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Nutrition and Health Survey in Taiwan (NAHSIT) 1993-1996: Dietary Nutrient Intakes Assessed by 24-Hour Recall

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Abstract

A Nutrition and Health Survey carried out in 1993-1996 used a multi-staged, stratified, clustered sampling design. A representative and season-balanced sample of Taiwan was obtained form 21 townships, 3 each in 7 geographical or cultural strata. 24-hour recalls were obtained form 5,834 individuals (2.923 men and 2,911 women) aged 13-64. Chinese herbs and nutrient supplements were not include in the calculation of dietary intakes. Mean daily intakes of calories and macro-nutrients for men are: 2,203 Kcal, 82.6g of protein, 79.5g of fat, and 272 g for carbohydrate. Protein, fat and carbohydrate consist of 15.5%, 33.5%, and 51% of the total calories, receptively. Mean intakes of calories and macro-nutrients for women are: 1,569 Kcal, 61.6 g or protein, 61.1 g of fat, and 200 g of carbohydrate. Percent calorie from protein, fat and carbohydrate were 15.4%, 34.4%, and 50.1%, respectively. Men ingested daily 1.4 mg of thiamin, 1.3 mg of riboflavin, 16.2 mg of niacin, 168 mg of ascorbic acid, 8090 I.U. of vitamin A, 7.8 mg of vitamin E, 504 mg of calcium, 14.2 mg of iron, 3821 mg of sodium, 344 mg of cholesterol, and 5.0 g of crude fiber. Women

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Abbreviations: P/M/S, polyunsaturated/monounsaturated/saturated fatty acids

ingested 1.1 mg of thiamin, 1.1 mg of riboflavin, 11.8 mg of niacin, 176 mg of ascorbic acid, 7,809 I.U. of vitamin A, 7.3 mg of vitamin E, 496 mg of calcium, 11.5 mg of iron, 3,569 mg of sodium, 264 mg of cholesterol, and 5.2 g of fiber. P/M/S ratio was 0.85/1.17/1 for men and 0.95/1.15/1 for women. The P/S ratio was lower than 1, the recommended value. The vitamin E / polyunsaturated fatty acid ratio was 0.36 for men and 0.41 for women. Overall speaking, the levels of percent calorie from fat and protein were higher, but that of carbohydrate was lower than the ideal values. Mean dietary intakes of vitamin E and calcium in men and women and iron in women were not above the values of the recommended daily nutrient allowances (RDNA). Dietary intakes of vitamin A and ascorbic acid were much beyond RDNA. Dietary cholesterol intake did not exceed 400 mg, recommended upper limit. There were some differences in dietary nutrient intakes among various age and sex groups. Women aged 13-24 and men aged 13-15 had the lowest values in % RDNA of several vitamins and minerals among all age-sex groups. However, carbohydrate intakes were the highest for these young people and for women aged 55-64. In this survey, Taiwan was divided according to dietary habits, geographic locations and urbanization index into 7 strata: Hakka area, mountainous area, eastern coastal area, Peng-Hu islands, metropolitan areas, provincial cities and class I townships, and class II townships. Unique characteristics of Hakka area was that percent calorie from protein was the highest and dietary vitamin E level was the lowest in comparison with others. Dietary intakes of riboflavin, calcium, iron, and crude fiber of the mountainous area were lower than those of other strata. Levels of thiamin, fat, saturated fatty acids, monounsaturated fatty acids, and calorie from fat were lower in Peng-Hu than other strata. Levels of niacin, polyunsaturated fatty acids, P/S ratio, protein, and calorie from carbohydrate were higher than those of others. The metropolitan areas had higher intakes of riboflavin, niacin, calcium, iron, and cholesterol, but lower P/S ratio. The provincial cities and class I townships had lower intakes of vitamin A, vitamin E, and polyunsaturated fatty acids than others. Class II townships had higher levels of monounsaturated fatty acids and percent calorie from fat, but lower level of calorie from protein than others. In comparison with previous two surveys, levels of vitamin A, thiamin, riboflavin, ascorbic acid, calcium, saturated fatty acids, cholesterol, and percent calorie from protein were higher than before, but levels of calories, protein, fat, carbohydrate, vitamin E, sodium, iron, monounsaturated fatty acids, and P/S ratio were lower than before. Percentage of fat and carbohydrate and crude fiber intake was similar to the previous survey values.

Key words: 24-h recall, dietary survey, nutritional status, Taiwan, Chinese

Introduction

Due to rapid economic development in Taiwan, dietary habits and life-styles of the people have been gradually transformed. In order to understand the current status of dietary nutrient intakes, we analyzed the data of 24-hour recall of people aged 13-64, obtained from Nutrition and Health Survey in Taiwan (NAHSIT), 1993-1996. It adopted a multi-staged, stratified, clustered probability sampling design. Taiwan was classified into 7 strata unique in dietary patterns, ancestral origins, geographical locations, or degree of urbanization. Age, sex, and stratum-specific mean values of calories and various nutrients were calculated and compared with those of recommended daily nutrient allowances (RDNA), in order to provide reference information for public health policy. Comparison was also made with the national nutrition surveys carried out in 1980-1981 and in 1986-1988 (1,2) to elucidate the trends of dietary nutrient intakes.

Materials and Methods

Survey design

"The Nutrition and Health Survey in Taiwan (NAHSIT) 1993-1996" was carried out from July 1993 to June 1996 (3). The survey adopted a multi-staged, stratified, clustered sampling scheme. According to the characteristics of ancestral origins, lifestyles, location, and urbanization index of the basic sampling units (as townships or city districts), the 359 sampling units of Taiwan were classified into 7 strata which were Hakka areas, mountainous areas, two east coast counties, Peng-Hu islands, metropolitan areas, provincial cities or class I townships, and class II townships. Three townships or city districts were selected within each strata with probabilities proportional to sizes (PPS). Three villages or city blocks were selected in each township or city district also with PPS. A designated number of subjects (either 8 or 16) were sampled for each age (4-6, 7-12, 13-18, 19-44, 45-64, and 65+) and sex (men and women) group to give a total of 160 samples in each village or city blocks. The sample size in 63 villages or city blocks was 9,962. However, only those of aged 13-64 were administered with 24-hour recall. There were 6,048 recalls obtained. To consider seasonal effect in this subtropical land, we balanced the number of villages surveyed in season. In the three year survey period, one township of each of the seven strata have been surveyed in each season of the three (July-October, November-February, and March-June).

24-hour recall (Figure 1)

Included in this procedure of 24-hour recall in Taiwan were several components: inquiring about foods and dishes consumed in the past 24 hours, assessing the amounts of individual foods or dishes consumed, and obtaining from the cook the recipes and the cooking methods used for food preparation. Data collection was carried out inside the household. Interviewers used several tools to appraise the amounts of foods

consumed. These tools included food piece models (corn kernels, carrot cubes, green beans, string beans, green vegetable leafs, green-color shred, beige-colored slice, beige-color shred, meat shred, meat slice, and ground meat), abstract food models (a dozen of hollow hemisphere with varied sizes, transparent plastic board with grid lines, a deck of plastic pieces, and a roll of cloth tapes), measuring cups and spoons, and an electronic weight. Information was obtained on cooking methods, location, time, all the sauces, condiments, and spices used, shapes of each food ingredient, status of the foods (raw, edible, cooked, and uncooked), food models used, and measures based on models. During the process, Q-cards were designed for the sauces, condiments, and spices used in the food preparation and on drinks, desserts, side dishes, snacks, and alcohol.

