

Transitions Of Food Groups And Nutrients In The Northeast Of China: A 3-Year-Interval's Follow-Up Study

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Abstract

Objective: To explore the dietary patterns and changes in population of northeastern Chinese over time.

Design: A longitudinal, descriptive, comparative, population-based study.

Setting: Heilongjiang, China.

Study participants: 1468 and 1418 participants aged 0-95 who had complete records on the three 24-hour dietary recalls in 1997 and 2000 surveys, respectively.

Results: Differences in food consumption and nutrient intake existed in groups divided by gender, residence and household income. The staple food was cereals which offered 53.4 – 70.1% of the total energy in diet of any populations, and the next was fat and protein with 19.2 – 34.3% and 10.4 – 12.0%, respectively. Fat and protein devoted more proportion of energy than carbohydrate did in diet of the participants in developed and urban areas, and with higher income.

Conclusion: Certain increases in energy from protein, alongside a significant rise in energy from fat and a visible decline in energy from carbohydrate, were documented as main features in dietary patterns of Northeastern Chinese during the study period.

This survey was conducted in Heilongjiang, by Heilongjiang Provincial Centre for Disease Control and Prevention. The research was completed with financial assistance from the US National Institutes of Health (NIH) (R01-HD30880 and R01-HD38700) and statistical analysis was supported by the Alumni Association of Sasakawa Medical Scholarship and Chronic disease Division, School of Medicine, the University of Queensland.

INTRODUCTION

Related to nutrition transitions worldwide, nutrition and epidemiologic transitions have begun and are proceeding at extremely accelerated rates in developing countries including China that is urbanising rapidly and also continues to experience a very rapid growth in income per capita⁽¹⁾. With its flying development in economy, China has indeed quickly experienced her several periods of dietary pattern changes, such as collecting food, famine, receding famine

and degenerative diseases, since the foundation of the People's Republic of China in 1949 and has been in her fifth period – behavioral change from late 1980s on^(2, 3). Changes which took 50 years to occur in the US have been compressed into as short as 7 years in China⁽⁴⁾.

Due to state of the coexisting pockets of under- and over-nutrition in China and other developing countries^(4, 5), intervention measures should be taken in order to gain a balanced and healthy dietary pattern and quality, and furthermore to prevent people away from suffering chronic diseases such as hypertension, diabetes mellitus and cancers. These measures can only be taken after full understanding of nutritional status and problems existed in eating patterns. Beginning in late 1950s, China performed four nationwide nutritional surveys in the years of 1959, 1982, 1992 and 2002. Heilongjiang Province (HLJ) has participated in the surveys as a sample province since then, but in spite of that, no complete data are available for description of the changes

in nutrition among HLJ residents yet apart from a little information revealed by the nation.

HLJ, a boundary province to USSR in the northeast of China, is characterised with its agriculture and is less developed in economy. In this study we want to explore the dietary patterns and changes of HLJ residents over time and we also make some comments upon the existing dietary patterns.

SUBJECTS AND METHODS

STUDY POPULATION

As one of the project provinces of the China Health and Nutrition Survey (CHNS) which is a longitudinal and an ongoing survey covered eight provinces in China starting in 1989 and follows the human subjects approval procedures of both the University of North Carolina School of Public Health and the Chinese Academy of Preventive Medicine (CAPM, now renamed as China CDC), HLJ, replacing Liaoning, has performed the project since 1997. A multi-stage, random-cluster, weighted sampling scheme was used to draw the sample surveyed in the province according to CHNS' protocol^(1, 2, 6). There were six sampling spots chosen, namely two cities Harbin (provincial capital) and Shuangyashan (lower-income city), and four counties, Shuangcheng, Anda, Fujin and Jixian. Within each county, the town where the county government is located was selected, and then three other villages were chosen randomly. While within each city, urban and suburban neighbourhoods were selected randomly. The sample design was consisted of 24 primary sampling units (villages, towns or sub-districts from the six cities and counties), including 480 households, and covering 1470 individuals aged 0-92 (31.2±17.8) in 1997 and 1418 aged 0-87 (33.0±17.8) in 2000, respectively, after the exclusion of those respondents who were not examined physically or interviewed for dietary information. To ensure adequate sample size, new household were added in later surveys to replace those who were lost to follow up mainly due to migration or removal out of the community.

