Food intake patterns in urban Beijing Chinese

Ping Fu,[1] Hua Zhang,[2] Susan M Siew,[2] Shu-qin Wang,[1] Anna Xue,[1]
Bridget H-H Hsu-Hage,[2] Mark L Wahlqvist,[2] Yu-feng Wang[3] and Xue-xia Li[3]

[1]*Institute of Nutrition and Food Hygiene, Chinese Academy of Preventive Medicine, Beijing, China*
[2]*Department of Medicine, Monash University, Melbourne, Victoria, Australia*
[3]*Epidemiology Station of Chongwen District, Beijing, China*

This study investigated the food consumption patterns of 430 Beijing Chinese adults and assessed the impact on these patterns of the following socio-demographic characteristics: gender, age, educational achievement, and gross household income. Food intake by category, food variety and meal patterns were assessed using a 156-item food frequency questionnaire. It was found that gender and age were the most important factors to influence food consumption patterns. Men consumed more wheat products, red meat and tea, whereas women consumed more vegetables, fruit, nuts, fish, eggs and milk. Women also tended to consume a wider variety of food than did men. Furthermore, it was found that younger and more educated people tended to consume a wider variety of food. Age also had an important influence on the food intake. Younger and generally more educated adults tended to consume foods associated with affluence: meats, soft drinks and beer, while the older population tended to consume more vegetables (women only), milk and tea in their diets. Because education is closely correlated with age in this Beijing Chinese population, it appeared to have little effect on the food intake patterns, after adjusting for age. The older members of this population, who probably have a decreased functional reserve of nutrients, and the less educated, appeared not to be taking advantage of the availability of a wide variety of food, further increasing the risk of nutrient deficiency. On the other hand, the younger and more educated, who tended to consume a wide variety of foods, were more likely to maintain adequate nutritional standards. However, their tendency to consume food associated with affluence, such as meat and beer, may point toward an increased risk of those diseases prevalent in affluent societies, such as obesity, diabetes, cardiovascular disease, certain cancers and osteoporosis. Ongoing nutrition surveillance and appropriate nutrition education will be required increasingly for Beijing Chinese and similar communities.

Key words: Chinese, China, Beijing, food intake, meal pattern, breakfast, food variety, age, elderly, gender, education, affluence.

Introduction
The diets of contemporary Beijing Chinese are becoming more complex compared with those of a decade ago. Changes in food intake are likely to operate differentially. Food habits are determined not only by personal behavioural expression, but are also influenced by cultural, religious and economic factors. Cardiovascular disease risk and diabetes among Beijing Chinese are increasing,[1] which is likely to be multifactorial, but related to economic development and cultural change. In Shanghai, a city undergoing similar changes to Beijing, estimates of how changes in food intake indices are affecting mortality are emerging.[2] This paper reports the food consumption patterns of adult urban Chinese in Beijing, using an adapted food frequency questionnaire. This method has been used rarely in the past, especially in this population, but is now being used more widely in large-scale epidemiological studies.[3] It is important in assessing long-term food consumption patterns, which is necessary in order to study the effects of changing food intake patterns on the chronic health of Beijing Chinese.

Methods
Study design and subjects
This was a collaborative study between Monash University, Department of Medicine, Australia and the Institute of Nutrition and Food Hygiene of China in Beijing. This cross-sectional study recruited 430 Chinese adults (196 men and 234 women) living in Beijing. Subjects were selected randomly from occupational units within the Chun-wen district of Beijing. Subjects were eligible for inclusion in this study only if they had been residents of the Chun-wen district for at least 5 years. Subjects were aged 25 years or older and were deemed to be healthy.

Food intake assessment
In 1995, subjects participated in an assessment of food habits and cardiovascular risk. A standard protocol was used so that comparable data could be obtained. Their dietary intake was estimated, using a 156-item Chinese food frequency questionnaire. This questionnaire was adapted from a semi-quantitative questionnaire developed by Hsu-Hage and co-workers.[4] The period probed by the questionnaire is 1 year. Modifications of this questionnaire were made so as to adapt it to eating practices pertaining to the Beijing food culture. All reference portions were determined using local household measurements such as a Chinese rice bowl, a glass or a tea cup as well as other traditional cooking utensils and natural units (e.g. an apple). Food items were classified into