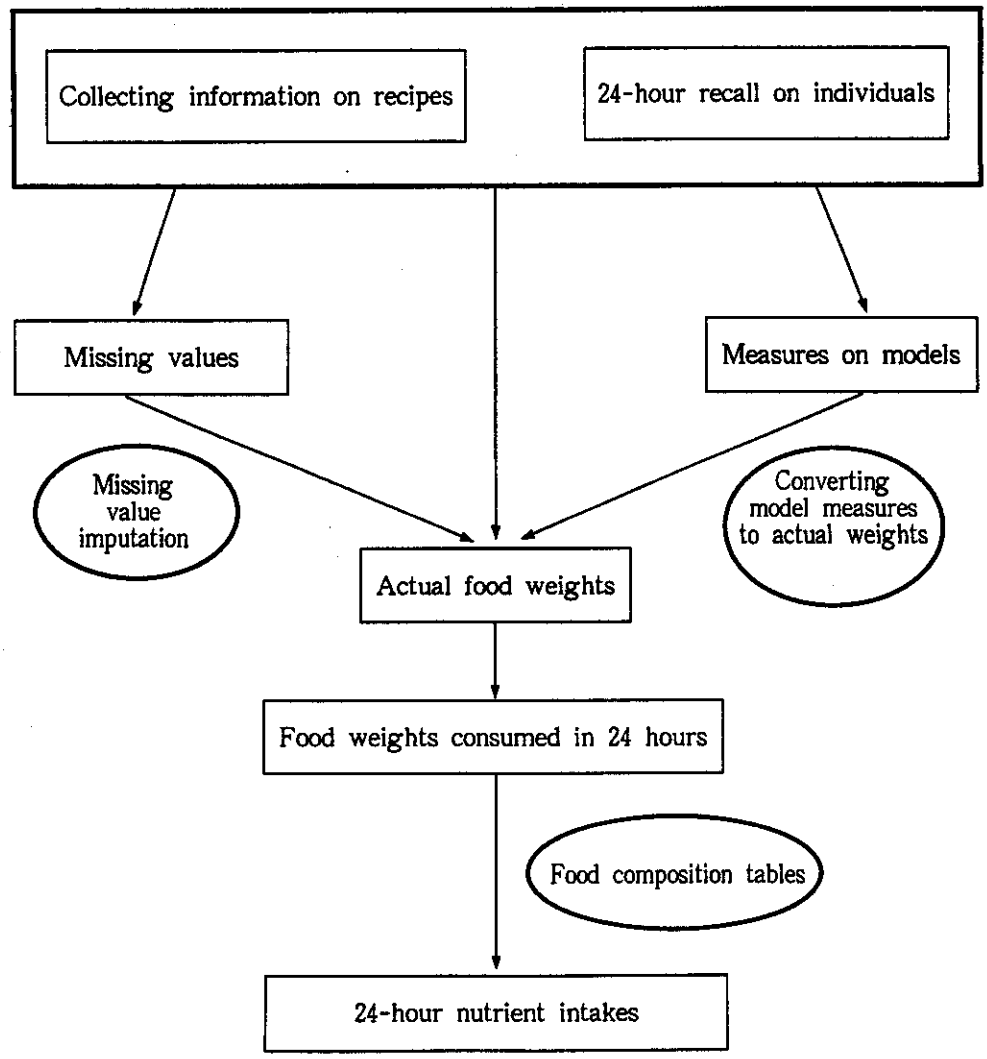

Figure 1 Data collection and management procedures for 24-hour recall

Data entry system

Data collected on 24-hour recall was entered in the field daily with a lap-top computer in order to correct missing and unclear data on site. A data entry system was designed for the food models system described above, in which food names were entered and a corresponding food code could appear and be selected by cursor to avoid coding errors.

Correspondence between measures of food models and actual food weights

Thousands of equations linking measures of food models and food weights were established by experiments. Validation studies were carried out for these equations. Correction factors generated from the validation study were built into the equations.

Procedures to establish equations corresponding the food model measures to food weights are described as follows

(a) Food piece models: Given each food consumed, percentile values were obtained for the model weights. The food weights corresponding to the 5%, 25%, 50%, 75%, and 95% of the model weights were obtained by weighing the same volume of foods. This procedure was repeated 3 times by each of two technicians to generate 30 data points ($5 \times 3 \times 2$). Regression analyses were carried out to obtain the equations to relate model weights to food weights. We also established equations relating food models among one another.

(b) Hollow hemisphere models: Hemisphere models were designed to measure the size of fruits and other round-shaped foods. The maximum and minimum sizes of hemisphere used for a given fruit were obtained from the survey data. Fruits or foods in repeat corresponding to 5 sizes in the range were purchased and weighed (N=10). Regression analyses were carried out to obtain the equations to relate the model diameters to food weights.

(c) Abstract models: We described foods by length; length and width; length, width, and height; and area and height. The maximum and minimum volumes calculated from the above measures for a given food were obtained from the survey data. Foods in repeat were prepared for 5 volumes in the range and weighed (N=10). Regression analyses were carried out to obtain the equations relating food volumes to food weights.

All equations were forced to go through the origin. Polynomial terms were allowed. Dietary data in measures of various kinds of food models were transformed into food weights which were further adjusted according to the validation coefficients established elsewhere (4).

Missing data

There were two major types of missing data: (1) missing sauces, condiments, and spices information for dishes and (2) missing weight for dish or food items consumed by subjects.

In terms of sauces, condiments, and spices, there were 11.1% missing, represent-

ing 14201 items among 128440 items. In order to impute the missing data, we first classify all sauces, condiments, and spices to categories (e.g., sugar, soy-sauce, salt, etc.). Then same dishes with complete information were grouped to obtain estimates of sauces, condiments, and spices in unit of food weight. These estimates were then used to impute missing sauces, condiments, and spices data according to the food weight consumed.

There were 6595 items with missing weights of individual foods or dishes (4%) among a total of 164747 items. In order to impute the data, we first grouped all dishes to several categories (e.g., stir-fried leafy vegetables, stir-fried squashes, stir-fried meat piece and vegetables, etc.). Missing data were imputed according to the following priority.

1. Age-, sex-, dish-specific food weight;
2. Age-, sex-, dish type-specific food weight;
3. Sex-, dish type-, food category-specific food weight;
4. Sex-, and food category-specific food weight.

Computation of individual nutrient intake data

Individual food intake data were obtained from recipes and the percentage of foods consumed from each dish. Sauces, condiments, and spices added by individuals in the eating process were also included in computation.

Food amounts were then converted to nutrient levels, based on the Nutrient Composition Data Bank for Foods of Taiwan Area established by the Food Industry Research and Development Institute (5). In computing the percentage of plant source or animal source of protein and fat, we assumed a 1:1 ratio (w:w) for foods such as sandwich, hamburger, dumplings, and soups).

Comparison with previous two surveys

Previous two surveys used inventory method (1,2) to assess dietary intake of the families and Composition of Foods Used in Taiwan (6) was used to compute nutrient levels. In the previous surveys, dietary nutrient intake was computed for an artificial 20-34 year male (3,4). In order to compare with the previous data, the same computation method and nutrient data bank were used with this survey data. Trends of these three surveys were compared and described in the text.

Nutrient data base

The major data bases used in this analysis were "Nutrient Composition Data Bank for Foods of Taiwan Area" (5) and "Composition of Foods Used in Taiwan" (6). Other data bases included: Nutrient Composition Table for Marketed Processed Foods (7), Food Composition Table (8), Food/Analyst plus CD-ROM (9), Food Composition and Nutrition Tables (10), Bowes & Church's Food Values of Portions Commonly Used (11), Food Composition Table For Use in East Asia (12), Dietary Manual for Republic of China (13), Quantity Food Production – Menu Design (14), and nutrient information provided by manufacturer.

Due to the limitation of the nutrient data base; Chinese herbs, nutrient supplements, and health foods were not included in the computation. Nutrient contents of many foods in the two major data banks are based on uncooked foods. Therefore, effects of cooking and storage on nutrient contents were not considered for the home-made dishes. Data on fatty acids were not complete. Several assumptions were made for calculating fatty acid content:

Content of monounsaturated fatty acid = Content of oleic acid;

Content of polyunsaturated fatty acids (PUFA)

= Content of unsaturated fatty acids − content of monounsaturated fatty acid (4).

Statistical analyses

SAS software was used to compute mean nutrient intakes, standard errors, and percentages of the RDNA. Weighing process was used in the analyses. There were two sets of age-, sex-, and stratum- specific weights for questionnaire data and for physical examination data, respectively (3). In these analyses, questionnaire weights were used.

Results

Age and sex-specific nutrient values

We obtained 6,048 dietary recalls in three years for residents of Taiwan, aged 13-64. Excluding pregnant and lactating women, and those with extreme values, there were 5,834 recalls from 2,923 men and 2,911 women. Their age and sex distribution and age- and sex-specific daily nutrient intakes are listed in Table 1.

Energy and macro-nutrients

Energy: Adult male in Taiwan ingested an average of 2,203 kcal a day. Adult female ingested 1,591 kcal. Among various age groups, men aged 16-19 and aged 25-34 had higher energy intakes than other age groups, but men aged 55-64 had the lowest intake value. Women ingested much less energy than men. In women, age groups of 20-24 and 55-64 had lower energy intakes than other age groups. Average energy intakes in various age groups ranged between 89% and 115% of RDNA in men and between 72% and 100% in women. The percent RDNA was the lowest for men and women aged 13-15 and aged 16-19 as compared to other age groups.

Protein: Adult men consumed in average 82.6 g of protein. Adult women consumed 61.6 g. Both values were above RDNA. Men aged 16-19 (89.6 g) had the highest daily protein intake compared to other age groups. Men aged 55-64 had the lowest level (73.8 g). Women's intakes were less than men in every age group with means ranging from 52 g to 66 g. Protein intakes of men in every age group were above RDNA, ranging 114%-137%. Intakes of women were also above 95% of RDNA, ranging 95%-120%.