DIETARY DATA

The data were obtained from CHNS-based surveys, rounds of the 1997—2000 in HLJ, with two methods for collecting dietary data – measurements of household food inventory and individual intake from a free-living population. Detailed household food consumption (HFC) data and individual dietary intake (IDI) data were collected for three consecutive days. For the former, HFC was determined from inventory

change by weighing all foods in stock (including edible oils, sugar, salt and other condiments) from the start to the end of each day; foods purchased or produced at home during the survey period should be weighed and added into the inventory. Food preparation waste or those used for any other purpose except eaten by family members should also be weighed and subtracted from the inventory. The data collected herein were used to supplement the IDI data⁽⁷⁾. For the latter, IDI from the same 3 consecutive days was collected from all family members based on a 24-hour recall by face-to-face interviews at each participant's house, except children aged below 12 years whose food consumption was recalled by asking the child's mother or a mother substitute who handled food preparation and feeding in the household.

Dietary intake was expressed by the consumption per capita per day. The dietary data from both household inventory and individual 24-h recall were converted to nutrients according to the 1991 Chinese food consumption tables (FTC)⁽⁸⁾.

ANTHROPOMETRIC DATA

In this study, anthropometric measurements were made following standardized procedures^(3, 6, 9, 10). Specific training on anthropometric assessment was provided at the beginning of each survey. Height and weight were measured (with study participants in light indoor clothes and without shoes) in centimeter and kilogram respectively during the course of dietary surveys by trained health workers, from which the body mass index (BMI) was calculated [BMI= weight (kg)/height (m²)]. The World Health Organization's cut-off points^(3, 11,12,13) for BMI were used to defined underweight (BMI<18.5 kg m⁻²) and overweight (BMI≥25 kg m⁻²), of which obesity was defined as BMI≥30 kg m⁻².

STATISTICAL ANALYSIS

Population characteristics were examined in the descriptive analysis. We attempted to compare any differences between/among gender, residence and household income. The changes in diet and nutrients, either macronutrients or micronutrients, during the 1997—2000 period were examined in the study sample stratified by gender, time, place of residence, sample spots, household income. The data input program was designed and offered by School of Public Health, the University of North Carolina. All data management and analyses were performed by using STATA (Version 8.0, College Station, TX).

RESULTS

BASIC FEATURES OF THE STUDY POPULATION

There were 1,470 (male: 736; female: 734) participants in 1997's survey and 1,418 (male: 706 & female: 712) in 2000's. There was no significant difference in size between two genders in the two surveys (Pearson $\chi^2 = 0.0035$, $P = 0.953$) (see table 1). There was difference in average ages between the two surveys ($P < 0.01$) and the age proportion was different too (Pearson $\chi^2 = 9.6808$; $P = 0.021$) in two surveys, among which majority of participants were under 60 (about 92%). There was no difference in mean ages between genders no matter whether it was considered separately ($P = 0.37$ in 1997 and $P = 0.52$ in 2000) or as a whole ($P = 0.27$). This was because that almost all the participants ($n = 1091$) were nearly three years older in 2000 than they were investigated in 1997.

