A dietary survey of the Chinese population in urban and rural areas of Tianjin

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Objectives: A survey was carried out to assess the food pattern and of nutrient intakes of 15-64 year old Chinese in Tianjin.
Design: The survey was randomised and the diet assessed by weighing household food items and by individual food records over 3 consecutive days.
Setting: The survey was carried out in Tianjin; the third largest city in China (population about 8 million).
Subjects: A random stratified multi-level cluster sampling technique was used. Of the 5233 eligible subjects, 207 dropped out, and the response rate was 96%.
Results: Distinct differences in dietary patterns and nutrient intakes were found between subjects living in urban and rural areas. The diet of urban people was richer in fat and high quality protein compared with that of rural people. Energy intake from fat was about 31% in the urban diet and about 21% in the rural diet. Low intakes of vitamin A, riboflavin, calcium and zinc were found in both areas, with the situation being worse in the rural areas. Sodium intake was found to be high in both areas. Cholesterol intake was much higher among urban people.
Conclusion: The present survey revealed that the intake of some nutrients was lower than recommended and that total sodium intake was very high in Tianjin. An integrated nutrition intervention program would appear necessary for such a population.

Key words: Dietary survey, food and nutrient intakes, Tianjin, China, rural, urban

Introduction

The availability of various foods has increased with rapid economic development in China in recent years. However, the incidences of cardiovascular disease, cerebrovascular disease and certain cancers have also risen significantly[1,2]. In Tianjin, the third largest city in China, non-communicable diseases have been identified as a major health problem since the 1980s. In 1985, essential hypertension was diagnosed in 11% of Tianjin's urban residents aged 15 or above. Mortality from cerebro-vascular, cardiovascular diseases and cancer combined accounted for 73% of total deaths in Tianjin in 1989[3].

The first national community-based intervention project aimed at reducing the risk factors for non-communicable diseases was started in Tianjin in 1984. The prevention and control of hypertension was the first priority of this project. Because diet has been identified as an important factor relating to the changes seen in disease patterns[4,5], research which focuses on diets in Tianjin's population has been given emphasis.

Based on a nationwide nutrition survey in China in 1982 and some subsequent smaller local nutrition surveys it can be said that diets have improved with increasing living standards in China[6-8]. Because most of the previous nutrition surveys in China have been carried out on a household basis, information about the food consumption and nutrient intakes of individuals is, however, lacking. In this report, we present individual food and nutrient intakes from a dietary survey carried out in Tianjin in 1992.

Subjects and methods

The dietary survey was carried out in the autumn of 1992. It covered the whole population of Tianjin. A sample representative of the Tianjin civilian (non-institutionalised) population was obtained through a random stratified multi-level cluster sampling[9]. Urban and rural areas were sampled separately using the same procedure. First, 8 districts (urban) and 6 counties (rural) were selected randomly. Then, 17 urban streets and 10 rural communities were selected from each district and county sampled. From these samples, 2 resident sections in each street and 2 villages in each community were chosen for the survey. The total number of households was selected from the household register was 1510. Every resident in a sampled household became a subject in the survey. Of the 1510 households selected, 181 (12%) refused to take part in the survey. These households were replaced with other randomly selected households using the same sampling method. Of the 5233 eligible persons, 207 subjects only, were unable to participate in the survey because they were not available during the survey period. The response rate of the individual persons was 96%. Altogether 3682 (73%) of 5026 persons in the households were between 15 to 64 years of age, and are the focus of these analyses (1804 men and 1878 women). Basic characteristics of these subjects are presented in Table 1.

The methods used for assessing the diet were food weighing plus three-day food records. The collection of data was carried out by trained health care workers. Standardised scales which weighed up to 5 kg (±0.01 kg) were used for most foods. Weighing scales, which measured up to 0.5 kg (± 0.001 kg) were used for weighing salt, monosodium glutamate, and sodium carbonate. The survey started after supper on the first day by measuring and recording all foods in each household including raw materials, processed foods and home prepared foods of the survey. Then for three consecutive days food records were collected on individual food intake data. The health workers visited each household after supper on the second day of the survey. They recorded new foods bought during the day and the number of household members and visitors present at each meal. On a 24-hour recall basis, individual food intake was estimated using the bowls and plates in the household and food consumed away from home was collected by individuals. Food waste was estimated when weighing was not

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possible. The same visit was repeated for 3 days. All household foods were again weighed and recorded on the forth day of the survey after the three day food records had been collected.

Table 1. Mean of age, weight, height (± standard deviations) and other baseline characteristics of the subjects.

