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Urban-Rural Comparison of Nutrient Intake by Adult Women in Shandong Province, China

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QU, J.-B., ZHANG, Z.-W., XU, G.-F., SONG, L.-H., WANG, J.-J., SHIMBO, S., WATANABE, T., NAKATSUKA, H., HIGASHIKAWA, K. & IKEDA, M. *Urban-Rural Comparison of Nutrient Intake by Adult Women in Shandong Province, China* Tohoku J. Exp. Med., 1997, **183** (1), 21–36 —— In 1996, 24-hour food duplicate samples were collected from two groups of 50 nonsmoking women each; one group was in Jinan, the capital city for of Shandong Province in China, and the other in a farming village in Zhangqiu area some 30 km away from the city. They had also physical examinations including hematology and serum biochemistry tests. Nutritional analysis of the duplicate samples were conducted utilizing standard food composition tables for Chinese populations. The urban-rural comparison between the two groups showed that women in Zhangqiu took significantly less lipid (54 g/day) and more carbohydrate (335 g/day) than Jinan counterparts (76 g lipid and 254 g carbohydrate/day), although there was no significant difference in total energy and protein intake (1968 kcal/day in Jinan vs. 2071 kcal/day in Zhangqiu, and 67 g protein/day in Jinan vs. 61 g/day in Zhangqiu). The intakes of the three major nutrients were sufficient in majorities of members in both groups. Iron intake was also sufficient (22 and 25 mg/day in Jinan and Zhangqiu, respectively), but intake of calcium was insufficient in more than a half of the subjects in both groups. Zhangqiu women heavily depended on plant-based foods both for protein and lipid, whereas the dependency was less remarkable among Jinan women. —— Continental China; middle-aged women; nutrition; plant-based food; urban-rural difference

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It is well understood through experiences that food habits in rural areas are different from that in urban areas (Ikeda et al. 1988; Nakatsuka et al. 1988; Moon et al. 1997). Such is especially true in a vast country like China (e.g., Ge et al. 1996). No detailed urban-rural comparison has ever been conducted in the continent, however, to examine possible differences not only in terms of nutrient intakes but their leading sources.

A twin survey was conducted by the food duplicate method (Acheson et al. 1980; Shimbo et al. 1993, 1994) in a provincial capital and in a farming village in the vicinity of the city to compare the food habits of adult women who live in areas geographically close yet under different urbanization conditions. Special attention was taken to detect possible differences in protein and lipid sources. Substantial urban-rural difference in consumption of leading cereals will be reported in a separate paper (Shimbo et al. 1997).

Materials and Methods

Study population and study design

Two surveys were conducted in parallel in October, 1996, one in the provincial capital of Jinan in Shandong Province, China and the other in a farming village of Baiquan in Zhangqiu area some 30 km east to the city. A group of 50 adult women medical staffs (e.g., medical doctors, nurses, and clerks) in Shandong Medical University in Jinan and 50 farming women in the village volunteered to participate in the study. The participants were all nonsmoking and non-habitually drinking, and mostly married. Women in the village in Zhangqiu area were matched by age to the Jinan women as far as possible. They offered 24-hour duplicates of food (see below for details), peripheral blood and morning spot urine samples, and also had physical examination including anthropometry. Any social occasions were carefully excluded so that everyday foods be collected. Blood snamples were drawn from cubital vein 2.5–3 hours after taking any foods or drinks.

Food duplicate collectdion

Protocol for collectdon of 24-hour total food duplicates (Acheson et al. 1980) was previously described in detail (Shimbo et al. 1993, 1994, 1996a, b; Ikeda et al. 1996; Moon et al. 1997; Zhang et al. 1997). In brief, each participant was asked to cook foods for one hypothetical women in addition to real family members, and collect food duplicates in the amount and in the way as she consumed (eg., use of soya bean sauce or vinegar) in metal leakage-free plastic containers (or bottles for soup and drinks) for a given 24-hour period. She submitted her food duplicate sample to the survey team when she had health examination.

Nutritional evaluation and other examinations

The procedures of nutritional evaluation were also previously detailed

(Shimbo et al. 1993, 1994, 1996a, b; Ikeda et al. 1996; Moon et al. 1997; Zhang et al. 1997). Each food item in the food duplicate was separated and weighed, and the item was coded by veteran Chinese nutritionists in accordance with the Food Composition Tables for Chinese (National values, Part 1; Institute of Nutrition and Food Hygiene 1991a). The nutrient intakes in each meal and snack (and thus in an entire day as a sum) were calculated from the code numbers and the weight records (Zhang et al. 1997) taking advantage of the Food Composition Tables (Institute of Nutrition and Food Hygiene 1991a). In practice, the tables covered essentially all food items (Zhang et al. 1997).