Table 1 Age- and sex-specific daily nutrient intakes in Taiwan NAHSIT 1993-1996

Sex	Age (year)	N	Energy			Protein				Fat			Carbohydrate		
			Mean (kcal)	SD (kcal)	% of RDNA	Mean (g)	SD (g)	% of RDNA	% of total calories	Mean (g)	SD (g)	% of total calories	Mean (g)	SD (g)	% of total calories
Men	13-15	589	2221	1673	89%	81.0	46.5	125%	14.5%	78.1	118.9	31.5%	301	170	54.0%
	16-19	411	2368	1010	89%	89.6	45.0	128%	15.2%	80.5	63.6	30.6%	320	131	54.2%
	20-24	149	2267	1350	103%	88.7	70.1	137%	16.0%	71.1	63.0	28.8%	306	173	55.2%
	25-34	400	2412	1586	115%	87.8	47.4	135%	15.0%	96.8	137.6	37.3%	279	128	47.7%
	35-54	857	2081	998	99%	79.9	42.5	123%	15.9%	71.3	60.2	32.0%	261	120	52.1%
	55-64	517	2075	1336	101%	73.8	62.0	114%	14.7%	78.3	106.8	35.0%	253	107	50.3%
	19-64	1963	2203	1280	104%	82.6	50.3	127%	15.5%	79.5	95.7	33.5%	272	129	51.0%
Women	13-15	590	1577	861	72%	57.5	32.0	96%	14.5%	53.1	60.2	30.2%	219	104	55.3%
	16-19	400	1574	650	75%	59.6	30.8	108%	15.1%	56.1	42.5	32.0%	208	92	52.8%
	20-24	142	1495	938	83%	52.2	29.9	95%	13.9%	63.8	63.8	38.2%	180	106	47.9%
	25-34	383	1514	658	89%	61.6	34.4	112%	16.1%	57.7	43.9	34.0%	190	96	49.8%
	35-54	908	1696	1641	100%	66.0	45.8	120%	15.6%	65.7	118.0	34.9%	210	145	49.6%
	55-64	488	1485	972	90%	57.0	33.3	104%	15.3%	48.3	87.2	29.2%	207	96	55.5%
	19-64	1952	1591	1247	93%	61.6	39.5	112%	15.4%	61.1	90.7	34.4%	200	122	50.1%

Table 1 Age- and sex-specific daily nutrient intakes in Taiwan NAHSIT 1993-1996 (Cont.)

Sex	Age (year)	Thiamin			Riboflavin			Ascorbic acid			Niacin			Vitamin A			Vitamin E			Vitamin E/ PUFA ratio
		Mean (mg)	SD (mg)	% of RDNA	Mean (mg)	SD (mg)	% of RDNA	Mean (mg)	SD (mg)	% of RDNA	Mean (mg)	SD (mg)	% of RDNA	Mean (I.U.)	SD (I.U.)	% of RDNA	Mean (mg)	SD (mg)	% of RDNA	
Men	13-15	1.26	1.13	.97%	1.3	1.15	93%	123	166	246%	16.4	12.3	96%	4970	7186	108%	6.74	7.27	56%	0.33
	16-19	1.38	0.87	106%	1.44	0.99	96%	155	275	282%	20.9	21.1	123%	5786	9046	116%	7.76	6.09	65%	0.39
	20-24	1.47	1.44	134%	1.33	1.17	111%	175	244	292%	17.6	14.6	117%	5050	9280	101%	7.1	7.27	59%	0.38
	25-34	1.39	0.98	126%	1.41	1.42	118%	163	219	272%	17.4	12.1	124%	7844	11958	157%	7.92	6.03	66%	0.32
	35-54	1.41	2.28	128%	1.24	1.05	103%	180	217	300%	15.0	9.4	107%	9090	17722	182%	8.01	7.02	67%	0.39
	55-64	1.13	1.04	113%	1.07	0.93	97%	161	190	268%	14.3	21.7	102%	8863	13117	177%	7.54	6.77	63%	0.34
	19-64	1.37	1.69	125%	1.29	1.17	107%	168	215	280%	16.2	14.0	114%	8090	14500	162%	7.81	6.76	65%	0.36
Women	13-15	1.06	2.09	96%	1.07	1.09	89%	138	274	276%	12.6	12.5	84%	3950	6601	86%	5.86	4.6	59%	0.40
	16-19	0.93	0.78	85%	1.12	0.74	93%	115	141	209%	12.4	10.3	89%	4256	4498	101%	6.08	5.23	61%	0.40
	20-24	0.86	0.66	96%	0.89	0.68	89%	144	162	240%	10.1	6.4	84%	5972	8705	142%	6.43	4.74	64%	0.37
	25-34	0.96	0.75	107%	1.17	1.21	130%	179	295	298%	12.0	9.5	109%	6823	10858	162%	6.98	5.86	70%	0.39
	35-54	1.22	1.48	136%	1.15	0.96	128%	188	271	313%	12.6	10.0	115%	8607	12500	205%	8.2	8.08	82%	0.43
	55-64	1.09	1.41	136%	1.2	1.6	133%	170	233	283%	10.3	6.4	94%	10036	12616	239%	6.5	6.06	65%	0.46
	19-64	1.08	1.21	121%	1.13	1.1	123%	176	259	293%	11.8	9.1	106%	7809	11528	186%	7.33	6.86	73%	0.41

Table 1 Age- and sex-specific daily nutrient intakes in Taiwan NAHSIT 1993-1996 (Cont.)

Sex	Age (year)	Calcium			Iron			Sodium		Saturated fatty acids		Monounsaturated fatty acids		Polyunsaturated fatty acids		P/M/S ratio	Cholesterol			Crude fiber	
		Mean (mg)	SD (mg)	% of RDNA	Mean (mg)	SD (mg)	% of RDNA	Mean (mg)	SD (mg)	Mean (g)	SD (g)	Mean (g)	SD (g)	Mean (g)	SD (g)		Mean (mg)	SD (mg)	% of RDNA	Mean (g)	SD (g)
Men	13-15	464	367	58%	13.07	8.86	87%	3352	3032	26.2	38.7	28.7	52.8	20.5	24.9	0.78/1.10/1	383	292	96%	3.61	3.4
	16-19	523	498	65%	15.53	10.36	104%	3169	2239	27.5	21.3	30.2	26.6	19.9	17.3	0.73/1.10/1	396	273	99%	4.52	4.43
	20-24	453	382	57%	16.05	18.25	107%	4394	7014	24.3	25.0	25.7	24.3	18.6	17.3	0.77/1.06/1	383	271	96%	5.27	7.3
	25-34	513	504	86%	15.44	12.26	154%	4257	5470	31.2	45.7	37.2	61.6	24.9	26.8	0.80/1.19/1	405	318	101%	5.22	5.66
	35-54	517	426	86%	13.32	8.91	133%	3339	4248	22.3	19.3	25.7	24.0	20.6	20.5	0.92/1.15/1	305	263	76%	5.26	5.19
	55-64	501	394	84%	12.19	9.33	122%	4352	5817	23.5	36.8	29.4	46.4	22.0	24.7	0.93/1.25/1	271	312	68%	4.96	4.26
	19-64	504	444	81%	14.2	11.56	133%	3821	5174	25.4	32.2	29.6	41.6	21.6	22.5	0.85/1.17/1	344	292	86%	5.11	5.46
Women	13-15	388	323	55%	10.56	7.55	70%	2480	1965	18.5	23.1	18.3	23.9	14.5	16.0	0.78/0.99/1	241	209	60%	3.87	4.15
	16-19	432	329	62%	10.55	6.22	70%	3027	4078	19.0	15.4	19.8	17.8	15.2	13.2	0.80/1.04/1	289	249	72%	3.71	3.67
	20-24	349	271	50%	9.7	7.2	65%	2956	3131	19.8	21.8	24.0	27.1	17.5	15.1	0.89/1.22/1	282	320	71%	4.1	3.8
	25-34	457	454	76%	11.21	6.8	75%	3036	2399	17.8	13.9	19.7	16.0	18.1	17.5	1.01/1.10/1	308	485	77%	5.33	6.74
	35-54	555	496	93%	12.64	11.56	84%	4160	6461	20.0	38.0	23.4	52.9	19.3	23.4	0.96/1.17/1	252	253	63%	5.67	5.44
	55-64	552	587	92%	9.95	6.58	100%	3548	4241	15.2	28.6	17.0	39.6	14.0	18.6	0.92/1.12/1	183	247	46%	5.05	4.92
	19-64	496	472	81%	11.45	9.26	80%	3569	4878	18.8	29.4	21.7	40.1	17.9	20.1	0.95/1.15/1	264	343	66%	5.22	5.57

Fat: Adult men consumed in average 79.5 g of fat. Women consumed 61.1 g. Fat intakes in men were higher than women in the same age group. In men, age group of 25-34 had the highest intake (96.8 g) and age group 55-64 had the lowest fat intake. In women, age group of 55-64 had the lowest fat intake (48.3 g).

Carbohydrate: Adult men in Taiwan consumed an average of 272 g of carbohydrate. Women consumed 200 g. The carbohydrate intakes in men were higher than those of women in all age groups. Men in age group of 16-19 had the highest mean carbohydrate intake (320 g). The intake levels dropped in older age groups. The value was the lowest in age 55-64 (253 g). There were no such trends in women. Women aged 13-15 (219 g) had the highest carbohydrate intake, but women aged 20-24 had the lowest mean intake (180 g).

Percent calorie from macro-nutrients: For adult men, percent calories from protein, fat, and carbohydrate were 15.5%, 33.5%, and 51%, respectively. For adult women, they were 15.4%, 34.4%, and 50.1%. Sex- and age-specific values for percent calorie from protein were 13.9-16.1%. Percent from fat were 28.8-38.2%. Percent from carbohydrate were 47.7-55.5%. Recommended values from DOH for protein, fat, and carbohydrate were 10-14%, 20-30%, and 58-68% (12). Our data indicated that percent calorie from protein was slightly higher than the recommended value for almost all age groups in 20-64. In terms of percent from fat, almost all age groups had higher than recommended values except men aged 20-24 and women aged 55-64. We found in this survey that percent calories from protein was slightly higher than the recommended percentage in almost every age group between 20 and 64. In terms of percent calories from fat, most age groups had a level over 30%, except age 20-24 in men and age 55-64 in women. The percentage was as high as 38% for women aged 20-24 and for men aged 25-34. As to carbohydrate, the percentage was lower than the recommended level in all age and sex groups.