Items	Men (1804)	Women (1878)
Age (years)	38.4±14.0	38.8±13.6
Weight (kg)	67.0±11.8	58.7±10.6
Height (m)	1.70±0.06	1.59±0.06
BMI (kg/m^2)	23.1±3.7	23.3±4.1
Occupation		
Blue-collar workers	570	388
White-collar workers	464	349
Retired and housewives	161	622
Farmers	368	246
Students	128	114
Service workers	79	122
Unemployed	21	28
Education		
0-6 years	551	775
7-12 years	1061	991
l3 or above	180	97
Area		
Urban area	1133	1184
Rural area	671	694

Table 2. Age-adjusted mean daily intakes of foods in grams (± standard deviations) among the 15-64 year old population in Tianjin by sex and area.

	Men			Women		
	Urban (n=1133)	Rural (n=671)	SOD	Urban (N=1184)	Rural (694)	SOD
Cereal Products	429±122	543±163	***	332±92	440±131	***
Wheat products	261±130	385±166	***	190±97	299±128	***
Rice	159±101	118±102	***	132±76	105±86	***
Corn flour	9±26	40±63	***	10±25	36±57	***
Legumes	11±21	6±24	***	9±18	4±14	***
Vegetables	360±190	322±196	***	330±167	280±162	***
Potatoes and roots	34±53	75±120	***	38±61	63±97	***
Fruits	78±136	23±66	***	90±152	29±98	***
Meat products	118±90	42±71	***	91±67	28±48	***
Pork	79±66	32±48	***	62±50	23±35	***
Beef	24±56	4±28	***	18±40	2±13	***
Chicken	11±34	4±26	***	8±26	2±16	***
Organs	4±17	2±16	*	3±16	1±11	**
Milk	39±89	6±43	***	43±91	5±32	***
Eggs	54±46	22±39	***	51±42	19±36	***
Fish	58±72	40±74	***	57±67	36±68	***
Oil	35±27	32±28	*	30±25	27±22	ns
Nuts	6±22	4±18	*	4±18	3±20	ns
Sugar	3±8	1±3	***	3±8	1±5	***
Alcoholic drinks, ml	7±23	8±31	ns	-	-	

Analyses of covariance, * p< 0.05, ** p< 0.01, *** p< 0.001
SOD: Significance of difference

The data were checked and coded by trained quality control groups and keyed into computers located in the surveyed districts and counties. The completed data were sent to the Tianjin Food Safety Control and Inspection Institute, for rechecking. Food consumption data were analysed using the 1991 Food Composition Tables and SPSS computer program in Kuopio University, Finland (Preventive Medicine Academy of China). All the mean values for men and women in urban and rural areas have been adjusted for age. Tests of significance were conducted using analyses of covariance.

Results

In both sexes, there were distinct differences in the mean consumption of most foodstuffs between urban and rural areas for both sexes (Table 2). The consumption of cereal and root products was higher among rural people and the intake of animal foods, vegetables, and fruits was higher among urban people. Pork was the major source of meat products in both areas. Very low intakes of sugar and alcoholic drinks were seen in both areas. Even though there were differences in the consumption of milk and bean products, the consumption level was low in both areas.

The differences in food consumption patterns between both areas have brought about differences in the intakes of most nutrients (Table 3). The nutrients listed in Table 3 refer to ones where there are recommended dietary allowances in China. In addition, intakes of sodium, potassium, magnesium and cholesterol are presented. No significant differences were found in intakes of energy, vitamin C or iron between the two areas. Low intakes of vitamin A, calcium, riboflavin and zinc were found in both areas, with rural people having lower intakes than urban people. A high intake of sodium was found in both areas. The intake of sodium (expressed as NaCl) was 14-16 g in the urban areas and 15-17 g in the rural areas. The intake of potassium was low, especially for women. A high sodium to potassium ratio was observed in both areas ranging from 3.1-3.6. The intake of cholesterol was much higher from the urban diet than the rural diet (454 mg per day for urban men and only 182mg for rural men) and the figures were similar for women.