Evaluation of nutrient intake was made in comparison with the nationally recommended daily dietary allowances for adult women in the People's Republic of China (Chinese RDA in short; Institute of Nutrition and Food Hygiene 1991b). The RDA values are set by sex, by age group, and by the grade of daily physical exercise. RDA values for adult women of different ages with the lightest and middle grade phsical exercise are shown in Table 1 as examples. The grade of physical exercise of the women studied was determined for the selection of RDA values through a clinical interview with the study subjects, followed by discussion

TABLE 1. *Recommended dietary allowances for Chinese women by age range*

Energy and nutrient	(unit/day)	Physical exercise					
		Lightest			Middle grade		
		18–44[a]	45–59	60–69	18–44	45–59	60–69
Energy	(kcal)	2100	1900	1700	2700	2400	2100
Energy	(MJ[b])	8.8	8.0	7.1	11.3	10.0	8.7
Protein	(g)	65	65	60	80	75	70
Lipid energy ratio	(%)	20–25	20–25	20–25	20–25	20–25	20–25
Minerals							
Calcium	(mg)	800	800	800	800	800	800
Iron	(mg)	18	12	12	18	12	12
Zinc	(mg)	15	15	15	15	15	15
Vitamins							
Vitamin A	(RE[c]μg)	800	800	800	800	800	800
Vitamin B_1	(mg)	1.1	1.2	1.2	1.4	1.3	1.3
Vitamin B_2	(mg)	1.1	1.2	1.2	1.4	1.3	1.3
Nicotinic acid	(mg)	11	12	12	14	13	13
Vitamin C	(mg)	60	60	60	60	60	60
Vitamin D	(μg)	5	5	10	5	5	10
Vitamin E	(mg)	10	12	12	10	12	12

Cited from Institute of Nutrition and Food Hygiene (1991b).

[a]Age range in years.

[b]Calculated from values in kcal, taking a conversion factor of 1 kcal = 4.184 kJ.

[c]In retinol equivalency.

among participating research staff in reference to the definition given in the Chinese RDA Tables (Institute of Nutrition and Food Hygiene 1991b); the Jinan women were classified as those with the lightest physical exercise, whereas the Zhangqiu women (who were farmers) were as those with the middle grade physical exercise. A $\pm 20\%$ allowance was given in the evaluation to cope with day-to-day variation in food intake, so that the nutrient intake was considered as appropriate when the calculated value was within a range of 80–120% of the corresponding RDA (Shimbo et al. 1993, 1994; Zhang et al. 1997).

Hematology and serum biochemistry tests were carried out in Japan by conventional methods.

Statistical analysis

A normal distribution was assumed for intake of most nutrients, and therefore arithmetic means and standard deviations (S.D.s) were calculated as statistical parameters. Student's unpaired t-test was employed for detection of any significant difference in means, and chi-squares test for difference in prevalence. When necessary, multiple regression analysis with stet-up procedures was conducted utilizing a program 'HALBAU' (Takagi et al. 1994), which accepts two categories in case of a nominal scale.

Results

Demography, anthropometry, hematology and serum biochemistry

A majority (ca. 80%) of women in both groups were in a age range of 30–49 years. There was only a small (i.e., by 3 years) difference in ages between two groups, although it was statistically significant ($p<0.05$). Furthermore, there was a substantial overlapping in age distribution between the two groups. Despite the similarity in ages, Jinan women were taller and heavier with larger BMI {body mass index, or weight (kg)/[height (m)]^2} than their counterparts in Zhangqiu. Thus, more women in Jinan (20 people out of 50) were overweighted (with BMI of ≥ 25; Fatimah et al. 1995) than those in Zhangqiu (9 out of 50), with a significant ($p<0.05$) difference in the prevalence.

Hematology study showed that the overall prevalence of hypohemoglobinemia cases were 10% (with mean hemoglobin concentration of 13.3 g/100 ml) with no cases of eryhrocytopenia. Serum biochemistry on liver and kidney functions (consisting of AST, ALT, γ-GTP, LAP, LDH, CHE, LAP, triglyceride, total cholesterol, HDL cholesterol, total protein, albumin, A/G ratio, BUN, uric acid and creatinine) were not remarkable in all subjects both in Jinan and Zhangqiu (data not shown), except that triglyceride was elevated (i.e., >150 mg/100 ml serum) in 3 and 6 women in Jinan and Zhangqiu ($p>0.10$ for the difference), respectively. No association ($p>0.10$) of high BMI (>25) with elevated triglyceride (>150 mg/100 ml) was detected either in Jinan or in Zhangqiu.