Correspondence address: Dr Bridget H-H Hsu-Hage, Department of Medicine, Monash University, 246 Clayton Road, Block E, Level 5, Clayton, Victoria 3168, Australia.
Tel: 61 3 9550 5522; Fax: 61 3 9550 5524
E-mail: bridget.hsu-hage@med.monash.edu.au

eight major categories: cereals, meats, milk, vegetables, fruit, eggs, beverages, and others. Within each food group, subgroups were determined, based upon traditional Chinese food culture or foods of similar types. Subjects were asked to recall the frequency of consumption of the 156 items, in terms of the number of times they ate the food per day, per week or per month. The food frequency intakes for the various foods were obtained over a period of 12 months and these were converted into 'daily intake values', based on the Chinese food composition table.[5]

The daily intakes were expressed in grams of food per megajoule of total energy ingested per day and reported as mean ± standard deviation. Major food intakes were also ranked according to their mean values. Pearson's correlation coefficient was used to examine the relationship of food intakes to age, household income, and education level. Student's *t*-tests were performed to assess the differences in food intakes between subjects who ate breakfast and those who did not. Differences in food variety were assessed using the food product score[6] and food variety was correlated with age and education level. All differences were found to be significant at the 5% level.

Results

Socio-demographic characteristics

The socio-demographic characteristics of this study population are shown in Table 1. The mean age was 45.6 ± 13.1 years for men and 45.0 ± 12.9 years for women. The majority of subjects belonged to a household that earned a middle level gross household income of between 10 001 and 20 000 yuan RMB per annum. There were also some differences between genders in terms of occupational status and educational level. Notably, the proportion of women holding professional jobs (38%) was higher than that of men (30%). The proportion of men working in factories (51%) far exceeded any other occupational groups. Furthermore, 51% of males had completed 7–9 years of education, compared with 36% of women who had attained a similar level, while 40% of females had attained 10–12 years of education, compared with 33% of men who had reached a similar level.

Adjusted daily intakes of selected major food groups

Table 2 shows the ranked mean daily food intakes per megajoule of total energy intake by gender. After adjusting for age, it was shown that men had a higher consumption of wheat, red meat, beer and tea, whereas women had a higher consumption of leafy-green vegetables, cruciferous and other vegetables, fruit, nuts, fish, eggs and milk.

Relationships between daily food intakes and sociodemographic factors

Correlations between daily food intakes and socio-demographic factors by gender are shown in Table 3.

Age

Age appeared to have a relatively large effect on the patterns of daily food intakes within this study population. Among Beijing's male population, age was negatively correlated at a significant level with intakes of wheat, meats, beer and soft drinks, and positively correlated at a significant level with cereals other than wheat or rice, milk and tea. In women, age was negatively correlated with intakes of seafood other than fish and soft drinks, and positively correlated with intakes of

Table 1. Demographics of the study population (%)

	Male (n = 196)	Female (n = 234)
Age in years		
25–34	20.3	22.5
35–44	34.5	33.1
45–54	20.8	20.8
55–64	12.7	13.6
65 and over	11.7	10.2
Marital status		
Married now	93.3	96.6
Other	6.7	3.4
Occupational status		
Professional and administrative	29.9	38.3
Factory worker	50.8	33.0
Trades and services	8.6	9.7
Retired and domestic duty	10.7	19.1
Education in years		
0–6	14.8	21.0
7–9	51.0	36.3
10–12	32.7	39.7
13 and over	1.5	3.0
Annual gross household income (RMB in yuan)		
5000 to 10 000	0.5	0.4
10 001 to 20 000	99.0	98.7
20 001 and over	0.5	0.9

Table 2. Age-adjusted average food intake per day in grams, per megajaoule of energy ingested, by gender