Percentage of protein and fat from animal origin and from plant origin: Protein intake is composed of roughly 50% plant protein and 50% animal protein. The percentage of protein from animal source in age 25-34, 55%, was higher than those of all other age groups. The percentage from animal origin in age group 55-64, 47%, was lower than those of all other age groups (Figure 2). In terms of sources of fat, the percentage of fat from animal origin was higher in men (63%) than in women (55%). In men, age group 25-34 had the highest value (69.5%). Age group 35-54 had the lowest value (56.5%). In women, age group 35-54 had the highest value (55.8%). Age group 13-15 had the lowest value (47.3%) (Figure 3).

Vitamins

Vitamin B_1: Average intake of vitamin B_1 was 1.4 mg for adult men and 1.1 mg for women in Taiwan. These levels are higher than the RDNA. Men's intake levels were higher than women's of the same age group. In men, age 55-64 had lower intake level (1.1 mg) than other age groups. In women, age 35-54 had the highest value (1.2 mg). Age 20-24 had the lowest value (0.9 mg). Compared to RDNA, most age and sex groups had a mean intake higher except that men aged 13-15 and women aged 13-24 had a mean value lower but still over 80% RDNA.

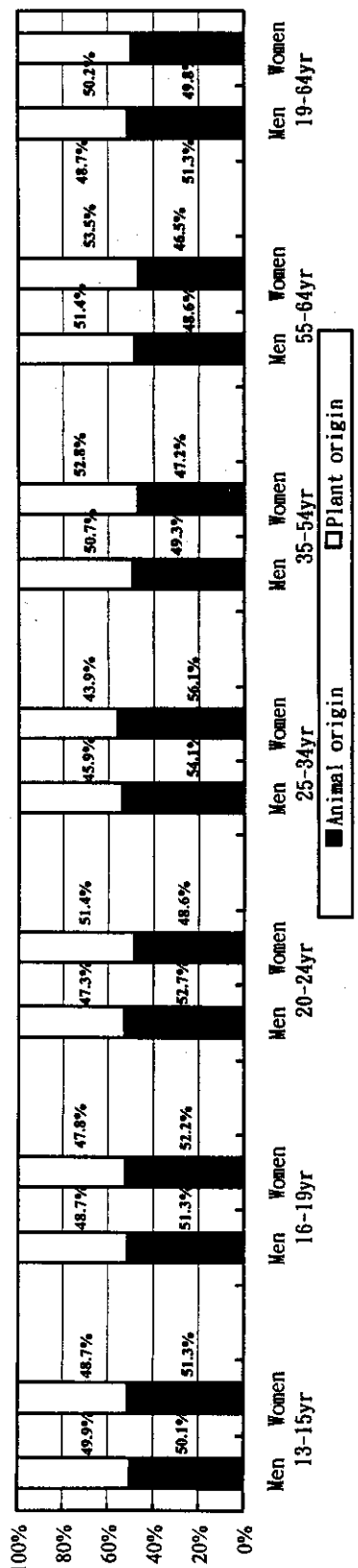

Figure 2 Percentage of dietary protein from animal origin and from plant origin based on results of NAHSIT 1993-1996

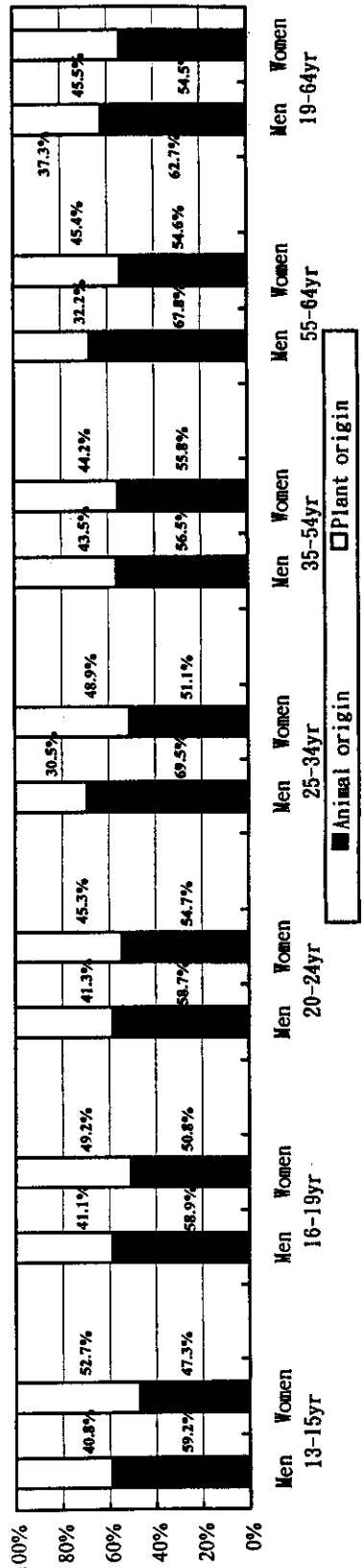

Figure 3 Percentage of dietary fat from animal origin and from plant origin based on results of NAHSIT 1993-1996

Vitamin B_2: Average intake of vitamin B_2 was 1.3 mg for adult men and 1.1 mg for adult women in Taiwan. These levels are higher than RDNA. Men's intake levels were in general higher than women's of the same age group except age 55-64. In men, age 16-19 had the highest intake (1.4 mg). Age 55-64 had the lowest intake (1.1 mg). Surveys carried out in 1980-1981 and in 1986-1988 showed that mean intake of vitamin B_2 was lower than the RDNA. (3,4). The results of NAHSIT found that most age- and sex-specific mean intake of vitamin B_2 are above 90% RDNA with only women aged 13-15 and 20-24 between 80-90% RDNA.

Vitamin C: Average intake of vitamin C was 168 mg for adult men and 176 mg for adult women in Taiwan. These levels are around three times of RDNA. Vitamin A intake in women was in general higher than that of men of the same age. Age- and sex-specific levels were all above the RDNA, ranging from 209% to 313%. The survey carried out previously also showed that vitamin C intakes were adequate. However, none of the three surveys took into account the vitamin C loss in food preparation. The vitamin C ingested should be less than what is reported here.

Niacin: Average intake of niacin was 16.2 mg for adult men and 11.8 mg for adult women in Taiwan. These values are higher than RDNA. In men, age 13-15 had the highest intake (20.9 mg). The age group 55-64 had the lowest value (14.3 mg). Women ingested less niacin than men in all age groups. Women, age 20-24 (10.1 mg), had lower level of intake than others. Comparing to RDNA, every sex- and age-specific mean value was larger than 80% RDNA, ranging from 84% to 124%.

Vitamin A: Average intake of vitamin A was 8090 I.U. in adult men and 7809 I.U. in adult women in Taiwan. These values were much higher than the RDNA. Age- and sex-specific means of vitamin A intake vary widely, ranging from 86% to 239% of RDNA.

Vitamin E: Average vitamin E intake was 7.8 mg for adult men and 7.3 mg for adult women, approximating 70% of the RDNA. Comparing to RDNA, intake levels of most age and sex groups were below 80% RDNA except for women aged 35-54 (82%). However, the mean vitamin E / PUFA ratios in women as a whole and in most age groups were adequate ($>$ 0.40). The ratio in every age group of men (0.32-0.39) was lower than the desirable value.

Minerals

Calcium: Average intake of calcium was 504 mg in adult men and 496 mg in adult women, approximating 80% of the RDNA. In men, age group 20-24 (453 mg) had lower intake than other groups. In women, age groups of 13-15 (388 mg) and 20-24 (349 mg) had the lowest values. Age group 35-54 had the highest value (555 mg). The results of NAHSIT indicated that intakes of men and women in various age groups below 24 were between 50-65% of RDNA and those above 25 were between 76-93%.

Iron: Average intake of iron was 14.2 mg in adult men of Taiwan, which is over RDNA. Average intake for women was 11.5 mg which is 80% of the RDNA. Iron intake of men is higher than that of women of the same age group. In men, age group 55-64 had the lowest intake (12.2 mg). In women, age 35-54 had the highest intake value (12.6 mg). Age group 20-24 had the lowest value (9.7 mg). Comparing to RDNA, various age groups in women 35 and above had mean intakes greater than 80% RDNA. Various age groups in women younger than 35 had mean intakes around

70% RDNA. In men, with the exception of age 13-15 (87% RDNA), most age groups had mean intakes greater than RDNA.

Sodium: Average intake of sodium was 3821 mg (equivalent to 9.7 g of sodium chloride salt) in adult men and 3569 mg (9.1 g of sodium chloride) in women. Except for age 35-64, men's sodium intake was higher than women's of the same age group. In women, age 35-54 had a higher intake than others with an average of 4160 mg. Age 13-15 had a lower intake than others with an average of 2,480 mg.

Fatty acids and cholesterol

Saturated fatty acids: Average intake of saturated fatty acids was 25.5 g in adult men and 18.8 g in women. Men's intake levels were higher than women's of the same age group. Among various age groups, age 55-64 had the lowest levels (22.5 g in men and 15.2 g in women).