TABLE 2. *Age distribution, anthropometry and hematology of study participants in Jinan and in Zhangqiu*

Parameter	(unit)	All	Region		
			Jinan	Zhangqiu	p[a]
Number of participants		100	50	50	
Age	(years)	40.3±8.1	41.8±7.8	38.8±8.0	*
Minimum-Maximum		21-60	21-55	21-60	
Height (H)	(cm)	157.7±5.0	159.6±4.2	155.9±5.1	**
Weight (W)	(kg)	59.1±8.0	61.8±7.4	56.5±7.7	**
BMI (W/H^b)		23.7±2.9	24.3±3.1	23.2±2.5	*
Overweight cases	(%)[b]	33 (33%)	21 (42%)	12 (24%)	n.s.[f]
RBC counts	($\times 10^6/mm^3$)	4.53±0.32	4.48±0.27	4.58±0.35	*
Erythrocytopenia cases[c]	(%)	0 (0%)	0 (0%)	0 (0%)	n.s.
Hemoglobin	(g/100 ml)	13.3±1.3	13.1±1.5	13.6±1.0	*
Hypohemoglobinemia cases[d]	(%)	10 (10%)	6 (12%)	4 (8%)	n.s.
Hyperlipidemia cases[e]	(%)	9 (9%)	3 (6%)	6 (12%)	n.s.

Values are mean±S.D., unless otherwise specified.

[a]Asterisks indicate that the mean values are significantly (* and ** for $p<0.05$ and <0.01, respectively; n.s. for $p>0.10$) different from each other, as assayed by unpaired t-test or chi-squares test.

[b]The ratio of subjects who had BMI of $\geqq 25$ (Fatimah et al. 1995).

[c]$<3.80\times10^6$ RBC/mm^3.

[d]<12.0 g Hb/100 ml.

[e]>150 mg triglyceride/100 ml.

[f]$0.05<p<0.10$.

Intakes of major nutrients, minerals and vitamins by region and by age

Intakes of the three major nutrients, minerals and vitamins are summarized in Table 3. Whereas no difference was detected in over-all protein intake between women in Jinan (66.8 g/day) and those in Zhangqiu (61.8 g/day; $p>0.10$ for the difference by t-test), Zhangqiu women took significantly ($p<0.01$) less lipid (54.0 g/day) but more ($p<0.01$) carbohydrate (335.0 g/day) than their counterparts in Jinan (76.0 g lipid and 254.0 g cabohydrate/day). As a result, there was no significant difference ($p<0.01$) in total energy intake between the two groups (i.e., 1968 kcal/day in Jinan vs. 2071 kcal/day in Zhangqiu).

Calcium intake was about 550-560 mg/day in both groups ($p>0.10$ for the difference), but Zhangqiu women took more ($p<0.05$) iron (25.3 mg/day) than Jinan counterparts (21.6 mg/day). Intake of sodium and salt (sodium chloride) appeared to be higher in Jinan than in Zhangqiu, although both averages were lower than the current recommendation of 10 g NaCl/day (Institute of Nutrition and Food Hygiene 1991b). The values obtained, however, may need further validation as to be discussed in the Discussion section. Regarding vitamins,

TABLE 3. *Energy and nutrient intake by study region*

Energy and nutrient	(unit/day)	All	Region		
			Jinan	Zhangqiu	p^a
Number of participants		100	50	50	
Energy	(kcal)	2020±571	1968±447	2071±669	n.s.
Energy	(kJ)	8450	8234	8665	
Protein	(g)	64.0±23.1	66.8±22.1	61.1±23.8	n.s.
Lipid	(g)	65.1±25.9	76.0±23.0	54.0±24.0	**
Lipid energy ratio	(%)	29.1±8.6	34.6±6.0	23.6±7.1	**
Carbohydrate	(g)	294.7±98.8	254.0±62.0	335.0±111.0	**
Crude fiber	(g)	12.4±6.7	11.1±4.3	13.6±8.2	*
Minerals					
Calcium	(mg)	556±255	557±265	555±245	n.s.
Iron	(mg)	23.4±10.0	21.6±7.9	25.3±11.4	*
Phosphorus	(mg)	1020±363	987±298	1054±415	n.s.
Potassium	(mg)	1688±613	1803±566	1574±636	*
Sodium	(mg)	3162±1468	3423±1630	2901±1232	*
NaCl	(g)	8.0±3.7	8.7±4.1	7.4±3.1	*
Vitamins					
Vitamin A	(RE μg)	341±297	431±281	252±284	**
Vitamin B_1	(mg)	0.73±0.36	0.86±0.34	0.60±0.32	**
Vitamin B_2	(mg)	0.88±0.35	0.92±0.30	0.83±0.40	n.s.
Vitamin C	(mg)	95.5±64.5	93.0±65.0	98.0±64.0	n.s.
Vitamin E	(mg)	30.1±14.9	31.0±13.0	29.0±17.0	n.s.

