Thematic Article

Implications from and for food cultures for cardiovascular disease: diet, nutrition and cardiovascular diseases in China

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The change of lifestyle of Chinese people, along with the development of the national economy, has caused significant changes of the disease pattern in China. This includes the shift from predominantly communicable diseases to non-communicable diseases, such as cancer, cardiovascular disease, diabetes and obesity. This paper summarises epidemiology research results on the relationship between diet, nutrition and cardiovascular diseases (CVD) available in China. Most data used in this paper are from correlation studies. While the information is very useful in generating hypotheses on dietary and nutritional risk factors for CVD, both prospective studies and population-based intervention trials are needed to further verify these hypotheses. The information in this review clearly shows that diet and nutrition play important roles in the occurrence of CVD and hypertension in the Chinese population. Therefore, dietary means should be an important part of the strategies for the control of CVD and hypertension in China.

Key words: cardiovascular disease, China, diet, nutrition.

Introduction

Since 1950, the annual gross national product (GNP) in China increased from 12.5 to 168.8 US dollars per capita, and the average household purchasing power increased more than four times.[1] China's improved standard of living has brought about significant changes in health and disease. These include a reduction in diseases of poverty (infant death, communicable diseases, nutritional deficiency), the doubling of life expectancy from 35 years in the 1950s to 67 (male) and 71 (female) years in 1995 (Table 1) and the increase of chronic non-communicable disease.

Changes of disease pattern in China

The change of lifestyle of Chinese people, along with the development of the national economy, has caused significant changes of disease patterns in China. One example is the shift from predominantly communicable diseases to non-communicable diseases, such as cancer, cardiovascular disease, diabetes and obesity. Based on the statistics from the Ministry of Health, the mortality rates of acute infectious diseases and tuberculosis have decreased significantly since 1957 (Table 2). In contrast, cancer, cerebrovascular disease and ischemic heart disease have become the leading causes of death. Chronic diseases now account for more than 70% of the total mortality in China. Among these non-communicable diseases, cardiovascular diseases (CVD), including coronary heart disease (CHD), hypertension heart disease (HHD) and stroke, have increased dramatically in the past years since 1957 to 1997 (Fig. 1), and has become the number one cause of death in China.[2]

Diet and nutrition transition in China

The dietary pattern of Chinese people has undergone dramatic changes since the 1950s, especially in the last 20 years. Based on the national food consumption data, there is a clear trend of a slight decrease in grain consumption and a significant increase of animal food and oil (Table 3).

Three national nutrition surveys (NNS) have been conducted in China since the 1950s.[3,4] The results from the first (1959) NNS showed that national average energy intake was 2060 kcal and the protein intake was 57 g per capita per day; food from plant sources contributed 89% of the dietary protein. The second NNS carried out in 1982 showed that the nutritional status of the Chinese population was greatly improved as compared to the data in the 1950s. The average energy intake has increased to 2484 kcal and protein intake increased to 67 g per capita per day. The third NNS conducted in 1992 showed that the average energy intake was decreased slightly to 2328 kcal and protein intake remained the same (68 g); however, the fat intake has increased to 58.3 g, as compared with 49.3 g in 1982 (Table 4). The main features of the dietary transition are the decrease of grain and carbohydrate intake and the increase of animal foods and oil/fat intake (Tables 5,6,7). Using fat intake as the indicator of dietary pattern, the dietary fat intake of urban Chinese is close

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to the 30% of total dietary energy intake, the upper guideline level. In the major metropolitan cities, such as Beijing, Shanghai and Tianjin, the average fat intake all exceed 30% of the total dietary energy intake. Therefore, the trend of westernization of diet in Chinese people is quite evident.

Relationship between diet, nutrition and CVD in China

The relationship between diet, nutrition and CVD has been studied in a number of epidemiological studies throughout China and selected study results are discussed below.

Correlation between dietary transition and CVD mortality in Shanghai

Zhao *et al.* investigated retrospectively the changes in food consumption and disease-specific mortality of Shanghai population from 1950 to 1985 (Figs 2,3).[5] The energy from grain products decreased from 80 to 83% of the total energy intake in the 1950s to 68–72% in the 1980s. The energy from animal foods increased from 6.5 to 8.5% in the 1950s to 17.5–18.0% in the 1980s. In the same period, health status and patterns of disease mortality also changed. For example, the average lifespan of males and females increased from 42.0 and 45.6 years in 1950 to 72.1 and 76.4 years in 1985, respectively. There was a rapid decline of infectious diseases and a very dramatic increase of CVD mortality. The results from simple correlation between CVD and food consumption are shown in Table 8, which show a significant positive correlation ($P < 0.01$) for the consumption of meats, egg, sugar, saturated fatty acids and CVD. Therefore, it is highly likely that dietary changes have played an important role in the changes of disease pattern in Shanghai, although there might be other causal factors.