Unsaturated fatty acids: Average intake of monounsaturated fatty acids was 29.6 g in adult men and 21.7 g in women. Average intake of polyunsaturated fatty acids was 21.6 g in adult men and 17.9 g in women. The intake levels of both monounsaturated and polyunsaturated fatty acids were higher in men than in women of the same age groups. In terms of monounsaturated fatty acids, men aged 25-34 (37.2 g) had higher values than other age groups. Women aged 20-24 (24 g) had higher values than others, but women aged 55-64 (17 g) had lower value than others. In terms of polyunsaturated fatty acids, men aged 25-34 (24.9 g) had higher values than other age groups. Women aged 25-54 (18-19 g) had higher values than others.

P/M/S ratio: The average P/M/S ratio was 0.85/1.17/1 for adult men. It was 0.95/1.15/1 for women. Proportion of monounsaturated fatty acids was higher than that of polyunsaturated and that of saturated fatty acids in all age- and sex- groups. In men, age 55-64 had the highest P/S ratio (0.93) and age 16-19 had the lowest value (0.73). In women, age 13-15 had the lowest P/S value (0.78). Department of Health recommended a P/S value of 1 to adults (12). In this survey, mean P/S ratio for women aged 25-54 was close to one. Men and women aged 55-64, men aged 35-54, and women aged 20-24 had a mean P/S ratio around 0.9. All other age groups had a ratio between 0.73-0.8.

Cholesterol: Mean cholesterol intake in adult men was 344 mg and that in women was 264 mg. The intake level was higher in men than in women of the same age and higher in those aged < 35 than those aged > 35. The lowest level was found in those aged 55-64. DOH recommended less than 400 mg of cholesterol a day for adults (13). The only age-sex group with a mean value over 400 mg was men aged 25-34.

Fiber: The mean crude fiber intake was 5.1 g for adult men in Taiwan and that was 5.2 g for women. The lowest values were found in men and women aged 13-15 with an average of 3.7 g.

In summary (Figure 4), mean intake levels of protein, vitamin B_1, B_2, A, and C were close to or over the RDNA. Among these nutrients, vitamin C and A were much higher than RDNA. But mean intake levels for vitamin B_1 and B_2 in teens were lower than RDNA. For calcium and vitamin E, intake levels of most age-sex groups were lower than 80% RDNA. Iron intake in men was adequate, but women aged < 55 had an intake lower than RDNA. For men aged < 34, their cholesterol intake levels were close to the upper limit Ret by DOH. Mean intakes of cholesterol were close to 300 mg or below for men in other age groups and for women as a whole.

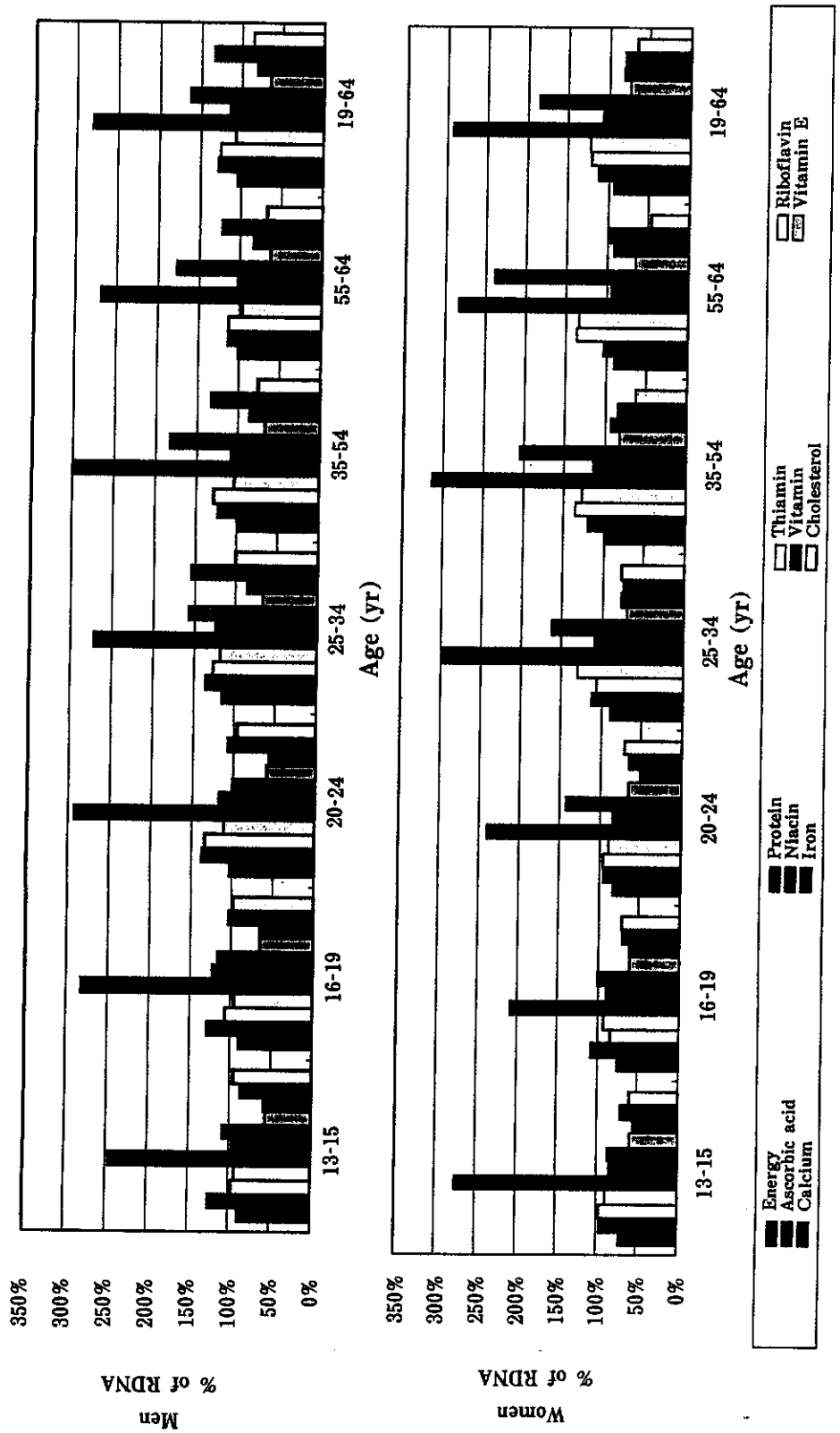

Figure 4 Age and sex-specific nutrient intakes expressed as per cent of recommended daily nutrient allowances, based on results of NAHSIT 1993-1996

Strata-specific nutrient intake values (Table 2)

Energy and macro-nutrients

Energy: Men had a higher energy intake than women across strata. The highest value in men (2,455 Kcal) was observed in the East Coast area. The highest value in women (1,764 Kcal) was in the metropolitan area. Energy intake values in Peng-Hu islands and in provincial cities and class I townships were lower than other areas for both men and women.

Protein: Men had a higher protein intake than women in all strata. Men's protein intake levels in mountainous area, east coast, Peng-Hu islands, and metropolitan areas approximated 90 g which was higher than other strata. Men's intake (78.4 g) in the provincial cities and the class I townships was the lowest. Women in metropolitan areas had a higher protein intake than those in other strata.

Fat: Men had higher dietary fat intake than women across all strata. Men (65 g) and women (53 g) in Peng-Hu islands had the lowest intake level among all.

Carbohydrate: Men had higher carbohydrate intake than women in all strata. Women (184 g) in Hakka stratum and in mountainous area had the lowest intake among all strata.

Percent calories from macro-nutrients: Percent calories from protein ranged between 14.4%-17.7% which was higher than the recommended value (10-14%) (13). Among all strata, the class II townships had the lowest; and Peng-Hu islands had the highest. Percent calories from fat ranged from 31% - 37% with the exception of Peng-Hu men (29%). Among all strata, Hakka area and the class II townships had the highest percent calories from fat; and Peng-Hu area had the lowest percent. Percent calories from carbohydrate in all strata was less than the recommended value (58-68%) (13) . Hakka area had the lowest values (men :49.9%, women: 47.5%), but Peng-Hu island had the highest values (men: 53.2%, women: 51.7%). Peng-Hu stratum was unique in that its percent fat was lower, but percent protein and percent carbohydrate were higher than other strata.

Vitamins

Water soluble vitamins: Men's vitamin B_1 intake was higher than women's in all strata. Peng-Hu's vitamin B_1's intake in both men (1.18 mg) and women (0.96 mg) was lower than other strata. In terms of vitamin B_2, mountainous area had a lower dietary intake levels (men: 1.21 mg, women: 0.99 mg); metropolitan cities (Men: 1.41 mg, women: 1.34 mg) had a higher levels than other strata. The lowest vitamin C intake in men was observed in mountainous area. Women's intake was the highest in Hakka stratum (148 mg) but lowest in Peng-Hu islands (151 mg). In terms of niacin, men had higher intake level than women across strata. Peng-Hu islands and metropolitan areas had the highest values, but class II townships had the lowest values among all strata.