	Men (n = 196)		Women (n = 234)	
	Mean ± SD	Rank	Mean ± SD	Rank
Cereals				
Rice	46.2 ± 27.4	1	46.1 ± 21.7	1
Wheat**	41.7 ± 16.3	2	29.2 ± 12.7	2
Other	1.4 ± 1.9	18	1.7 ± 2.0	17
Vegetables				
Tuber	2.7 ± 3.0	13	2.9 ± 2.8	12
Legumes and products	7.4 ± 5.9	8	7.9 ± 12.7	7
Cruciferous and other vegetables	25.5 ± 12.1	4	28.3 ± 12.5	3
Leafy-green*	6.2 ± 4.2	9	7.5 ± 5.3	8
Dry vegetables	1.1 ± 1.3	19	1.1 ± 1.2	19
Fruits**	14.2 ± 9.3	5	23.8 ± 23.1	4
Nuts**	1.7 ± 2.9	16	2.9 ± 3.1	13
Meats				
Pork	8.8 ± 4.5	7	9.4 ± 5.0	6
Red meats*	2.7 ± 2.5	12	2.0 ± 2.2	16
Poultry	1.4 ± 1.7	17	1.3 ± 1.4	18
Fish*	2.3 ± 1.9	15	2.8 ± 2.0	14
Other seafood	0.7 ± 0.7	20	0.9 ± 0.7	20
Eggs**	4.6 ± 3.9	10	6.0 ± 4.6	9
Milk**	2.6 ± 4.4	14	5.5 ± 7.1	10
Beverages				
Soft drinks	3.7 ± 6.4	11	4.5 ± 8.4	11
Tea**	34.4 ± 38.6	3	16.0 ± 19.3	5
Beer**	12.8 ± 21.3	6	2.4 ± 6.6	15
Sweets	0.1 ± 0.5	21	0.1 ± 0.3	21

*P < 0.01; **P < 0.001.

Table 3. Pearson's correlation coefficient between daily food intake and socio-demographic factors: age, education level and income (*r* values)

| | Men (*n* = 196) | | | Women (*n* = 234) | | |
	Age	Education level#	Income#	Age	Education level#	Income#
Cereals						
Rice	–0.03	0.06	–0.05	–0.04	0.07	–0.006
Wheat	–0.18**	0.005	–0.04	–0.05	–0.04	0.03
Other	0.29***	–0.17	0.04	0.20*	–0.14*	0.22*
Vegetables						
Tuber	–0.05	–0.04	0.04	–0.10	–0.25***	–0.05
Legumes and products	0.14*	0.15*	–0.02	0.18*	–0.09	–0.02
Cruciferous and other vegetables	0.11	–0.02	0.04	0.16*	–0.05	0.03
Leafy-green	0.12	–0.007	0.01	0.21*	–0.19	0.04
Dry vegetables	–0.08	0.03	0.11	0.02	–0.03	–0.004
Fruits	0.06	0.12	–0.06	0.09	0.07	0.05
Nuts	0.03	–0.04	–0.06	–0.10	–0.04	0.04
Meats						
Pork	–0.16*	–0.05	0.10	–0.05	–0.05	–0.05
Red meats	–0.24**	0.20*	0.16*	–0.04	–0.09	0.10
Poultry	–0.21*	–0.009	–0.05	–0.10	0.12	–0.07
Fish	–0.12	–0.10	0.08	0.007	0.06	–0.06
Other seafood	–0.12	–0.004	–0.004	–0.16*	–0.14*	0.01
Eggs	0.10	–0.06	–0.05	0.03	0.03	0.08
Milk	0.38*	–0.15*	–0.03	0.19*	0.16*	–0.03
Beverages						
Soft drinks	–0.15*	–0.006	–0.02	–0.18*	–0.43**	–0.009
Tea	0.38*	–0.06	–0.01	0.59*	–0.16*	–0.06
Beer	–0.23*	–0.03	0.02	0.02	0.03	0.05
Wine	–0.05	0.008	–0.007	–0.0	0.09	0.39**
Sweets	0.06	0.10	–0.01	–0.10	–0.07	–0.01
Other	0.18*	–0.15*	–0.005	0.15*	0.03	0.07

\#, adjusted for age; * $P < 0.05$; $P < 0.01$; *** $P < 0.001$.

cereals other than wheat or rice, vegetables other than tuberous vegetables, milk and tea. The effects of age on food intake patterns of men and women were generally comparable. The consumption of rice by both genders appeared to be unaffected by age.

Education
After adjusting for age, eduation had a minimal effect on food intake patterns in both men and women. In men, it was negatively correlated with wheat intake. Similarly in women, education was negatively correlated with intakes of cereals other than wheat or rice and tea.

Income
After accounting for the confounding influence age had on it, income also appeared to have only a marginal effect on the food intake of Beijing Chinese. Among men, it was positively correlated with intakes of red meats after adjusting for age. In women, income was positively correlated with cereals other than wheat or rice, and for wine in particular.

Food variety
Table 4 shows the food score distribution of different ages and education levels by gender. Men consumed a mean of 63% of the 156 items investigated, whereas women consumed a significantly higher mean of 67% of these items in the 12-month study period. Age and education level of the Beijing Chinese population had some effect on the diversity of foods consumed. In both men and women, age appears to

have had a negative association with food variety score. The difference between both genders appears to be most profound at a younger age, whereas the food variety score of older women tended to approach that of their male counterparts. However, even after adjusting for age, women on average still consumed a wider variety of food than men. Education level attainment also had some effect on the food variety consumed. More educated males and females tended to consume a wider variety of food than less educated males and females.