Figure 1

Table 1: Sociodemographic and characteristics of study sample population

	1997 [n (%)]	2000 [n (%)]	
All	1470	1418	
Gender			Pearson $\chi^2 = 0.0035$
Male	736 (50.1)	706 (49.8)	$P = 0.953$
Female	734 (49.9)	712 (50.2)	
Age (years old)			$t = 2.7599$
Mean age	31.2	33.0	$P < 0.01$
Male	30.8	32.7	
Female	31.8	33.3	
<18	373 (25.4)	331 (23.3)	Pearson $\chi^2 =$
18-39	652 (44.4)	586 (41.3)	9.6808
40-59	339 (23.1)	397 (28.0)	$P = 0.021$
≥60	106 (7.2)	104 (7.3)	
Residence			Pearson $\chi^2 = 0.6205$
Urban	472 (32.1)	436 (30.7)	$P = 0.431$
Rural	998 (67.9)	982 (69.3)	
Household Income (Monthly)	1465	1182	
Low (≤¥1000)	317 (21.6)	275 (23.3)	Pearson $\chi^2 = 0.9984$
Medium (¥1001-2149)	536 (36.6)	423 (35.8)	$P = 0.607$
High (≥¥2150)	612 (41.8)	484 (40.9)	
Mean BMI (kg/m ²)	21.5 (±4.1)*	22.1 (±4.2)*	$t = 4.1438$
(18.5-24.9)	848 (57.7)	767 (54.1)	$P < 0.001$
<18.5	328 (22.3)	265 (18.7)	Pearson $\chi^2 =$
≥25	256 (17.4)	335 (23.6)	19.0528
≥30	38 (2.6)	51 (3.6)	$P < 0.001$

Note: * where the numbers in parentheses are standard deviations.

Of the study samples, there were twice as many participants who lived in rural areas as those lived in urban and the proportion remained almost the same over time ($P = 0.431$). From the point of monthly household income, most of them (75%) were at a level of medium or high in both survey years.

379 out of 1470 (25.8%) participants withdraw from the follow-up study, because of removal of one community at Anda after 1997 and the growing number of away-from-home students and farmers. There were no significant difference statistically in mean food consumption and in dietary patterns between the drop-off and those still remained in the survey in 1997, and so was that between the newcomers and the remainders in 2000. It can be said from

this point of view that the withdrawal of the drop-off and the participation of the newcomers would not have much influence on making analyses and conclusions. Due to incomplete information on household income in 2000, only 1182 out of 1418 questionnaires, with satisfying income information, were used in analysis.

The percentage of participants who were underweight (BMI >18.5 kgm⁻²), overweight (BMI = 25.0-29.9kgm⁻²) or obese (BMI ? 30.0 kgm⁻²) was calculated by using recommended international cutoffs. Among the participants, the mean BMIs were 21.5 (±4.1) in 1997 and 22.1(±4.2) in 2000, respectively. The percentages of underweight, overweight and adiposity were 22.3, 17.4, 2.6 in 1997 and 18.7, 23.6, 3.6 in 2000, respectively, which showed the underweight in the population was getting smaller and the numbers of overweight or obesity were increasing (Pearson $\chi^2 = 19.0528$; $P < 0.001$).

CHANGES OF FOOD GROUPS

We regrouped food into more than 12 groups, i.e. cereals, tofu (and its products), bean, potato, vegetables, fruit, meat (and its products), poultry (and its products), milk (and its products), egg (and its products), fish (aquatic products), alcohol (including beer, wine and all kinds of drinks containing alcohol) and others which were omitted in the analysis. Consumption of these food groups was compared over time, between genders, residence and among household income (see table 2).

Figure 2

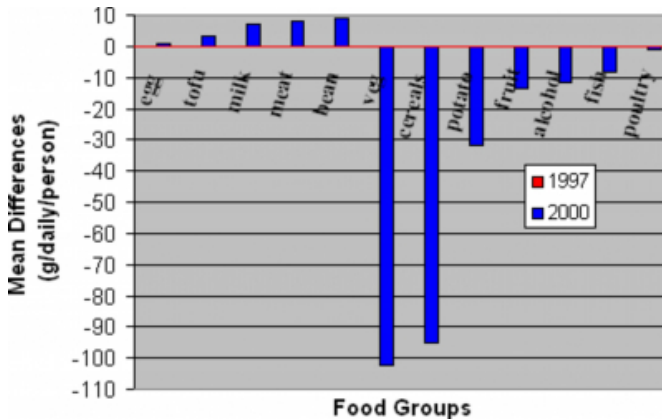
Table 2: Comparisons of foods consumed among different subpopulations and time

