particularly notable in rural Guangzhou, an area that has undergone striking economic development. In three of the four areas surveyed, mean total fat intake exceeded the PRC recommendation of 20-25% of energy[5].

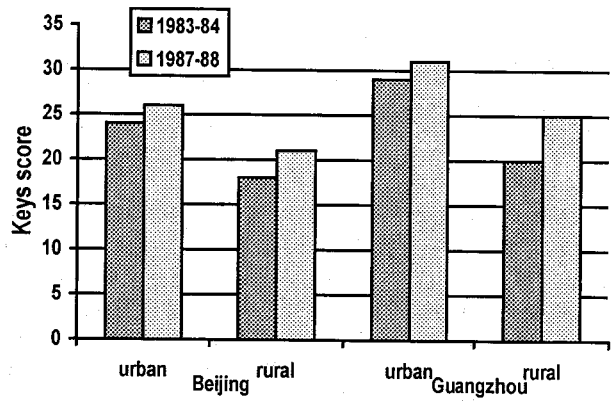
Figure 8. Mean values of dietary cholesterol in 1983-84 survey and 1987-88 survey in Beijing and Guangzhou.



Changes in energy balance over the two survey periods present a complicated picture. While BMI increased in all cohorts, reported energy intake increased only slightly in Guangzhou and Beijing urban men. Given the rather substantial increase in proportion of fat in the diet, especially in rural Guangzhou, energy balance may have been mediated in some way by the fat content of the diet. Alternatively, or concomitantly, energy expenditure may have dropped as work shifted from manual agrarian to more sedentary occupations. There is also an effect of aging on energy expenditure.

Comparison of our data with the China Health and Nutrition Survey (cited in ref. 4), shows that the Beijing and Guangzhou mean intake of energy from fat was somewhat higher in both surveys than the national average of 18% for adults. However, there was a similar trend toward higher fat in urban compared to rural samples. The China Health and Nutrition Survey also showed higher income to be associated with higher intake of fat and animal products. Similar findings were reported in a survey in Seoul, Korea. Fat intake nationwide had increased consistently since 1975 and was higher in urban areas and upper income groups[6]. Comparison of PRC-USA Chinese diets with U.S. dietary patterns in 1989-91 is shown in Table 10. While direct comparison is difficult because meat and grain mixtures are not disaggregated, it appears that U.S. consumption of animal products still exceeds that in China and that China still has a more favourable intake of fruits, vegetables and grain products. Keys scores in the PRC cohorts are still considerably lower than a score of 49 estimated for the U.S. adult population (unpublished data; National Center for Health Statistics, 1994).

Figure 9. Mean Keys scores in 1983-84 survey and 1987-88 re-survey in Beijing and Guangzhou.



Keys score=1.35(2S-P)*1.5Z where S=% Kcal saturated fatty acids, P=% Kcal polyunsaturated fatty acids and Z=sq rt dietary cholesterol mg/1000 Kcal

We have recently reported on the relationship between dietary factors and serum cholesterol in these populations. Results showed that even in populations with relatively low

serum lipids, the Keys score was significantly associated with total and LDL cholesterol levels[7]. Hence, if the dietary trends observed in this study become widespread and persistent, CHD will no longer be a rarity in China, especially given the concomitant patterns of smoking and blood pressure. Current Chinese policy, adopted in 1993, recognises the twin problems of malnutrition and diet related degenerative diseases[8]. Planning for the transition from traditional to contemporary and a more diversified food demand emphasises a diet structure based on grains associated with appropriate amounts of vegetable products and meat. Different development goals are set for different areas. Growth in animal products will be hastened in rural areas, along with measures to solve the starvation problem in poverty areas. Millions of people in China still face starvation. In the cities and economically developed areas such as the coast, emphasis will be on improving the structure of the diet and excess consumption of alcohol and "rich" foods.

Figure 10. Mean values of alcohol in 1983-84 survey and 1987-88 survey in Beijing and Guangzhou.

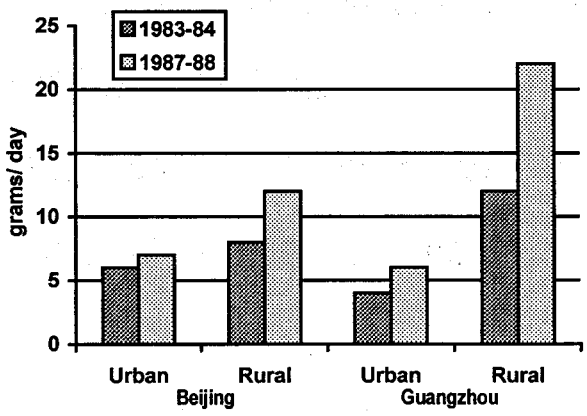


Table 10. Comparison of mean intakes of selected food groups in China (1987-88) and U.S.[1] (1989-91).

Food	China		U.S.
(g/day)	Beijing	Guangzhou	
Meat	60	79	56[2]
Poultry	1	7	24[2]
Fish	8	59	13[2]
Total flesh foods	69	145	181[2]
Eggs	23	19	16
Milk	17	5	294
Fats	21	17	15
Legumes	41	13	20
Staples	517	512	335[3]
Vegetables	285	243	183
Fruits	86	55	151
Total plant foods	930[4]	823[5]	689
Sweets	40	43	53
Alcoholic Bev	29	28	61

[1]Source USDA Continuing Survey of Food Intakes of Individuals, 1989-91, (white males and females 20 years and older)
[2]Does not include 88 grams of mixtures mainly meat, poultry, fish
[3]Does not include 86 grams of mixtures mainly grains
[4]Does not include 31 g salt preserved products
[5]Does not include 21 g salt preserved products

In summary, this survey shows a shift toward more atherogenic food patterns in areas undergoing rapid economic growth. These areas are targeted in specific nutrition policies for urban and affluent populations. Continued monitoring of food and nutrient intake is warranted.

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Changes in food, nutrient and energy intake in People's Republic of China samples of urban and rural north and south adults surveyed in 1983-84 and resurveyed in 1987-88

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摘　要

在一项心血管病危险因素的前瞻性研究中分析了中国四个人群的膳食类型. 四个人群包括北京城市及农村，广州城市及农村. 总计在1983－84年调查及1987－88年复查了10076名35－54岁男性及女性. 在约10％的小样本中获取了膳食数据，计北京城市167人农村178人，广州城市198人，农村230人. 每次调查对每个受检者进行三天24小时膳食回忆. 比较两个时期的平均摄入量表明肉，禽，鱼（除广州农村外），蛋（农村），奶（除北京农村外）类及含酒精饮料均增加. 最大的改变是摄入肉类增加29％－39％，含酒精饮料增加71％－104％，以及城市样本脂肪摄入增加33％－35％. 这种改变反映了动物蛋白质，脂肪. 饱和脂肪酸平均摄入量的增高及Keys分值的上升. 四个人群样本中有三个平均总脂肪摄入量超过中国建议的占总热量20％－25％的范围.

在此期间，全部样本的体重指数均增高，尤其在男性（3％－6％）. 这些调查是在中国经济迅速发展的时期进行的，显示出这种改变促使膳食类型及热量平衡趋向于增加心血管病的危险因素.

关键词：膳食调查，中国，营养素摄入量，心血管

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