Values are mean±S.D.

[a]Asterisks show that the means are significantly (* and **for $p<0.05$ and <0.01, respectively; n.s. for $p<0.10$) different from each other, as assayed by unpaired t-test.

Jinan women took more ($p<0.01$ when evaluated in terms of retinol equivalency) vitamin A (431 RE μg/day) and more ($p<0.01$) vitamin B_1 (0.86 mg/day) than those in Zhangqiu (252 RE μg vitamin A and 0.60 mg vitamin B_2/day).

As stated above, the subjects were mostly 30–49 year-old, and numbers of younger or older subjects were too small to make statistical comparison meaningful. Multiple regression analyses were conducted taking region, age and height as independent variables, and one of energy, protein, lipid, lipid energy ratio, carbohydrate and BMI as a dependent variable. Height was taken as an independent variable because RDA is defined by height in addition to other characteristics in some countries, e.g., Japan (Ministry of Health and Welfare 1994). The results (Table 4) showed that region was the most (and often the only) influential variable for lipid, lipid energy ratio and carbohydrate, in agreement with the observation in Table 3. None of the three independent variables was significantly ($p<0.05$) influential to energy and protein. Age affected BMI

TABLE 4. *Multiple regression analysis for possible influence of age on nutrient intake*

Dependent variable	Influential[a] independent variable			
	Variable	PCC[b]	p	R^2
Energy	None			
Protein	None			
Lipid	Region	0.428	<0.01	0.182
Lipid energy ratio	Region	0.641	<0.01	0.414
	Height	0.223	<0.05	0.429[c]
Carbohydrate	Region	0.410	<0.01	0.188
Body mass index	Age	0.301	<0.01	0.091

Independent variables employed were age, height and region.
[a]Those with $p<0.05$ for PCC.
[b]Partial correlation coefficient.
[c]Region and height in combination.

significantly ($p<0.01$), but not energy or nutrient intake. Accordingly, the effects of age were not taken into account in further analyses.

Evaluation of nutrient intakes in terms of recommended daily dietary intakes

Sufficiency of intake of each nutrient was evaluated in comparison with RDA values (given in Table 1) with a 20% allowance. Because the grade of physical exercise was different between the Jinan women and the Zhangqiu women, their nutrient intake was evaluated in two steps. Namely, both groups were evaluated first by application of RDA for lightest physical exercise for more direct comparison (Evaluation A for the Zhangqiu women in Table 5), and also after application of RDA for middle grade physical exercise to the Zhagqiu women because they were farmers (Evaluation B) and that for lightest physical grade to the Jinan women.

Comparison between Jinan and Zhangqiu with Evaluation A showed that excess lipid intake was more ($p<0.01$) prevalent in Jinan (37 women or 74%) than in Zhangqiu (10%). Reversely, vitamin B_1 insufficiency was more prevalent ($p<0.01$) in Zhangqiu than in Jinan. In cases of intakes of calcium, vitamin A and vitamin B_2, the insufficiency ratio was about 50% or even higher in both groups.

Further evaluation of the Zhangqiu group with RDA values for those with middle grade physical exercise (i.e., Evaluation B) showed that the insufficiency ratio was more than 50% for protein, calcium, and vitamins A, B_1, and B_2. The observation that almost a half (23 people or 46%) of the participants were insufficient of energy intake appears to be contradictory to the good BMI values (i.e., 23.3 for Zhangqiu women; Table 2). This point will be discussed later.