Table 4. Food variety score as a percentage of items consumed from 156-food items in food frequency questionnaire

| | Men (*n* = 196) | | Women (*n* = 234) | |
	Mean (%)	SD (%)	Mean (%)	SD (%)
Mean food score	63		67*	
Age group				
<35 years	65.4	17.9	71.7	12.8
35–44 years	64.0	20.6	70.5	12.1
45–54 years	64.0	16.6	66.3	15.9
55–64 years	61.5	15.6	63.8	14.5
>65 years	54.0	14.8	54.6	13.0
F test	$P > 0.05$		$P < 0.001$	
Education level				
0–6 years	53.6	15.3	58.6	14.5
7–9 years	60.4	18.8	69.4	12.6
10–12 years	70.4	15.5	69.4	14.1
>13 years	78.2	12.9	76.6	16.1
F test	$P < 0.001$		$P < 0.001$	

*Student's *t*-test, $P < 0.001$.

Meal intake patterns

Both men and women ate a mean of 3.1 meals per day. A total of 82% of subjects ate three or more meals per day, while 5.2% ate two meals per day. A total of 6.6% of men and 2.4% of women often skipped breakfast. There were slightly differing food intake patterns between subjects who ate breakfast and those who did not. Notably, men who ate breakfast regularly also consumed more legumes and leafy-green vegetables than those who did not, whereas the consumption of red meat, milk and eggs was higher in women who ate breakfast regularly compared with those who skipped this meal. The food intake patterns of these two groups are shown in Fig. 1. The Beijing breakfast most often consumed comprised *mantou* (wheat-flour bun), *you tiao* (deep fried bread) and rice porridge. Breakfast cereals were not consumed.

Discussion

In recent times, largely as a result of rapid economic growth and consequent changes in the demographic profile of the population, the people of Beijing have undergone substantial changes in their diet.[7,1] Rice, having become increasingly available and affordable, has gradually taken over from wheat as the staple food. There has also been an increase in the consumption of meat or animal-derived foods and other foods associated with affluent Western cultures. These changes may have certain health implications, given the complex effects of food on human health and well-being. For example, the increased consumption of animal-derived foods and the associated increased saturated fat intake may increase cardiovascular risk prevalence. As well as changes in the diet of the whole population, variations in dietary intake patterns
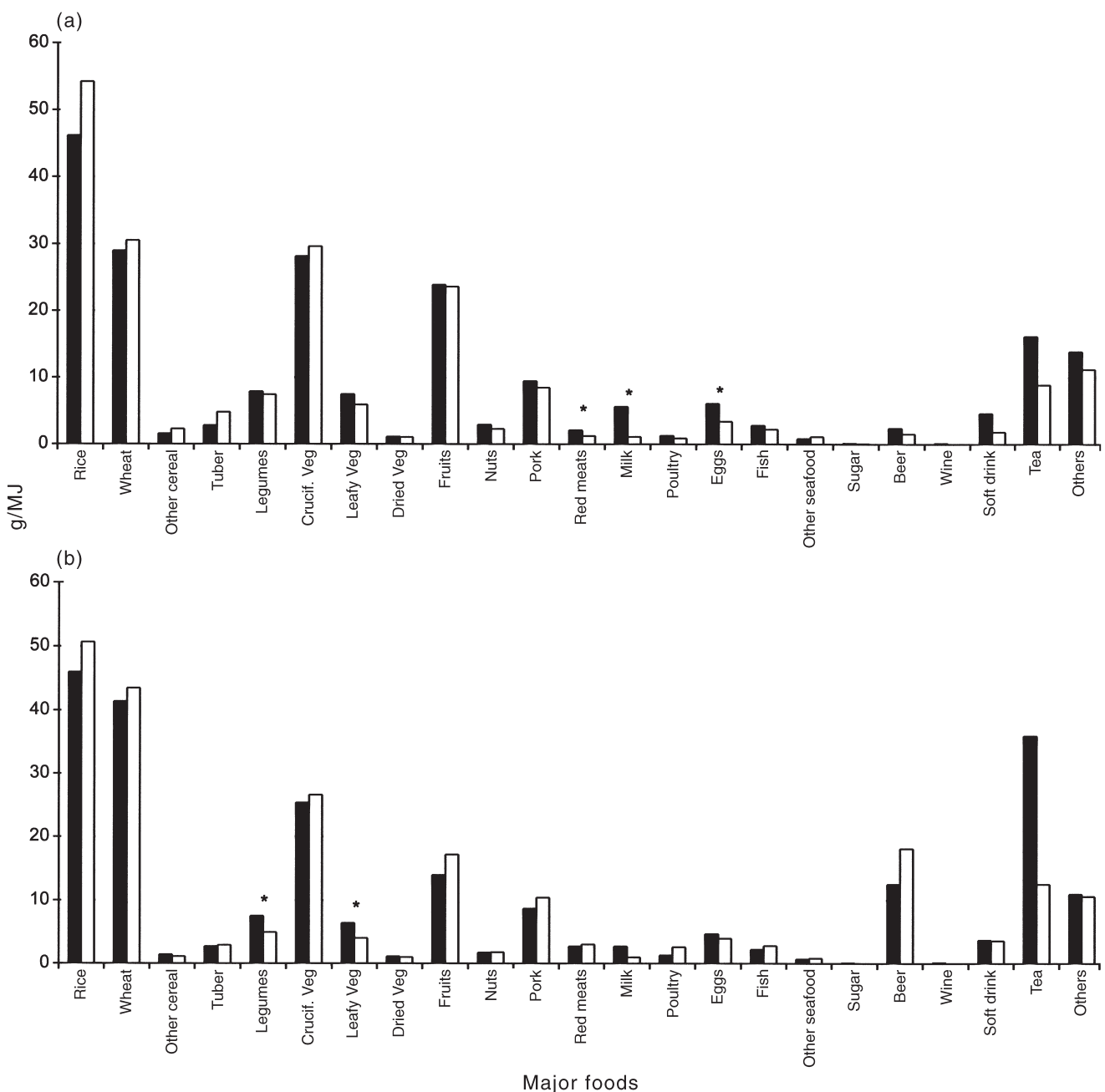