		Gender				Residence				Family Income			
		Total	Male	Female	Pvalue	Urban	Rural	Pvalue	Low	Medium	High	Pvalue	
Cereals	1997	466.1	499.2	432.9	<.01	396.5	499.0	<.01	494.9	476.2	440.0	<.01	
	2000	371.0	399.4	342.8	<.01	339.6	395.4	<.01	360.1	367.5	357.7	0.09	
	Pvalue	<.01	<.01	<.01		<.01	<.01		<.01	<.01	<.01		
Potato	1997	108.7	114.7	102.7	0.03	90.2	47.4	<.01	142.5	103.4	95.8	<.01	
	2000	77.1	79.2	74.9	0.34	125.9	72.3	<.01	100.0	73.4	74.1	<.01	
	Pvalue	<.01	<.01	<.01		<.01	<.01		<.01	<.01	<.01		
Vegetable	1997	269.5	267.8	271.2	0.84	234.2	286.2	<.01	264.0	278.6	264.8	0.73	
	2000	167.2	182.6	152.1	<.01	152.1	174.0	<.01	174.8	164.1	165.8	0.96	
	Pvalue	<.01	<.01	<.01		<.01	<.01		<.01	<.01	<.01		
Fruit	1997	27.0	22.8	31.3	0.03	60.8	11.0	<.01	5.3	12.8	51.0	<.01	
	2000	13.4	10.9	15.9	0.05	25.5	8.0	<.01	2.9	9.7	21.5	<.01	
	Pvalue	<.01	<.01	<.01		<.01	0.11		0.32	0.26	<.01		
Tofu	1997	29.0	31.7	26.3	0.06	30.8	28.1	0.39	19.7	32.1	31.1	<.01	
	2000	32.5	34.2	30.8	0.22	43.5	27.6	<.01	27.7	28.9	36.9	0.02	
	Pvalue	0.08	0.42	0.08		<.01	0.80		0.07	0.34	0.10		
Bean	1997	56.5	56.1	56.8	0.86	68.8	50.6	<.01	45.8	50.6	67.5	<.01	
	2000	65.6	69.3	61.9	0.10	54.6	70.5	<.01	82.4	61.1	68.6	<.01	
	Pvalue	<.01	<.01	0.23		<.01	<.01		<.01	0.04	0.83		
Meat	1997	35.3	38.5	32.2	0.03	76.4	15.9	<.01	10.7	29.6	52.9	<.01	
	2000	43.4	46.5	40.3	0.05	65.1	33.8	<.01	24.6	38.9	54.7	<.01	
	Pvalue	<.01	0.02	<.01		0.01	<.01		<.01	0.01	0.65		
Poultry	1997	9.7	10.3	9.0	0.51	9.1	9.9	0.71	8.7	6.6	13.0	0.02	
	2000	8.8	8.9	8.7	0.92	11.5	7.6	0.06	8.9	8.2	7.9	0.95	
	Pvalue	0.54	0.48	0.88		0.37	0.18		0.95	0.48	0.04		
Fish	1997	22.2	22.7	21.8	0.73	41.3	13.2	<.01	12.4	17.5	31.6	<.01	
	2000	13.8	13.2	14.3	0.52	16.1	12.7	0.08	11.4	14.4	16.1	0.20	
	Pvalue	<.01	<.01	<.01		<.01	0.78		0.74	0.23	<.01		
Milk	1997	4.1	4.7	3.6	0.42	6.8	2.9	<.01	2.5	5.1	4.2	0.35	
	2000	11.1	10.4	11.7	0.54	27.4	3.8	<.01	0.2	5.1	21.4	<.01	
	Pvalue	<.01	<.01	<.01		<.01	0.40		0.02	0.99	<.01		
Egg	1997	28.9	29.0	28.8	0.93	44.9	21.3	<.01	16.1	24.8	39.3	<.01	
	2000	29.6	31.7	27.4	0.06	29.7	29.5	0.92	26.1	29.4	35.3	0.01	
	Pvalue	0.65	0.24	0.45		<.01	<.01		<.01	0.09	0.13		
Alcohol	1997	18.9	35.7	2.1	<.01	39.8	9.1	<.01	3.6	9.6	35.2	<.01	
	2000	7.4	13.2	1.6	<.01	8.3	7.0	0.67	1.0	7.3	10.7	0.07	
	Pvalue	<.01	<.01	0.58		<.01	0.41		0.18	0.54	<.01		