Table 2 Strata-specific daily nutrient intakes in Taiwan NAHSIT 1993-1996*

Sex	Strata	N	Energy		Protein			Fat			Carbohydrate		
			Mean (kcal)	SD (kcal)	Mean (g)	SD (g)	% of RDNA	Mean (g)	SD (g)	% of total calories	Mean (g)	SD (g)	% of total calories
Men	Hakka area	285	2222	1447	85.9	67.6	15.6%	84.0	99.4	34.4%	274	176	49.9%
	Mountainous area	286	2384	1583	90.1	58.7	16.2%	84.3	92.4	34.2%	275	173	49.6%
	East coast area	287	2455	1363	92.9	58.2	16.0%	86.5	96.2	33.5%	294	161	50.6%
	Penghu islands	273	2092	1100	89.3	54.4	17.7%	65.2	70.3	29.1%	268	140	53.2%
	Metropolitan areas	268	2158	1235	89.8	56.0	16.8%	73.5	89.7	30.9%	279	135	52.2%
	Provincial cities and urbanization class I townships	276	2115	1302	78.4	51.7	15.4%	75.4	99.3	33.4%	260	124	51.2%
	Urbanization class II townships	288	2309	1244	82.6	42.5	14.7%	86.7	94.1	34.8%	283	122	50.5%
	Total	1963	2203	1280	82.6	50.3	15.5%	79.5	95.7	33.5%	272	129	51.0%
Women	Hakka area	278	1545	951	60.2	43.1	15.5%	63.6	68.7	36.9%	184	111	47.5%
	Mountainous area	284	1559	909	58.4	40.0	15.5%	59.7	60.4	35.6%	184	88	48.9%
	East coast area	275	1615	945	63.4	37.5	15.8%	62.4	67.7	35.0%	197	100	49.1%
	Penghu islands	281	1519	795	65.8	49.1	17.2%	53.1	53.9	31.2%	198	98	51.7%
	Metropolitan areas	277	1764	2233	70.8	53.7	16.1%	67.3	159.1	34.4%	218	187	49.5%
	Provincial cities and urbanization class I townships	270	1488	712	59.7	37.6	15.9%	54.5	47.5	32.8%	192	98	51.3%
	Urbanization class II townships	287	1614	880	58.3	28.7	14.4%	65.2	73.5	36.3%	199	93	49.2%
	Total	1952	1591	1247	61.6	39.5	15.4%	61.1	90.7	34.4%	200	122	50.1%

*Aged 19-64

Table 2 Strata-specific daily nutrient intakes in Taiwan NAHSIT 1993-1996* (Cont.)

Sex	Strata	Thiamin		Riboflavin		Ascorbic acid		Niacin		Vitamin A		Vitamin E		Vitamin E/ PUFA ratio
		Mean (mg)	SD (mg)	Mean (mg)	SD (mg)	Mean (mg)	SD (mg)	Mean (mg)	SD (mg)	Mean (I.U.)	SD (I.U.)	Mean (mg)	SD (mg)	
Men	Hakka area	1.49	1.39	1.26	0.93	188	204	16.8	13.4	7775	10797	7.63	6.64	0.34
	Mountainous area	1.62	1.53	1.21	1.01	148	201	18.4	14.0	7965	14724	8.25	7.62	0.34
	East coast area	1.58	1.53	1.26	1.03	197	255	18.2	25.3	10101	20290	8.5	6.84	0.37
	Penghu islands	1.18	1.09	1.42	1.52	160	162	18.8	15.2	7338	9588	10.09	11.71	0.42
	Metropolitan areas	1.39	1.1	1.41	0.99	194	241	18.7	17.6	8011	11712	8.06	6.67	0.40
	Provincial cities and urbanization class I townships	1.42	2.37	1.19	1.01	154	202	15.7	14.6	7807	16371	7.49	6.83	0.37
	Urbanization class II townships	1.27	0.83	1.34	1.42	168	212	15.3	9.4	8386	13385	7.98	6.61	0.34
	Total	1.37	1.69	1.29	1.17	168	215	16.2	14.0	8090	14500	7.81	6.76	0.36
Women	Hakka area	1.13	0.92	1.05	0.78	197	221	11.7	8.1	7557	7751	6.86	6.3	0.39
	Mountainous area	1.09	1.08	0.99	0.97	172	263	11.7	8.6	7780	12488	8.42	10.17	0.42
	East coast area	1.21	1.99	1.08	0.97	182	203	11.5	7.8	8940	11263	7.82	7.25	0.42
	Penghu islands	0.96	1.18	0.99	0.87	151	180	13.1	10.1	6884	10176	7.82	7.39	0.39
	Metropolitan areas	1.16	1.12	1.34	1.13	169	207	14.0	12.3	8259	11192	8.05	6.42	0.42
	Provincial cities and urbanization class I townships	1.11	1.51	1.11	1.07	193	331	11.7	8.7	7636	12250	7.11	7.88	0.42
	Urbanization class II townships	0.98	0.72	1.03	1.13	157	180	10.6	6.6	7717	10987	7.12	5.53	0.39
	Total	1.08	1.21	1.13	1.1	176	259	11.8	9.1	7809	11528	7.33	6.86	0.41

*Aged 19-64

Table 2 Strata-specific daily nutrient intakes in Taiwan NAHSIT 1993-1996* (Cont.)

Sex	Strata	Calcium		Iron		Sodium		Saturated fatty acids		Monounsaturated fatty acids		Polyunsaturated fatty acids		P/M/S ratio	Cholesterol		Crude fiber	
		Mean (mg)	SD (mg)	Mean (mg)	SD (mg)	Mean (mg)	SD (mg)	Mean (g)	SD (g)	Mean (g)	SD (g)	Mean (g)	SD (g)		Mean (mg)	SD (mg)	Mean (g)	SD (g)
Men	Hakka area	520	456	13.46	10.42	3784	3888	26.8	33.7	31.7	42.4	22.4	25.1	0.84/1.18/1	346	338	5.56	6.02
	Mountainous area	392	354	12.99	9.61	3906	3310	26.0	30.1	31.4	37.3	24.5	26.9	0.94/1.21/1	379	443	4.13	4.61
	East coast area	567	563	14.61	10.38	3927	3814	27.7	35.4	32.9	40.7	22.7	21.2	0.82/1.19/1	372	330	5.52	5.2
	Penghu islands	487	423	14.34	12.23	3948	5693	18.4	17.7	20.4	21.3	24.1	36.5	1.31/1.11/1	360	322	4.54	4.86
	Metropolitan areas	557	462	15.27	10.08	4025	6180	24.3	30.3	26.3	39.1	20.3	20.6	0.83/1.08/1	380	308	5.89	6.01
	Provincial cities and urbanization class I townships	471	392	13.98	14.24	3643	5745	24.3	33.8	27.9	43.3	20.4	22.2	0.84/1.15/1	324	276	4.88	5.95
	Urbanization class II townships	514	481	13.95	8.66	3912	3936	27.0	31.0	33.0	40.9	23.3	23.2	0.86/1.22/1	344	289	4.96	4.45
	Total	504	444	14.2	11.56	3821	5174	25.4	32.2	29.6	41.6	21.6	22.5	0.85/1.17/1	344	292	5.11	5.46
Women	Hakka area	478	389	10.8	8.28	3383	4834	19.7	23.2	23.1	29.2	17.5	17.6	0.89/1.17/1	251	237	5.2	4.65
	Mountainous area	403	409	9.55	6.78	3161	2493	17.1	18.5	20.2	22.5	19.9	22.2	1.16/1.18/1	251	243	4.65	6.91
	East coast area	535	539	11.88	8.64	4331	7503	18.3	19.9	21.2	25.9	18.4	16.6	1.01/1.16/1	254	230	5.39	5.4
	Penghu islands	405	335	10.27	6.65	3490	3299	14.5	14.1	16.3	16.8	20.2	26.4	1.39/1.12/1	272	422	4.67	4.62
	Metropolitan areas	547	392	12.91	9.04	3813	4748	21.5	51.0	23.5	72.1	19.1	28.3	0.89/1.10/1	292	351	5.18	5.18
	Provincial cities and urbanization class I townships	506	539	11.17	11.11	3476	5519	16.8	15.9	18.7	18.7	16.9	16.4	1.01/1.11/1	268	401	5.38	6.57
	Urbanization class II townships	455	428	10.98	6.57	3520	3933	19.8	24.3	24.3	32.2	18.4	18.0	0.93/1.23/1	243	259	5.06	4.37
	Total	496	472	11.45	9.26	3569	4878	18.8	29.4	21.7	40.1	17.9	20.1	0.95/1.15/1	264	343	5.22	5.57

*Aged 19-64

Fat-soluble vitamins: Provincial cities and the class I townships had the lowest vitamin A intake (men: 8,613 I.U., women: 7,903 I.U.). Hakka strata and provincial cities and class I townships had the lowest vitamin E intake. In men; Hakka area, mountainous area, and class II townships also had the lowest vitamin E / PUFA ratios (0.34); but Peng-Hu islands and metropolitan areas had the highest values. Women in all strata had a ratio close to 0.4, the desirable values (0.39-0.42).

Minerals

Calcium: Mountainous area (men: 392 mg, women: 403 mg) had a lower calcium intake levels than others. Metropolitan areas had the highest levels (men: 557 mg, women: 547 mg) among all strata.