Figure 1. Mean intake of major foods per megajoule of energy per day in (a) women and (b) men who ate breakfast (■) and those who did not (□). * *P* < 0.01

within this population of Beijing Chinese related to a number of socio-demographic characteristics. These included gender, age, and level of education attained. Some differences in food intake patterns were also detected between those who ate breakfast and those who did not; a practice which may partly reflect work patterns.

There are different food intake patterns among the men and women of Beijing. After adjusting for total energy intake, men consumed more wheat products, red meats, tea and beer than their female counterparts, who consumed more fruit and vegetables. The food choices of Beijing men tended to be influenced by the traditional northern Chinese diet, whereas the beverages they drank tended to be associated with Western culture. However, Beijing women, whose diets were limited by affordability, tended to choose foods perceived as being 'healthy', such as vegetables, fruit and fish.

Of the three socio-demographic factors studied, age had the most profound effect on food intake patterns within this population. This has been demonstrated in other studies.[1,2] In general, especially among men, age was negatively correlated with foods that are often associated with Western diets, such as meats, soft drinks and beer. After adjusting for age, education and income had only a small effect on food intake patterns. However, the effect of income on food intake patterns may not be fully realized in this study because the majority of subjects (approximately 99%) share a similar household income (between 10 001 and 20 000 yuan RMB). This is, in part, a limitation of the study design in that defined categories were too broad and were not indicative of the income spread of the population. Furthermore, subjects interviewed may not have been willing to disclose their true income. One must also take into account that the spread of income in society is a characteristic of the population itself and in Beijing, a remnant of the economic infrastructure of the old communist China, before its combination with a market-driven approach from 1978. Education level in Beijing is very age dependent, with younger people tending to be more educated than their elders.

Despite differences in food consumption patterns within the population, the average daily diet of Beijing Chinese still consisted largely of foods derived from plants, although the consumption of animal-derived foods had increased, especially among the younger generation. This is reflected in a significantly increased animal fat intake and decreased cereal intake in the last 40 years.[7] However, the two foods with the largest daily intake (g/MJ) by both men and women were still rice and wheat. This is comparable with Chinese Melburnians,[8] who largely originate from southern China and who follow the food habits of the south in that they consume mostly rice, water and tea.