In general, the average food intakes of the study population decreased over time ($P < 0.01$) with the exception of increased intakes of bean, meat and milk ($P < 0.01$), and of statistically unchanged intakes of tofu, poultry and eggs ($P = 0.08$). This would be more clarified if the consumed amounts of food groups in 1997 were taken as a baseline and then the comparison was made (figure 1). The transitions of both men's and women's food intakes were consistent with those of the whole study population, and almost so were transitions of food consumptions in the subpopulations in different residences or with different incomes. But there were a few distinctions. Instead of bean in urban and milk in low- and medium-income subpopulations, they consumed more tofu, and less milk and more eggs over time respectively.

Figure 3

Figure 1: Changes in Mean Food Consumption during 3 Years



There were not statistically significant differences in food intakes between male and female participants, except that females consumed more fruit and vegetables than males did. Urban subpopulation had few intakes of cereals, potatoes and vegetables, but more intakes from other food groups. People tended to consume more food, but not cereals and potatoes which were less eaten in meals, with increased family incomes.

CHANGES OF MAIN MACRONUTRIENTS

In this study, energy, protein, fat, fibre and carbohydrate were taken into consideration to figure out their changes in people's dietary transitions over time and in different subpopulations. Of concern are these macronutrients which are the integrated responders of food value, in any studies related to nutrition. From 1997 to 2000, intakes of energy, proteins, fibres and carbohydrates reduced with the exception of fat which showed a bit elevation in average intake over time, but there was no statistical significance ($P = 0.62$) (see table 3). In spite of decreases in intake, the intake proportions of energy, protein and fat from animal food rose. The results were mostly consistent when we explored the changes of macronutrients among subgroups with different genders, residences and family incomes. The urban participants reduced their intakes of fat and percentages of energy, proteins and fat from animal food, but the rural participants increased their fat intakes.

Figure 4

Table 3: Comparisons of macronutrients consumed among different subpopulations and time