TABLE 5. *Excess or insufficient intake of energy and nutrients, by region and by age*

Energy and nutrient	Excess or Insufficiency	Number of cases[a] (%)	Number of cases by region				
			Jinan	Zhangqiu		p	
				A[b]	B[b]	A[b]	B[b]
Number of participants		100 (100%)	50	50	50		
Energy	Excess[c]	16 (16%)	7	9	2	n.s.	n.s.[f]
Energy	Insufficient[d]	25 (25%)	12	13	23	n.s.	n.s.[f]
Protein	Insufficient	26 (26%)	12	14	29	n.s.	**
Lipid	Excess[e]	42 (42%)	37	5	5	**	**
Calcium	Insufficient	60 (60%)	29	31	31	n.s.	n.s.
Iron	Insufficient	9 (9%)	4	5	5	n.s.	n.s.
Vitamin A	Insufficient	84 (84%)	39	45	45	n.s.	n.s.
Vitamin B_1	Insufficient	66 (66%)	25	41	46	**	**
Vitamin B_2	Insufficient	49 (49%)	23	26	33	n.s.	**
Vitamin C	Insufficient	24 (24%)	12	12	12	n.s.	n.s.
Vitamin E	Insufficient	3 (3%)	0	3	3	n.s.[f]	n.s.[f]

Two sets of RDA were employed for evaluation of nutrient intakes of Zhangqiu population i.e., RDA for lightest physical exercise (as in the case of Jinan population) and RDA for middle grade physical exercise (because they were farmers). p-Values are by chi-squares test (** for $p<0.01$; n.s. for $p<0.10$).

[a]In case RDA for lightest physical exercise was applied to both populations.

[b]A is with RDA for lightest physical exercise, and B is with RDA for middle grade physihcal exercise.

[c]More than 120% RDA. For RDA, see Table 1.

[d]Less than 80% RDA.

[e]The lipid energy ratio (or the ratio of lipid over total nutrients in terms of energy) is >30%, as 1.2 time the upper limit of RDA (20–25%) by Institute of Nutrition and Food Hygiene (1991b).

[f]$0.05<p<0.10$.

Food intake by three meals and snack

In order to evaluate relative weight of the three meals and snack, food (by weight) and energy intakes in Jinan and Zhangqiu were classified by the four occasions of food intake (Table 6). The analyses of food intake showed that breakfast was lighter and lunch and dinner wee heavier than others both in Jinan and in Zhangqiu. It was also shown that women in Zhangqiu took heavier lunch, but quite less snack than Jinan women. Analyses of energy intake gave essentially the same results. Of particular interest in very small snack in Zhangqiu, which accounted less than 2% of total energy intake of the day.

TABLE 6. *Total food intake and energy intake by three meals and snack, and by study region*

Item Meal and snack (unit/day)		All	Region		
			Jinan	Zhangqiu	p[a]
Number of participants		100	50	50	
Total food intake					
Whole day	(g)	1745±619 (100%)	1817±609 (100%)	1673±620 (100%)	n.s.
Breakfast	(g)	387±220 (22.2%)	357±176 (20.5%)	417±253 (25.0%)	n.s.
Lunch	(g)	535±282 (30.7%)	486±287 (26.6%)	584±268 (36.0%)	*
Dinner	(g)	564±270 (32.3%)	538±198 (31.4%)	591±322 (34.5%)	n.s.
Snack	(g)	259±387 (14.8%)	436±464 (8%)	82±148 (4.5%)	**
Energy intake					
Whole day	(kcal)	2020±576 (100%)	1968±452 (100%)	2071±676 (100%)	n.s.
	(kJ)	8152	8234	8665	
Breakfast	(kcal)	482±227 (23.9%)	448±178 (22.8%)	516±262 (24.7%)	n.s.
	(kJ)	2017	1874	2159	
Lunch	(kcal)	726±307 (35.9%)	668±211 (34.0%)	874±371 (37.9%)	*
	(kJ)	3038	2795	3280	
Dinner	(kcal)	710±252 (35.2%)	686±188 (35.2%)	733±303 (35.7%)	n.s.
	(kJ)	2971	2870	3067	
Snack	(kcal)	102±132 (5.0%)	166±151 (8.0%)	38±64 (1.7%)	*
	(kJ)	427	695	159	

Values are mean±S.D. (% in parenthesis, taking the whole day value as 100).
[a]Asterisks show that the means are significantly (* and **for $p<0.05$ and 0.01, respectively) different from each other, as assayed by unpaired t-test.

Weight of plant foods as sources of protein, lipid, and energy

Classification of whole food items into plant- and animal-based foods was carried out to identify the relative weight of animal- and plant-based foods as the sources of protein and lipid, and then energy as a whole. Animal-based foods were further classified into meats (e.g., pork, beef and poultry). Fish and shellfish, and others (e.g., eggs and milk). In practice, consumption of precooked foods such as cakes were very limited and essentially all foods were classifiable.

Analysis for protein sources of foods in Zhangqiu (Table 7) showed that Zhangqiu women took protein almost exclusively (i.e., more than 90%) from plants and very small portions from meats and fish, although total protein intake was comparable with that in Jinan. A counterpart analysis in Jian disclosed similar trends, but the dependency on plant protein was less remarkable in the sense that Jinan women took more meats and fish than those in Zhangqiu.