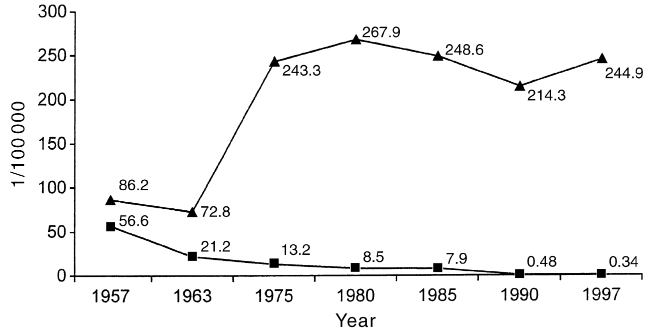

Figure 1. Mortality trend of cardiovascular disease in China, 1957–1997. (▲), cardiovascular disease; (■), infectious disease. Source: Health Statistic Yearbook of China (1990–1997).

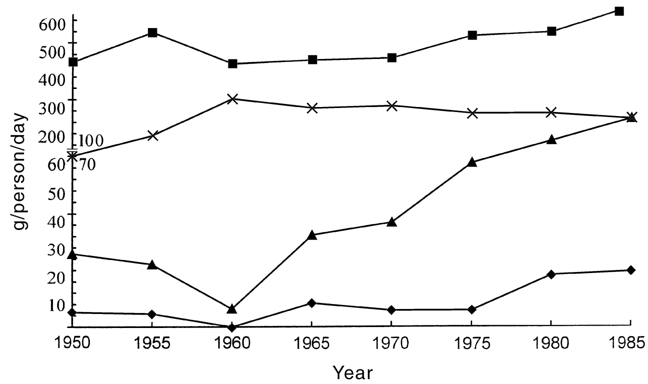

Figure 2. Changes in food consumption in Shanghai from 1950 to 1985 (g/person/day). (■), cereals; (×), vegetables; (▲), meat and poultry; (◆), sugar. Source: Zhao FJ *et al.* Studies on the relationship between changes in dietary patterns and health status. Asia Pacific J Clin Nutr 1995; 4: 294–297.

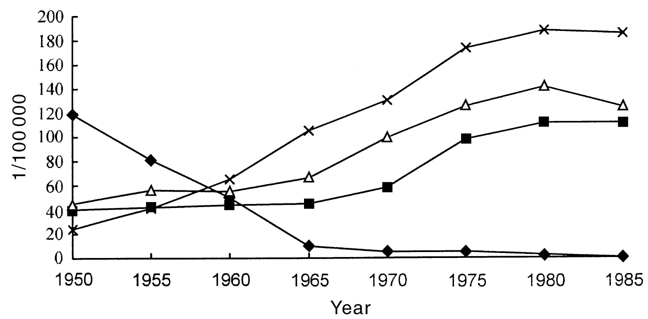

Figure 3. Changes in major causes of mortality (1/100 000) in Shanghai from 1950 to 1985. (×), cancer; (◆), infectious disease; (■), heart disease; (▲), cerebrovascular disease. Source: Zhao FJ *et al.* Studies on the relationship between changes in dietary patterns and health status. Asia Pacific J Clin Nutr 1995; 4: 294–297.

Table 1. Changes of life expectancy (years) in Chinese people from 1949 to 1995

Year	Total	Male	Female
1949	35.0	–	–
1957	57.0	–	–
1973–75	65.0	63.6	66.3
1982	67.8	66.4	69.3
1995	68.6	66.9	70.5

Source: Statistical Yearbook of China (1995), Statistical Publishing House of China, Beijing.

Table 2. Changes in mortality rate of major diseases in China (1/100 000)

Year	Acute infectious disease	Cancer	Hypertension	CHD	Diabetes	Cerebrovascular disease
1957	56.60	36.9	–	–	–	–
1962	25.02	40.92	–	–	–	–
1975	34.32	111.49	–	27.35	3.59	–
1980	4.39	113.41	–	38.55	–	135.35
1985	2.59	113.86	–	37.84	–	117.52
1990	1.15	128.03	6.00	47.48	8.12	121.84
1992	–	125.76	8.82	51.29	9.65	122.69

Source: Annual Report of National Health Statistics, Ministry of Health, Beijing, 1992. CHD, coronary heart disease.

Table 3. Changes in food consumption of Chinese people (kg/person/year)

Year	Grains	Vegetable oil	Total animal foods	Sugar
1952	197.67	2.10	10.96	0.91
1957	203.06	2.42	12.29	1.51
1962	164.63	1.09	7.12	1.60
1965	182.84	1.72	12.41	1.68
1970	187.22	1.61	11.42	2.06
1975	190.52	1.73	13.59	2.26
1980	213.81	2.30	18.47	3.83
1985	251.69	5.08	26.48	5.57
1990	238.80	5.67	32.9	4.98
1991	234.50	5.89	35.1	4.98

Source: Statistical Yearbook of China (1992), Statistical Publishing House of China, Beijing.