There have been definite changes in the staple cereal consumption of this population. Traditionally, Beijing Chinese ate wheat products as their staple food. However, the current trend is a shift in consumption towards rice, the staple food of the southern Chinese. This trend is particularly evident among the younger generation and among females, who consumed substantially more rice than wheat per megajoule of energy ingested. After adjusting for energy intake, it was found that Beijing men consumed proportionately similar amounts of rice and wheat in their diet. For the growing number of young and more educated professionals in Beijing, this shift towards rice consumption may be partly due to the convenience and affordability of preparing and cooking rice rather than wheat products. Previously, the people of Beijing had little access to rice because the cost of transporting it from southern China, where it is largely grown, was too great. Now, given the economic development of the Beijing region, rice is becoming increasingly available and more affordable.

In comparison with a study of Melbourne Chinese,[9] the variety of food consumed by Beijing Chinese was similarly affected by age and education level. The so-called 'blue collar' workers, the aged and the less educated had a narrower spectrum of foods in their diets than the younger and more educated of these populations. This was despite an increasing availability of various foods following rapid economic development over recent years. Furthermore, when compared with men, women consumed a wider variety of food in both Melbourne and Beijing.

With the increasing availiability of a wider range of foods, particularly those associated with affluent Western societies, there has been in recent years an increase in the incidence of some non-communicable diseases, such as cardiovascular and cerebrovascular diseases, as well as in certain cancers.[10] Therefore, while consuming a wide variety of foods may be protective against nutritional deficiencies, consumption of foods associated with affluence may increase the incidence and prevalence of non-communicable diseases of affluence. This interplay between food variety rich versus protective food intake is one of the major nutritional issues for societies whose economies are in transition.

There is increasing interest in meal patterns and health.[11,12] In the present study, meal patterns were found to affect overall food intake. This is exemplified by the difference in food intake patterns observed between people who ate breakfast regularly and those who did not. The differing food patterns between these two groups may be partly, but not completely, accounted for by the foods consumed during breakfast. For example, women who ate breakfast tended to consume more milk than those who did not. This may be because, for many, a large proportion of the daily milk intake is consumed during breakfast. The importance of the differing food patterns may have an effect on micronutrient intake on disease risk profiles and ultimately on health outcome data.

Conclusion

Currently, Beijing Chinese have two major staple foods in their diets. The increasing consumption of rice over wheat, especially among the young and more educated of the population, reflects the modernization of food intakes in line with continuing economic development. This has also been related to an increase in the consumption of foods associated with more affluent societies, such as meats. Women in general had a healthier food intake pattern, with higher consumption of vegetables and fruits, and a wider variety of food than did men. The consumption of both tea and beer by men reflects both traditional Chinese cultural determination and the acculturation of Western diets by these Beijing Chinese. Also, it appears that skipping a main meal such as breakfast often leads to a decrease in the intake of some foods. Similarly, age was found to be an important determinant of food intake pat-

terns in this population. This effect is demonstrated in other studies of food intake and nutrient intake.[8,10]

The identification of current and continuing changes in the food intake patterns of Beijing Chinese have also highlighted potential health problems which may eventuate as a result of such dietary changes. In particular, the increased consumption of foods associated with affluence such as meats and beer, especially among the men, may result in an increased prevalence of diseases of affluence such as malignancies and cardiovascular diseases. Therefore, attention should be directed towards preventing such potential health consequences.

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北京市華人的食物模式

摘　　要

該研究調查了 430 位成年北京華人的食物模式，並評估了社會人口統計特徵，如性別、年齡、教育和家庭收入的影響，作者用一張 156 種食物頻率問卷評估食物類型、種類和膳食模式，結果發現性別與年齡是影響食物模式的最重要因素。男性消耗較多小麥製品、紅肉和茶，而女性消耗較多青菜、水果、堅果、魚、蛋和牛乳。女性食物的種類較男性多。此外，他們發現年輕和受教育多的人食物種類較廣。年齡對食物攝取也有重要影響，年輕和受教育多的成人消耗肉類、冷飲和啤酒較多，但年長者在他們的膳食中則多吃青菜（僅限于女性）、乳和茶。由于教育與年齡有密切的關係，因而調整年齡以後，對食物模式有少許影響。

很可能年長者營養素的儲備下降，加上食物種類較少，營養素缺乏的危險將會增加，另一方面，年青和受教育多者食物的種類較廣，較易維持足夠營養，但由于消耗肉類和啤酒較多，易患肥胖症、糖尿病、心血管疾病、某些癌症和骨質疏鬆症。最後作者認爲北京華人和相似的社會將要繼續增加營養監督和適當的營養教育。

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