Table 3. Age-adjusted mean daily intakes of energy and some nutrients among 15-64 year old population in Tianjin by sex and area (± standard deviations)

	Men			Women		
	Urban (n=1133)	Rural (n=671)	SOD	Urban (n=1184)	Rural (694)	SOD
Energy (Kcal)	2679±712	2649±711	ns	2143±536	2124±568	ns
Protein (g)	87±26	79±22	***	71±21	63±18	***
Fat (g)	92±41	62±39	***	76±32	49±31	***
Carbohydrate (g)	369±97	437±125	***	294±75	356±101	***
Vit A (ret eq, μg)	674±978	372±958	***	593±768	290±540	***
Thiamin (mg)	1.1±0.4	1.5±0.5	***	0.9±0.3	1.2±0.4	***
Riboflavin (mg)	1.0±0.5	0.8±0.3	***	0.9±0.4	07±03	***
Niacin (mg)	18±7	17±6	***	15±6	13±5	***
Vit C (mg)	95±84	100±78	ns	92±76	87±62	ns
Iron (mg)	28±22	26±10	ns	23±19	21±8	ns
Sodium (mg)	6523± 2522	6926± 2503	***	5710± 2222	6090± 2256	***
Potassium (mg)	2110±739	2028±823	*	1806±636	1646±636	***
Sodium/ potassium ratio	3.1±1.1	3.4±1.2	*	3.2±1.4	3.6±1.4	**
Calcium (mg)	498±288	400±273	***	427±237	320±203	***
Magnesium (mg)	360±131	411±137	***	301±105	334±108	***
Phosphorus (mg)	1203±357	1280±362	***	989±299	1033±288	***
Zinc (mg)	14±5	13±4	***	11±4	10±3	***
Selenium (μg)	73±30	49±22	***	60±24	39±17	***
Cholesterol (mg)	454±311	182±239	***	402±260	152±214	***

Analyses of covariance, * p< 0.05, ** p< 0.01, *** p< 0.001.
"ret eq" refers to retinol equivalents

The urban/rural differences in food patterns were also seen in the percentage distributions of energy intake from fat, protein and carbohydrate (Table 4). The percentage of total energy from fat was about 21% in the rural diet and about 31% in the urban diet.

The role of different food groups as sources of energy and energy-providing nutrients is presented in Table 5. Plant foods provided 66% of fat intake in the urban diet, and 63% in the rural diet. The major sources of cholesterol were eggs, and meat in both areas. Animal fat used in cooking was another source of cholesterol but only in rural areas (14%)

Table 4. Age-adjusted percentage distribution of energy intake from protein, fat and carbohydrate (± standard deviations)

E %	Men			Women		
	Urban (n=1133)	Rural (n=671)	SOD	Urban (N=1184)	Rural (694)	SOD
Protein	13.2±2.6	12.2±2.3	***	13.3±2.6	12.0±2.0	***
Fat	30.8±8.8	20.8±10.1	***	31.6±8.2	20.6±10.4	***
Carb	56.0±8.5	67.0±9.9	***	55.1±8.0	67.4±10.0	***

Analyses of covariance, *** $p < 0.001$.

Discussion

The present survey indicates differences in dietary patterns and nutrient intakes between individuals living in the urban and rural areas of Tianjin. The diet of urban people was richer in fat and high quality protein compared with that of rural people. The percentage of total energy from fat was 31% in men and 32% in women in the urban areas and 21% in the rural areas. It has been suggested by WHO that the percentage of total energy from fat should be 15-30%[10], and the Chinese recommendation is 20-25%[11]. The 1992 Tianjin results show similar urban-rural differences to previous dietary surveys nationwide in 1982, and to Tianjin in 1986. This implies that an improvement in living standards increased the intake of protein and fatty foods. Similar dietary and related lifestyle changes elsewhere have been argued to increase the prevalence of chronic disease[12].

Animal foods and bean products contributed 41% of protein in the urban diet and only 17% in the rural diet. An increase in the intake of bean products should improve protein quality in the rural diet and reduce the animal fat intake in the urban diet.

Some studies have suggested that some components of dairy products, probably calcium, exert a protective effect against hypertension[13-15]. The Chinese RDA for calcium intake is 800 mg The Tianjin study revealed that the intake of calcium was 62% of the RDA for men and 53% of the RDA for women in urban areas. In the rural areas, the intake of calcium was 50% of the RDA for men and only 40% of the RDA for women. Vitamin A intake was also found to be lower than the Chinese RDA (800μg) in both areas. The intake of vitamin A was 84% of the RDA for men and 74% of the RDA for women in the urban people. In the rural areas, the intake of vitamin A was 46% of the RDA for men and 36% of the RDA for women. The results suggest that advice to increase the consumption of foods rich in calcium and vitamin A, such as milk products and some vegetables would be of value. The development of fortified foods could also contribute to the dietary intake of calcium and vitamin A.