	Total	Gender		Pvalue	Residence		Pvalue	Family Income			Pvalue	
		Male	Female		Urban	Rural		Low	Medium	High		
Energy(kcal)	1997	2309.5	2468.4	2150.1	<0.01	2266.4	2329.8	0.18	2303.6	2343.3	2275.5	0.39
	2000	2016.5	2153.2	1880.9	<0.01	1965.5	2030.2	0.29	1929.1	1978.7	2068.3	0.03
		Pvalue		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
from animal food	1997	183.1	193.1	173.0	0.05	341.8	108.0	<0.01	81.4	157.1	258.7	<0.01
	2000	204.2	216.7	191.9	0.04	297.0	163.0	<0.01	133.0	184.9	251.6	<0.01
		Pvalue		<0.01	>.05	0.07	<0.01	<0.01	<0.01	0.04	0.60	
Protein	1997	62.8	67.2	58.4	<0.01	65.8	61.4	<0.01	59.3	62.3	64.9	<0.01
	2000	55.8	59.8	51.8	<0.01	57.5	55.1	0.06	53.0	53.8	58.1	<0.01
		Pvalue		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
from animal food	1997	12.0	12.6	11.4	0.10	22.0	7.3	<0.01	5.6	9.8	17.3	<0.01
	2000	12.8	13.4	12.1	0.05	17.0	10.9	0.01	9.1	11.7	15.8	<0.01
		Pvalue		0.15	0.31	0.29	<0.01	<0.01	<0.01	0.03	0.07	
Fat	1997	64.5	67.4	61.5	0.02	81.8	56.3	<0.01	50.3	64.2	72.3	<0.01
	2000	65.4	68.7	62.2	0.01	73.6	61.8	<0.01	51.1	63.0	76.3	<0.01
		Pvalue		0.62	0.64	0.80	<0.01	0.79	0.70	0.23		
from animal food	1997	14.0	14.8	13.2	0.08	26.3	8.2	<0.01	6.1	12.3	19.5	<0.01
	2000	15.8	16.9	14.8	0.04	23.5	12.4	<0.01	10.2	14.4	19.2	<0.01
		Pvalue		<0.01	0.04	0.07	0.03	<0.01	<0.01	0.07	0.79	
Fibre	1997	12.6	13.3	11.8	<0.01	11.1	13.3	<0.01	13.0	12.4	12.4	0.45
	2000	10.4	11.1	9.8	<0.01	10.2	10.5	0.26	10.8	9.9	10.7	0.06
		Pvalue		<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	
Carbohydrate	1997	365.4	390.3	340.3	<0.01	310.9	391.1	<0.01	401.3	376.5	336.1	<0.01
	2000	299.7	321.3	278.2	<0.01	272.3	311.9	<0.01	314.4	297.3	265.3	<0.01
		Pvalue		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

* 1kcal=4.184Kj

Men's intakes of macronutrients were greater than women's (P <0.01). Urban people had more intakes of protein and fat, especially from animal food, than their rural peers, but the latter had greater intakes of carbohydrates and fibres. There were no statistical discrepancies in energy consumption in both surveys (P >0.18) and in fibre intakes in 2000 (P =0.26), between urban and rural subpopulations, but the former tended to have larger portions of energy from animal food (P<0.01). Higher income group ingested more energy, proteins and fat, whereas lower income group ingested more carbohydrates (P<0.01). There were no statistical differences in fibre intakes in both years (P>0.06) and in energy consumption in 1997 (P=0.39).

It could be found that the intakes of energy, protein, fibre and carbohydrate decreased (P=0.000), while that of vitamins increased (P=0.003) and those of fat and minerals remained almost the same in 2000, compared with those in 1997. There existed, between genders, very significant differences in intakes of all macronutrients (P=0.000-0.002) except that of vitamins (P=0.121), that is, the male participants took more of these nutrients than their female partners did (table 3).

The discrepancy did also exist among participants between urban and rural residences, and in households with different income. In general, urban participants incepted more proteins, fat, minerals and vitamins (P=0.000-0.012), and few fibres and carbohydrates (P<0.001) from diet than rural ones did, while energy taken were almost the same between

the two groups (P=0.129). It was found that the same rules applied to household income, when the correlation between the consumed macronutrients and the income was addressed. The subjects in higher income households took in more proteins, fat, and vitamins (P=0.000-0.002), and those in lower income households incepted more carbohydrates (P<0.001) from diet with getting nearly the same amount of energy and minerals as the other two groups (P=0.112-0.505).

As addressing the issue of energy sources, the description (table 4) was similar with percentage of energy supplied from protein, fat and carbohydrates being over 99.0%. The biggest proportion of energy, 53.4 – 70.1%, was derived from that of carbohydrates, while energy from proteins and fat composed 10.4 – 12.0% and 19.2 – 34.3%, respectively, of the total energy. It was clear that the energy from fat increased and that from carbohydrate decreased over time between genders, locations and with enhancement of income.