Iron: Men's iron intake was higher than women's across strata. Men and women in metropolitan areas had the highest intake level (men: 15.3 mg, women: 12.9 mg). On the other hand, those in mountainous area had the lowest level (men: 13 mg, women: 9.6 mg).

Sodium: Men had a higher sodium intake than women across strata. Men in provincial cities and class I township had a lower sodium intake than those in other strata, approximating 3,643 mg. Women in the east coast counties had higher sodium intakes than those in other strata, approximating 4,331 mg. Sodium intake of the men in metropolitan areas (4,025 mg) was the highest among all strata. The intake of women in the metropolitan areas was 3,813mg which was lower than the east coast counties but higher than most of other strata.

Fatty acids and cholesterol

Saturated fatty acids: Men had higher levels than women in all strata. Men's intake was the highest in the east coast area (27.7 g) but the lowest in Peng-Hu islands (18.4 g). Women's intake was the highest in metropolitan areas (21.5 g) but lowest in Peng-Hu islands (14.5 mg). In general, intake level in Peng-Hu stratum was lower than others.

Unsaturated fatty acids: Men had higher levels than women across strata for either mono-unsaturated fatty acids or poly-unsaturated fatty acids. Dietary intake level was the highest in the provincial cities and class I townships (men: 33 g, women: 24.3 g), but the lowest in Peng-Hu islands (men: 20.4 g, women: 16.3 g). In terms of polyunsaturated fatty acids, the highest value was found in Peng-Hu (men: 24.1 g, women: 20.2 g). The lowest value was found in the provincial cities and class I township (men: 20.4 g, women: 16.9 g). In general, Peng-Hu islands had the lowest monounsaturated, but highest polyunsaturated fatty acids.

P/M/S ratio: In most strata, amount of monounsaturated fatty acids was higher that of polyunsaturated fatty acids and that of saturated fatty acids. The P/S ratio for men was lower than that for women in all strata. Among strata, Peng-Hu had the highest value (men: P/S = 1.31, women: P/S = 1.39), but metropolitan areas had the lowest value (men: P/S = 0.83, women: P/S = 0.89). Recommended ratio by DOH was P/S = 1 for adults(12). In men, only mountainous area had a P/S ratio (0.94)

close to 1.; the ratio of Peng-Hu (1.31) was over 1; and ratios of other areas were all less than 0.9. In women, the ratios in east coast counties and in provincial cities and class I township was close to 1; Peng-Hu and mountainous area had ratios over 1.1; and all other ratios were around 0.9.

Cholesterol: Men had higher intakes than women in all strata. The intake level of the metropolitan areas was the highest (men: 380 mg, women: 292 mg). DOH suggested that daily consumption should not be over 400 mg for adults (13). The mean values for men and women in all strata were less than 400 mg.

Fiber

Dietary crude fiber level was the lowest in the mountainous area (men: 4.1 mg, women: 4.7 mg).

In summary, comparing to other strata, Hakka stratum had a higher percent protein, but lower vitamin E intake. Mountainous area had lower levels of dietary vitamin B2, calcium, iron, and crude fiber. Peng-Hu islands had lower levels of vitamin B1, fat, saturated fatty acids, monounsaturated fatty acids, and percent fat, but higher levels of niacin, polyunsaturated fatty acids, P/S ratio, percent protein, and percent carbohydrate. Metropolitan areas had higher levels of vitamin B2, niacin, calcium, iron, and cholesterol; but lower P/S ratio. Provincial cities and class I township had lower levels of vitamin A and vitamin E, and polyunsaturated fatty acids. Class II townships had higher levels of monounsaturated fatty acids and percent fat, but lower percent protein than other strata.

Comparing dietary intakes of 1993-1996 with previous two surveys (Table 3 and Figure 5)

Energy and macro-nutrients

Mean energy intake calculated for an artificial man aged 20-34 (2142 Kcal) in this survey was lower than that found in the 1980-1981 survey (2,559 Kcal) and in 1986-1988 survey (2,293 Kcal), indicating a downward trends.

Mean protein intake in this survey was 79 g which was lower than the value of previous surveys (1980-81: 82g , 1986-88: 84 g). Mean dietary fat in this survey (81 g) was lower than the previous values (1980-81: 90 g, 1986-88: 92 g). Mean carbohydrate intake (265 g) was lower than that in 1980-81 (354 g) and in 1986-88 (286 g).

In terms of percent calorie from macro-nutrients, the percentages from protein, fat, and carbohydrate were 15.1%, 34.6%, and 50.3%. Percent from protein increased, percent from carbohydrate decreased, and percent from fat was between the values of two previous surveys.

Table 3 Comparing dietary intakes of 1993-1996 with previous two surveys (men aged 20-34)

Year of survey	Calories	Protein		Fat		Carbohydrate	
	(kcal)	(g)	% of total calories	(g)	% of total calories	(g)	% of total calories
1993-1996 (actual value)*	2369	88.1	15.3%	89.2	34.9%	287	49.8%
1993-1996 (calculated using the previous method)	2142	79.3	15.1%	80.9	34.6%	265	50.3%
1986-1988	2293	83.6	14.5%	92.2	36.0%	286	49.6%
1980-1981	2559	81.6	12.8%	89.9	31.7%	354	55.5%

Year of survey	Thiamin (mg)	Riboflavin (mg)	Ascorbic acid (mg)	Niacin (mg)	Vitamin A (I.U.)	Vitamin E (mg)	Vitamin E/ PUFA ratio
1993-1996 (actual value)*	1.41	1.39	167	17.4	7023	7.68	0.33
1993-1996 (calculated using the previous method)	1.44	1.3	207	15.2	7826	8.6	0.42
1986-1988	1.34	1.12	182	14.4	6517	11.7	0.41
1980-1981	1.37	1.09	145	15.2	6126	11	0.44

Year of survey	Calcium (mg)	Iron (mg)	Sodium (mg)	Saturated fatty acids (g)	Monounsaturated fatty acids (g)	Polyunsaturated fatty acids (g)	P/M/S ratio	Cholesterol (mg)	Crude fiber (g)
1993-1996 (actual value)*	495	15.6	4297	29.2	33.8	23.1	0.79/1.16/1	399	5.23
1993-1996 (calculated using the previous method)	585	16.4	4025	24.6	31.0	20.6	0.84/1.26/1	357	6.09
1986-1988	553	19.4	6400	20.9	33.9	28.2	1.35/1.62/1	347	6.9
1980-1981	532	16.8	6500	23.5	33.3	25.1	1.07/1.42/1	299	6.2

*N = 549

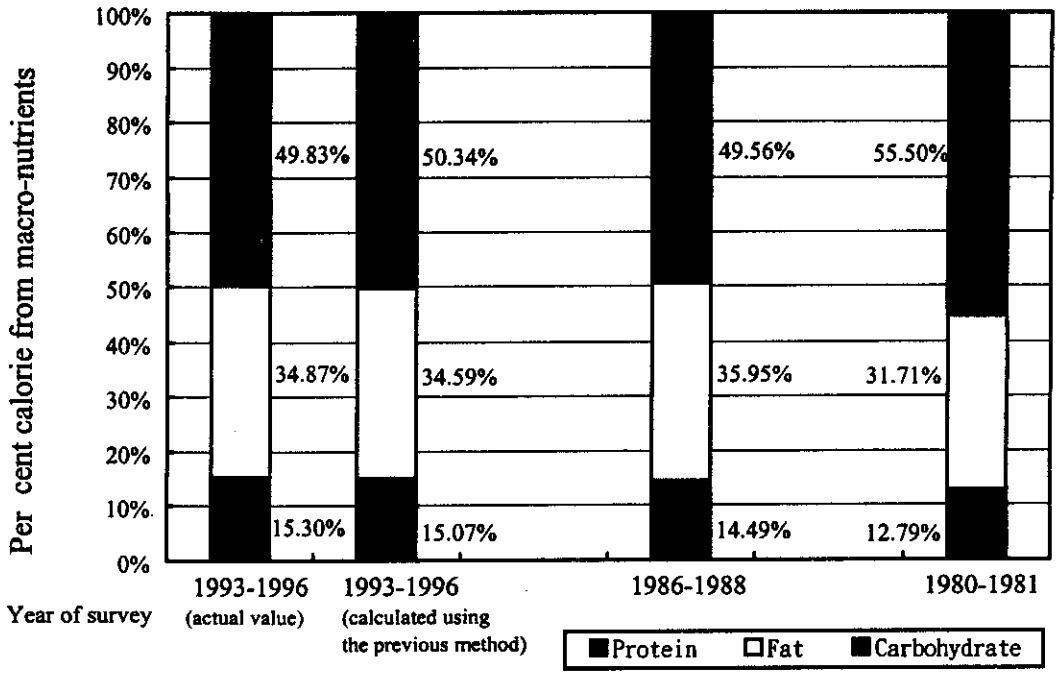

Figure 5 Per cent calorie from macro-nutrients in NAHSIT 1993-1996 and in previous surveys (men aged 20-34)

Vitamins

The dietary levels of vitamin B_1, B_2, and C were 1.44 mg, 1.3 mg, and 207 mg respectively, which were all higher than the previous values. Niacin intake level was 15.2 mg which was close to the 1980-81 value but higher than the 1986-88 value. Average vitamin A intake was 7,826 I.U. which was higher than the 1980-81 value (6,126 I.U.) and the 1986-88 value (6,517 I.U.). Mean vitamin E for this survey (8.6 mg) was much less than the previous values (≒ 11 mg). But the computed vitamin E to PUFA ratio (0.42) was not lower than the second nutrition survey (0.41). It is slighly lower than the first survey (0.44).