The analysis for lipid sources gave almost the same results with protein source analysis so that plant-based foods accounted for the more than 80% of total lipid

TABLE 7. *Protein and lipid sources by region*

Energy and nutrient Source	All	Region		
		Jinan	Zhangqiu	p[a]
Number fo participants	100	50	50	
Energy (kcal/day)				
Plants	1814±564 (89.8%)	1656±384 (84.5%)	1972±662 (94.8%)	**
[Cereals]	[1222±457 (60.5%)]	[995±274 (50.6%)]	[1448±492 (69.9%)]	[**]
[Pulses[b]]	[378±207 (18.7%)]	[411±189 (20.9%)]	[344±221 (16.6%)]	[n.s.]
Meats	182±148 (9.0%)	281±101 (14.0%)	82±120 (4.9%)	**
Fish and shellfish	18±47 (0.9%)	26±56 (1.2%)	10±27 (0.5%)	*
Eggs, milk, etc.	7±22 (0.3%)	5±19 (0.3%)	8±25 (0.3%)	n.s.
Total	2020±576 (100%)	1968±452 (100%)	2071±676 (100%)	n.s.
Protein(g/day)				
Plants	48.0±18.8 (75.0%)	40.0±11.9 (62.6%)	56.0±20.9 (91.9%)	**
[Cereals]	[33.0±13.3 (51.6%)]	[25.4±6.8 (38.0%)]	[40.5±14.2 (66.3%)]	[**]
[Pulses[b]]	[8.4±10.6 (13.1%)]	[7.8±8.6 (11.7%)]	[9.4±12.1 (15.3%)]	[n.s.]
Meats	12.5±14.0 (19.4%)	22.0±13.9 (31.7%)	2.9±3.7 (4.9%)	**
Fish and shellfish	3.1±8.2 (4.8%)	4.6±10.5 (5.3%)	1.6±4.4 (2.2%)	*
Eggs, milk, etc.	0.5±1.5 (0.8%)	0.3±0.9 (0.4%)	0.6±1.9 (0.9%)	n.s.
Total	64.0±23.3 (100%)	66.8±22.3 (100%)	61.1±24.1 (100%)	n.s.
Lipid (g/day)				
Plants	51.2±21.9 (78.6%)	56.5±19.7 (74.6%)	45.8±22.8 (84.9)	n.s.
[Cereals]	[11.5±8.9 (17.7%)]	[12.2±10.8 (16.0%)]	[10.8±6.4 (20.0%)]	[n.s.]
[Pulses[b]]	[41.1±20.8 (63.1%)]	[49.7±18.1 (65.3%)]	[32.5±19.8 (60.1)]	[**]
Meats	13.2±13.2 (20.2%)	18.7±11.4 (24.3%)	7.7±12.5 (14.0)	**
Fish and shellfisih	0.6±1.3 (0.9%)	0.7±1.5 (0.9%)	0.4±1.0 (0.8)	n.s.
Eggs, milk, etc.	0.2±0.8 (0.3%)	0.1±0.5 (0.2%)	0.2±1.0 (0.2)	n.s.
Total	65.1±26.0 (100%)	76.1±23.0 (100%)	54.0±24.3 (100)	**

Values are means (percentages). Values in square brackets are as a fraction of plant-based foods.

[a]Asterisks show that the means are significantly (* and ** for $p<0.05$ and 0.01, respectively) different from each other, as assayed by unpaired t-test.

[b]Pulses include peanuts.

source for Zhangqiu women, and that Jinan women took significantly ($p<0.05$) more lipid from meats than Zhangqiu women. As a result, Zhangqiu women heavily depended (by 94.8%) on plant foods as energy sources, and only little (less than 5%) on meats. Dependency of Jinan women on plant foods as energy source was les intense (i.e., by 84.5%) with more consumption of meats and fish.

Among the plant foods, cereals contributed substantially as protein sources. Such is especially so in Zhangqiu accounting for about 66% of total protein consumed, whereas it was 38% in Jinan; the difference between the two regions

was statistically significant ($p<0.01$; Table 7). For lipid sources, the role of pulses (including peanuts) was remarkable both in Jinan and in Zhangqiu, although the difference in the extent of contribution was also significant ($p<0.01$; Table 7). This food group contributed 65% of total lipid in Jinan and 60% in Zhangqiu.