Figure 5

Table 4: Comparisons of foods consumed among different subpopulations and time

	1997 (%Energy Sources)#			2000 (%Energy Sources)		
	Protein	Fat	Carbohydrate	Protein	Fat	Carbohydrate
	251.3(10.9)	590.4(25.1)	1461.4(63.3)	223.3(11.1)	588.8(29.2)	1198.8(59.5)
Gender						
Male	268.9(11.6)	607.0(26.3)	1561.3(67.6)	239.3(11.9)	618.3(30.7)	1285.4(63.7)
Female	233.8(10.1)	553.8(23.1)	1361.3(58.9)	207.4(10.3)	559.5(27.7)	1113.0(55.2)
Residence						
Urban	263.3(11.4)	735.9(31.9)	1243.7(53.9)	230.0(11.4)	662.2(32.8)	1089.4(54.0)
Rural	245.7(10.6)	506.9(21.9)	1564.4(67.7)	220.3(10.9)	556.2(27.6)	1247.4(61.9)
Family Income						
Low	237.4(11.8)	452.5(22.4)	1605.0(79.6)	212.1(10.5)	459.8(22.8)	1257.5(62.4)
Medium	249.1(12.4)	577.5(28.6)	1506.2(74.7)	215.1(10.7)	566.6(28.1)	1189.3(59.0)
High	259.6(12.9)	650.3(32.2)	1340.3(66.5)	232.3(11.5)	686.6(34.0)	1141.1(56.6)

Notes. The average energy consumptions were 2309.5 and 2016.5 kcal (1kcal=4.184Kj) in 1997 and 2000, respectively. # the numbers in parentheses are percentages of energy from proteins, fat and carbohydrates, respectively.

DISCUSSION

There have been many remarkable socioeconomic changes in China since 1980s and per capita GDP has increased over 10 times with per capita meat consumption having almost doubled in rural areas(14). For example, three nationwide nutrition surveys were conducted (before this study was performed) in 1959, 1982 and 1992 respectively in China. The results indicated that along with the deepening on reform and open policy and social economic development, the living standard of Chinese People has significantly improved, and the quality of dietary patterns and the nutritional status of Chinese population have greatly bettered 6,14. The dietary or food patterns have changed and begun to follow ‘a classic Western pattern’ 3, especially among those who live in urban areas and/or have a higher income, by the

fact that the total intake of most of the food groups appeared decrease over time with an average increased consumption of meat, tofu and milk, as showed in this study and others(2, 3, 15). The classic Chinese diet includes cereals [which has been the staple food in Chinese diet as recommended in Chinese Dietary Guideline (proposed by Chinese Nutrition Society in 1997)] and vegetables with few animal foods. It is a diet that many scholars consider most “healthful” when adequate levels of intake are achieved(3, 16,17,18). The diet of rural Chinese was characterised with the pattern lower in protein, especially animal protein, in calcium, phosphorus and selenium, but higher in sodium and animal fat(6, 15). Nowadays, farmers have become richer in many regions of the country and the rural diet also follows the same shift towards animal products that urban areas followed. Of great concern are the increased intake for fat and energy-born food, and the increase in the prevalence of consequent obesity, which has become an important public health challenge both in developed and developing countries.

Dietary patterns can be influenced by a variety of factors such as access to food, household dietary habit, individual or family socioeconomic condition, individual health status, and so on. Once the patterns are habitually formed, some of them will remain in one's lifetime. A study found that a large proportion of children track their dietary intake patterns from childhood into adolescence, and their dietary patterns change only marginally during pubertal development(19). Our study is consistent with the feature, which showed in Graph 1 that over a 3-year follow-up period the food-choosing patterns in 2000 was quite similar to those in 1997, only with the changes of the amount of food intake (two curves are quite alike). The food-choosing patterns determine what a dietary pattern will be, and whether adequate nutrients are taken in when the total amount of incepted food is constant. Although, in general, the consumption of several food groups decreased in 2000 compared with that in 1997, the proportion of underweight dropped and that of overweight or obesity increased according to BMI, which indicated that an excessive intake of some nutrients, for example energy, may exist. This point of view was supported when we addressed the proportion of total energy sources. Compared with the year 1997, fat provided more energy (up to 27.7 %) and less energy was provided by carbohydrate (down to 60.9%) with protein being a constant provider.