Relationships of dietary sodium and potassium to blood pressure have been reported in many studies. Several studies have shown a negative correlation between potassium and blood pressure and a positive correlation between sodium and blood pressure[16-18]. High sodium intakes were found in this survey compared to those generally reported by others[19-21]. In the INTERSALT study, 246mmol/24 h sodium excretion (equivalent to 14.2 g NaCl) was found in Tianjin subjects aged 20-59, the highest figure recorded in the whole study[22,23]. The results of the two studies are very similar since urinary sodium excretion is about 90-95% of intake[24]. The dietary sodium to potassium ratio in the population was much higher than the recommended level[25]. It was also reported in the INTERSALT study that the Tianjin had the highest sodium to potassium ratio (7.6) of all INTERSALT centres[23]. More studies are needed in relation to sources of dietary sodium and the effect of the sodium and potassium intake profile on blood pressure level inTianjin.

The association between dietary magnesium with blood pressure has been studied in recent years[26,27]. The intake of magnesium in a Chinese population is reported in this survey for the first time. Higher intakes of magnesium were found in rural people than urban in both sexes. Urban women had the lowest intake of magnesium which was 10% below the RDA[25].

WHO has recommended an intake level not greater than 300 mg cholesterol per day based on evidence that serum cholesterol levels may respond to dietary cholesterol especially with excessive saturated fat[10]. The intake of cholesterol was more than 400 mg per day in the urban residents. The most important source of cholesterol intake was eggs. More information on the intakes of cholesterol and associated fat in relation to health outcomes is needed for nutrition intervention programs.

The 1992 Tianjin dietary survey indicates that nutrition intervention programs are warranted so that people may modify their dietary patterns to prevent nutrient deficiencies and to reduce dietary risk factors related to chronic diseases. A change in the food behaviour of a population calls for related changes in the food environment. Support through food and nutrition planning, food policy and marketing approaches is required. Change also needs to involve agriculture, the food industry, the public health sector and other related sectors. An integrated approach will encourage more effective nutrition intervention.

Although further studies are necessary to clarify the role of dietary sodium, potassium, calcium and magnesium in the aetiology of hypertension among Chinese, the present Tianjin study suggests that there are possible public health benefits from increasing the intakes of calcium, vitamin A and potassium and decreasing the intake of sodium in the population. Reference to the concomitant food intake patterns and factors contributing to them and attention to these, is likely to be a preferred approach to addressing these putative nutrient-health issues.

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Table 5. Percentage supply of energy and energy-providing nutrients by different food groups and area

	Urban area					Rural area				
	Energy %	Protein %	Fat %	Carb %	Chol %	Energy %	Protein %	Fat %	Carb %	Chol %
Cereal Products	59	48	21	87	0	75	72	26	92	0
Legumes	2	5	2	1	0	1	3	1	0	0
Vegetables and roots	5	8	1	6	0	5	8	2	6	0
Fruits	1	0	0	2	0	0	0	0	1	0
Animal fat used in cooking	0	0	0	0	0	3	0	13	0	14
Plant oil	13	0	39	0	0	8	0	40	0	0
Meat	12	19	28	1	28	4	6	13	0	24
Fish	2	8	1	0	13	1	5	2	0	22
Milk and eggs	4	9	8	1	59	1	3	3	0	40
Beverages and sugar	1	0	0	1	0	1	0	0	0	0
Condiments	1	3	0	1	0	1	3	0	1	0

Carb: Carbohydrate; Chol: Cholesterol

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天津城、鄉居民膳食調查

目的: 研究目的在于評估15-64歲的天津華人食物模式及營養素攝入量.

研究設計: 本研究爲隨機抽樣，采用稱重法評估家庭食物消耗量，三日登記法記錄個人食物消耗量.

地點: 本研究在中國第三大城市天津（總人口約八百萬）進行.

調查對象: 采用分層整群抽樣法，共抽樣5233人，207人失訪，應答率爲96%.

結果: 調查表明，居住在城區與鄉村的調查對象的膳食模式和營養素攝入量有明顯的不同. 城區居民膳食中的脂肪及優質蛋白質攝入量高于鄉村. 城區居民脂肪熱量占總熱量的31%，鄉村爲21%. 城、鄉居民的維生素A、維生素B 2、鈣和鋅的攝入量都較低，鄉村更爲嚴重. 鈉的攝入量在城、鄉均較高. 城區居民的膽固醇攝入量高于鄉村居民.

結論: 本研究顯示，天津居民有些營養素的攝入量低于推薦量，而鈉的攝入量則非常高. 對這一人群進行綜合的營養干預是非常必要的.

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