Discussion

The present study on urban-rural difference in nutrient intake of women in Jinan (the provincial capital) and in a farming village in Zhangqiu area in the vicinity made it clear that the village people took less lipid and more carbohydrate than their counterparts in the city, as observed in Japan (Ikeda et al. 1988; Nakatsuka et al. 1988) and in Korea (Moon et al. 1997). Zhangqiu women depended heavily on plant-based foods as protein and lipid sources whereas such dependency was less remarkable in Jinan.

It is quite conceivable that food customs of people in a vast country like China should be various as a fnuction of local agricultural staples, and that dietary habits of people in farming villages should be different from that of inhabitants in large cities. Search for recent literature on food habits in cities and in villages in China resulted in rather small numbers of publications as summarized in Table 8 (i.e., Gao and Bi 1991; Zhang et al. 1992, 1994, 1997; Yu et al. 1993; Liu et al. 1994; Zhao et al. 1994; Ge et al. 1996). Among the reports, the book edited by Ge et al. (1996) carries the summary of the nation-wide nutritional survey conducted on about 8600 famlies (including those in Shandong Province), whereas others are on specific local populations of interest either in cities alone or that in villages only.

The overall view on Table 8 appears to suggest that people in rural areas depend more heavily on carbohydrate as sources of energy for daily life [61% (Zhang et al. 1994) to 69% (Ge et al. 1996)] than people in cities [31% (Yu et al. 1993) to 64% (Zhang et al. 1992)], which is in a close agreement with the present study result that women in Zhangqiu (the rural group) took more carbohydrate (i.e., accounting for 65% of total energy) than those in Jinan (the urban group; 52%). It was also observed in the present study that urban people in reverse generally took more lipid than rural people, in agreement with the results of other studies (e.g., Ge et al. 1996). One exception is the case reported by Zhang et al. (1994), in which people consumed 91 g lipid/day. This may be explaned at least in part by the fact that the survey was conducted in a fishing village where catches from sea should be readily available for domestic consumption, even though seafoods are generally not every rich in lipid.

Care should be taken in making quantitative evaluation of energy intake for women, because mort papers referred in Table 8 (except for that by Zhang et al. 1997 in which women were studied) gave the energy for men and women in combination (it was for men in case of Zhao et al. 1994). In China, men used to

TABLE 8. *Intake of major nutrients, as reported in literature*

Area Reference	Daily intake[a]						Remarks
	Energy (kcal)	Protein (g)	Lipid (g)	Carbohydrate (g)	Ca (mg)	Fe (mg)	
Urban areas							
The present study	1968	66.8 (13%) [26.9]	76.1 (35%) [19.5]	254.0 (52%)	557	22	Women in Jinan city.
Zhang et al. (1992)	2497	68.5 (11%) [16.1]	70.2 (25%) [35.5]	395.7 (64%)	674	36	Urban population, man and women combined ?
Yu et al. (1993)	1835	64.9 (14%) [—]	62.9 (31%) [—]	252.2 (31%)	614	21	Middle-aged in Jinan, man and women combined.
Liu et al. (1994)	3147	157.1 (20%) [—]	101.4 (29%) [66]	401.4 (51%)	1113	26	Population in a city, men and women combined.
Ge et al. (1996)	2395	75.1 (13%) [—]	77.7 (29%) [—]	340.5 (57%)	458	26	Cities in whole China, men and women combined.
Ge et al. (1996)	2339	79.2 (14%) [—]	74.1 (29%) [—]	334.0 (57%)	517	26	Cities in Scandong Prov., men and women combined.
Zhang et al. (1997)	1776	57.0 (13%) [21.4]	75.4 (38%) [27.0]	217.7 (49%)	439	24	Women in 3 cities.
Rural areas							
The present study	2071	61.1 (12%) [5.1]	54.0 (23%) [8.3]	335.0 (65%)	555	25	Women in Zhangqiu village.
Gao and Bi (1991)	2734	70.1 (10%) [—]	70.4 (24%) [—]	449.4 (66%)	718	60	Farmers, men and women combined.
Zhao et al. (1994)	2544	73 (11%) [9.5]	76 (27%) [—]	394 (62%)	760	35	Farmers in Shandong Prov., see the footnote[b].
Zhang et al. (1994)	2665	84 (11%) [31]	91 (28%) [—]	454 (61%)	810	28	Men and women in a fishing village.
Ge et al. (1996)	2294	64.3 (11%) [—]	48.3 (19%) [—]	397.9 (69%)	378	22	Villages in whole China, men and women combined.
Ge et al. (1996)	2312	71.6 (12%) [—]	47.8 (19%) [—]	393.4 (68%)	431	30	Villages in Shandong Prov., men and women combined.