This paper discloses the dietary patterns among north-eastern Chinese and possible differences from those nationwide. The large proportion of diet originated from the

food groups of cereals, vegetables and potato which composed 73.9% in 1997 and 68.3% in 2000 respectively with cereals (the staple food) 40.9% and 41.1%. The proportion of diet did not change much from 1997 into 2000, only with a bit increase for a few food groups of bean, meat and milk. Compared with the food consumption of nationwide in 1992, it was lower for most food groups except for vegetable, fruit, eggs and edible oil in HLJ, a less developed and agriculture-featured province. Later then on, food consumption has begun to decrease over time, except for tofu, meat, poultry, egg and alcohol (see table 5). Tofu, as a kind of plant product with cheap and quality source of protein in China, especially in rural areas, was of great increase in its consumption, which could also substitute insufficient animal food in diet to supple bodies with protein. Participants in low income households had to increase intake of accessible foods to satisfy themselves with enough nutrients because of having less accessible variety of diets than those in higher-income households(20, 21). For example, they took in more carbohydrate (because of increased intake of cereals) and more VC (which might result from incepting a great amount of vegetables in diet). The proportion of total energy derived from carbohydrate in high-income group was 10% less than that in low-income group, with that from fat increasing about 10%.

Figure 6

Table 5: Comparison and changes of food consumption

	Nationwide (1992)	HLJ		
		1992	1997	2000
cereals	439.9	411.1	466.7	372.5
tofu	7.9	6.3	26.7	32.6
potato	86.6	74.2	108.5	78.1
vegetable	310.3	337.1	268.4	168.7
fruit	49.2	96.0	26.5	13.3
meat	50.0	33.5	35.6	43.5
poultry	8.9	4.1	9.9	8.9
milk	14.9	12.5	4.0	12.1
egg	16.0	25.5	29.1	29.9
fish	27.5	21.2	22.3	14.1
oil	29.5	39.3	40.9	40.1
alcohol	1.8	1.0	19.0	7.5
cake	7.1	5.6	7.0	5.8

Note: data collected from Ge K. *The Dietary and Nutritional Status of Chinese Population: 1992 National Nutrition Survey*, Vol2 Beijing, China: People's Medical Publishing House, 1996, and this study.

Not only can bioavailability of nutrients, but also amount of them in diet determine the utilisation of nutrients by a body. Sufficient food of quality is crucial in achieving good status of nutrition. The differential findings in nutrient intake patterns of the population are consistent with those from many other studies(3, 4, 6, 18, 21, 22). Of great concern are the increasing intakes of fat (edible oil, meat and eggs), sodium (salt), and the decreasing takes of fibre (vegetables and fruit), which will devote to prevalence of non-communicable diseases (NCD) such as cardiovascular diseases, diabetes mellitus and cancers.

CONCLUSION

In general, the structure of food groups in the diet of northeastern Chinese did not change much over the 3-year period, but dietary patterns were keeping going into a westernized pattern. Certain increases in energy from protein, alongside a significant rise in energy from fat and a visible decline in energy from carbohydrate, were documented as main features in dietary patterns of Northeastern Chinese during the study period. This is because they were tending to take more animal foods and high-energy foods and few vegetables, fruit in their diet. It was possible that although the intake amount of both total and many food groups decreased the percentages of overweight and obesity rose with that of underweight down. The province will be challenged with new public health problems in the near future with such a rapid development of economy both in China and in the Province.

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