Minerals

Calcium intakes showed an increasing trend from 532 g, 553 g, to 585 g. Iron intake in this survey (16.4 mg) was close to the 1980-81 level (16.8 mg), but lower than the 1986-88 value (19.4 mg). Sodium intake showed a decreasing trend from 6,500 mg, 6,400 mg, to 4,025 mg.

Fatty acids and cholesterol

Saturated fatty acids increased from 23.5 g, 21 g, to 24.6 g, but mono-unsaturated fatty acids decreased from 33 g to 31 g and poly-unsaturated fatty acids also decreased from 25 g, 28.2 g, to 20.6 g. P/S ratio dropped from 1.07, 1.35 to 0.84.

Mean cholesterol intake in this survey was 357 mg which was close to the 1986-88 level (347 mg), but higher than the 1980-81 value (299 mg), indicating an increasing trend.

Fiber

The crude fiber intakes in three surveys were similar to each other. It was 6.1 g in this survey, 6.2 g in the 1980-81 survey, and 6.9 g in the 1986-88 survey.

Comparing to the previous surveys, reduced levels were found in this survey for intakes of calorie, protein, fat, carbohydrate, vitamin E, sodium, iron, mono- and poly-unsaturated fatty acids and for P/S ratio. Increased levels were observed for dietary vitamin A, B_1, B_2, and C, calcium, percent calorie from protein, saturated fatty acids, and cholesterol. Phosphorus and crude fiber intakes did not change.

Discussion

The 24-hour recall method used in our national survey was unique in many ways. We inquired not only about the kinds of foods and dishes consumed, but also the recipes and cooking methods for every dish possible in order to obtain information on the kinds and amounts of sauces, condiments, and spices, and cooking oil added during cooking. This is important because there are no standard recipes for many Chinese home-made dishes. A unique set of food models was designed for this national survey, including a dozen food-piece models designed for mixed dishes, and various kinds of abstract models. Validation studies have been carried out on both the food model system and the 24-hour recall using the models (4). The systematic error produced by the models were adjusted for the national survey. The underreporting rate for food items was only 7% according to the validation study (4), which is lower than the figures reported in the literature (15). If adjusting for the underreporting, the nutrient intake levels will switch from slightly less than to slightly higher than those of the second national nutrition survey.

Nutrient data base used in the computation was the newly published data base named "Nutrient Composition Data Bank for Foods of Taiwan Area". Systematic difference between the new and the old data bases should be considered.

Adult men aged 19-64 consumed daily 2,203 kcal, 82.6 g of protein, 79.5 g of fat, and 272 g of carbohydrate. Women of the same age consumed 1,591 kcal, 61.6 g of protein, 61.1 g of fat, and 200 g of carbohydrate. The intakes of energy, fat, and carbohydrate of the current survey were similar to the levels of the previous two surveys in Taiwan. Percent protein showed an increasing trend. Percents of protein

(15.5%) and fat (34%) in calories were higher, but percent of carbohydrate was lower than the DOH recommended values. Percent animal protein increased from 45% in the first nutrition survey, to 50% in the second survey, and remained at 50% in the current survey. The percent of animal fat was 59%, 55%, and 59% respectively in each survey.

Current sodium intake value was lower than those of the previous two surveys. However, it was still higher than the recommended value. The intake values of vitamin A, B_1, B_2, C, calcium, saturated fatty acids, and cholesterol were higher than those of the previous two surveys, indicating a more affluent dietary pattern at present time. However, it is a difficult task to maintain the current high intakes of vitamins and minerals but to reduce the amount of fat, protein, saturated fatty acids, and cholesterol. It is worth noting that P/S ratio, and levels of vitamin E and monounsaturated fatty acids have declined. The fiber intake was low as reflected by crude fiber. This phenomenon may affect the future trend of chronic diseases in Taiwan.

In terms of specific mean values of vitamins and minerals, dietary vitamin E, calcium in men and women, and dietary iron in women were lower than the RDNA, but dietary vitamins A and C were much higher than their RDNA. The RDNA of vitamin E in Taiwan was recommended much higher than that of U.S. due to a higher PUFA consumption. The mean vitamin E/PUFA ratio was adequate for women but low in men. P/S value was lower than 1, the DOH recommended value. Mean dietary cholesterol was not over 400 mg in either men or women.

Nutritional status of various age-sex groups differed slightly from the overall status. Women aged 13-24 and men aged 13-15 had more low vitamin and mineral intakes than other age groups. Intakes of vitamins B_1 and B_2 departed slightly from the ideal level in the younger age groups, particularly in women. Calcium and iron intakes of these age groups were also low. Women's iron intake was not enough, which was reflected in the data on anemia (16). On the other hand, the carbohydrate intake levels of these two younger groups and women aged 55-64 were the highest in all age-sex groups.

Figure 6 shows the age- and sex- specific comparison of caloric intakes between NAHSIT and NHANES III (The third National Health and Nutrition Examination Survey) (15). The caloric intake levels of American men and women were higher than those of Taiwanese men and women, respectively. But the level of Taiwan men was higher than American women.

Each of the seven strata investigated in this survey had its unique dietary pattern. Hakka areas had the highest percentage calorie from protein and lowest vitamin E intake. Mountainous areas had lower intakes of vitamin B_2, calcium, iron, and crude fiber than others. Peng-Hu islands had lower levels of vitamin B_1, fat, percentage calorie from fat, saturated fatty acids, monounsaturated fatty acids; but higher levels of niacin, polyunsaturated fatty acids, P/S ratio, and percentage calories from protein and carbohydrate. Metropolitan areas had higher intakes of vitamin B_2, niacin, calcium, iron, cholesterol, but lower P/S ratio than others. Provincial cities and class I

townships had lower intakes of vitamin A, E, and polyunsaturated fatty acids. Class II townships had lower percentage calories from protein, but higher levels of monounsaturated fatty acids and percentage calorie from fat. Since Chinese herbs and nutrient supplements were not included in this calculation, the data may not completely represent nutritional status.

The significance of using 24-hour recall in NAHSIT is several fold. It is the first time in national nutrition surveys carried out in Taiwan, age and sex-specific values were obtained for dietary nutrients. In addition, the food models, protocol, training manual, and computer-aided recording and calculation system have been established and documented for the modern Chinese diet. This tested method can facilitate application in the field of nutrition and public health.

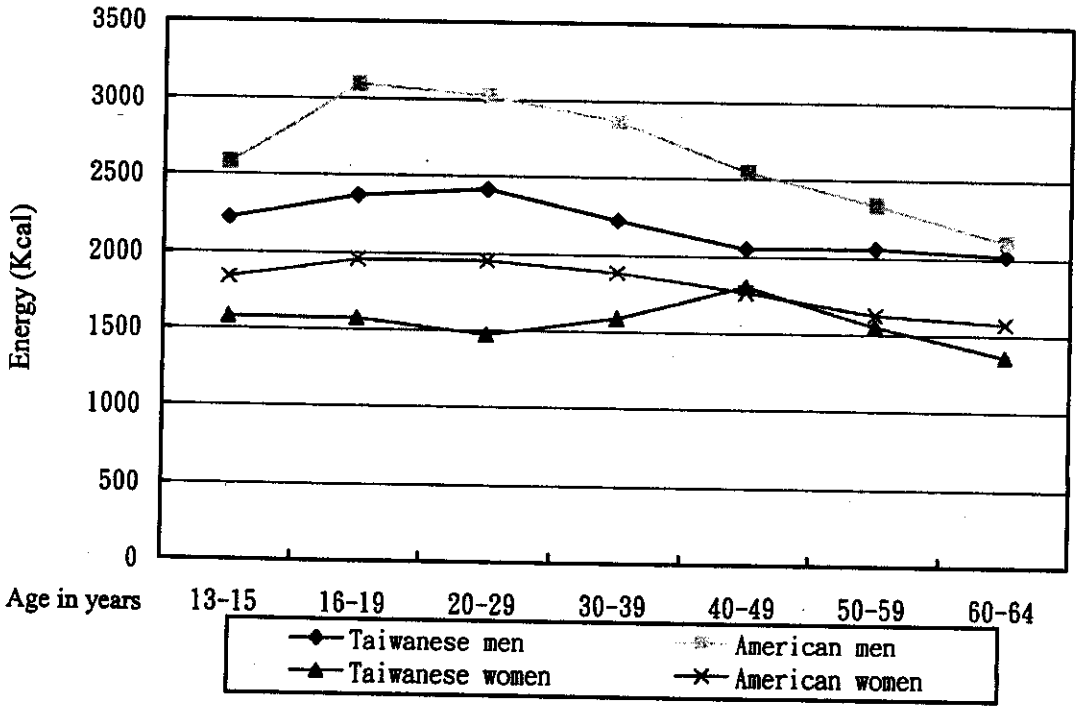

Figure 6 Age- and sex- specific calorie intakes in NAHSIT and in NHANES III

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