Values are mean intake (the account in % in total energy intake, calculated on energy basis) [the amount (g) of animal protein or lipid; — shows not reported]. In some cases, the percentages are calculated by the present authors. ? shows assumption because the gender was not stated in the original paper.

[a]Methods used are food (raw) weight recording, except for the present study in which the food duplicate method was employed. For details, see the Materials and Methods section and the Discussion section.

[b]Originally estimated by scoring of nutritional values of foods for men and women combined, and the values for men in conventional units are kindly supplied by Dr. C.-F. Zhao to the present authors.

take some 16% more energy than women (Institute of Nutrition and Food Hygiene 1991b). Assuming that the energy intake reported for two sexes combined is based on an equal number of men and women, it is possible to estimate that about 92% of the reported energy values (or 84% of the values for men) is the level for women. With such correction for women, the values cited in the table do not differ so much in reality from the present observation as they look. For example, the values of ca. 2400 and 2300 kcal/day for urban and rural populations, respectively (Ge et al. 1996) can be interpreted as 2200 and 2100 kcal for women in the two populations, respectively. In fact, in case of Zhao et al. (1994) whose survey site appears to be very close to that of the present study, they estimated that energy intake by men was 2544 kcal/day. This value is equivalent to 2137 kcal/day for women, which is essentially the same with the present study result. One exception is the value of 3147 kcal/day for an urban population reported by Liu et al. (1994), which would be equivalent to 2890 kcal for women, being much larger than the present observation.

Due attention should be paid to the nutrients which a large fraction (e.g., 50%) of the people take only insufficiently (Table 5). In doing so, care should also be exercised to RDA values cited in Table 1 on validity, because the evaluation as summarized in Table 5 is based on the RDA. Table 5 shows that food intakes of Zhangqiu farmers are insufficient of energy and protein in 46 and 58% of the population, respectively, when evaluated in terms of RDA for those with middle grade physical exercise such as farmers. The RDA values for 18–44 year-old women are 2700 kcal/day for energy and 80 g/day for protein (Table 1). Counterpart RDA values for 30–38 year-old 155 cm-tall Japanese farmers (i.e., with Grade III physical exercise) are however 2300 kcal energy and 70 g protein/day (Ministry of Health and Welfare 1994) which are 85% and 88% of corresponding Chinese RDA, respectively. Bearing in mind that Zhangqiu farming women with an average BMI of 23.2 (Table 2) are by no means lean, possibility should also be considered that the RDA values established in 1991 (Institute of Nutrition and Food Hygiene 1991b) may be too demanding under present day agricultural conditions. In fact, the energy RDA of 2700 kcal/day appeared to be never satisfied in any of the 5 reports on farming on fishing populations, asuming that women take 92% of the reported energy levels. For example, the highest value for rural populations in Table 8, 2734 kcal/day for the combined population (Gao and Bi 1991) would correspond to about 2500 kcal/day for women, well below the 2700 kcal/day RDA.

No studies (except for the present one) in Table 8 are detailed enough to quantitatively estimate the contribution of cereals and pulses as the sources of energy, protein and lipid, although some papers reported the consumed amounts of several foodstuff grouped as cereals, potatoes, etc. (e.g., Zhao et al. 1994). In this respect, the present paper is unique in reporting quantitatively the roles of these common plant foodstuff as protein and lipid sources in Chinese foods.

Whereas high nutritional quality of pulse protein especially that of soy bean is well known (e.g., Resources Council 1982, 1986), pulses (including peanuts) account for 15% of total protein or 18% of pant-based protein in food of the Chinese farmers, although this food group offered 60% of total lipid consumed.

Another important source of protein for Chinese farmers is cereals. Although the protein contents of cereals are low (e.g., protein content in wheat is around 10% by weight or less than one third of the content in soy beans), the large consumption of cereals makes this food group one of the major protein sources for Chinese farmers, very similar to the case of rice as a leading protein source for general Japanese population (Ikeda et al. 1988; Nakatsuka et al. 1988; Shimbo et al. 1994). Further detailed analysis of urban-rural differences in types of cereals consumed and their nutritional implications will be described in a separate paper (Shimbo et al. 1997).

Regarding salt intake, experiences suggest that the quantitative estimation of use of salt-impregnated seasonings needs great caution (Nakatsuka et al. 1988; Shimbo et al. 1993; Moon et al. 1997). This is especially true when foods are extensively cooked as are the cases of Chinese cuisine. The values observed in the present study should be therefore taken as preliminary in this sense. A program is currently in progress in this study group to examine the validity of the present observation on the nutrient elements through the instrumental analysis of the food homogenate samples (Shimbo et al. 1996a; Moon et al. 1996).

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