Table 4. Dietary intake of energy, protein and fat in China between 1959 and 1992 (per capita per day)

Year	Energy (kcal)	Protein (g)	Fat (g)
1959	2060	57	–
1982	2484	67	49.3
1992	2328	68	58.3

Source: 1. Chen, X and Ge, K: Nutrition transition in China: the growth of affluent diseases with the alleviation of undernutrition. Asia Pac J Clin Nutr 1995; 4: 287–293.
2. Ge, K. The dietary and nutritional status of Chinese population – 1992 National Nutrition Survey. Beijing: People's Medical Publishing House, 1996.

Table 5. National average of food consumption in 1992 and 1982 (g/per reference man/day)

	1992 NNS	1982 NNS
Cereals	439	498
Tubers	87	163
Bean and bean products	11	15
Vegetables	312	298
Fruits	50	28
Meats	58	42
Milk and milk products	14	9
Eggs	16	10
Fish and shrimp	28	12
Oils and fat	29	18

NNS, National Nutritional Survey.
Source: Ge, K *et al.* Changes of dietary pattern of Chinese population. J Hygiene Res 1996; 25: 29.

Table 6. Food source of energy (%) intake in 1992 and 1982

	1992 NNS	1982 NNS
Energy (%)		
Cereals	66.8	71.2
Tubers	3.1	6.2
Animal products	9.3	7.9
Sugar, starch	11.6	7.7

NNS, National Nutrition Survey.
Source: Ge, K *et al.* Report of the Third NNS. J Hygiene Res 1996; 25: 10.

Correlation between fatty acid and CVD mortality

An ecological study involving 65 counties in China was conducted in the 1980s by Chen *et al.*[6] Diet, nutrition and other lifestyle data as well as disease mortality were collected. The correlation between mortality of CVD, dietary pattern and nutrition status of the study population was extensively analyzed. The overall results showed consistent correlation between CVD mortality and dietary fatty acids. The results of two published papers are summarized here.

Red blood cell docosahexaenoic acid

Wang *et al.* found a significant positive correlation between dietary fish intakes and red blood cell (RBC) n-3 polyunsaturated fatty acids levels, especially with docosahexaenoic acid (DHA, $r = 0.640$, $P < 0.001$) (YQ Wang *et al.* unpubl. data, 2001). In turn, there was a strong inverse correlation between RBC DHA and CVD mortality (Tables 9,10). The proportion of DHA in RBC was significantly inversely associated with plasma triglyceride concentrations, but positively correlated with cholesterol and non-high-density lipoprotein cholesterol (HDL-C) concentrations in plasma. These results suggest that DHA and other n-3 unsaturated fatty acids has a role in the prevention and modulation of CVD in China, which is consistent with similar studies on CVD in western countries with high fat diets.

Oleic acid

The relationships between CVD (CHD, HHD, stroke) mortality and plasma lipids, and RBC fatty acid composition were examined based on the data from the China study (Fan *et al.*).[8] As shown in Table 11, there was no significant correlation between the various cholesterol fractions and the three CVD mortality rates. In contrast, plasma triglycerides was significantly positively associated with CHD and HHD, but not with stroke. The monounsaturated fatty acids (18:1 n-9, 20:1 n-9 and total) were significantly inversely associated, whereas the n-6 fatty acids were positively associated with all three CVD mortality rates. The magnitude of these associations varied and some of the associations were stronger than others. Considering that the RBC oleate levels were not associated with plasma cholesterol, but were strongly negatively associated with arachidonate concentrations, this suggests potential diminution of CVD by oleate through reduced platelet aggregability. The consumption of wheat

Table 7. Fat intake (% of total energy) in 1992 and 1982

	1992				1982
	Low income	Middle income	High income	Mean	Mean
National	15.6	21.3	29.0	22.0	18.4
Urban	2.7	30.1	32.3	28.4	25.0
Rural	14.8	18.0	23.1	18.6	14.3

Source: 1. Ge, K *et al*. Report of the Third NNS. J Hygiene Res 1996; 25: 10.
2. Institute of Health, Chinese Center for Preventive Medicine, Summary report of the 1982 NNS (unpublished).

Table 8. Correlation (*r*) between food consumption and CVD mortality in Shanghai

Food	Heart disease	Cerebrovascular disease
Cereals	– 0.2009	– 0.4542
Vegetables	– 0.0920	0.1124
Meat and poultry	0.9008**	0.8036**
Eggs	0.7892**	0.4996
Sugar	0.9359**	0.8460**

**$P < 0.01$.

Table 9. Correlation (*r*) between RBC n-s unsaturated fatty acids levels and fish intakes

	Fish intake
RBC DHA	0.640***
RBC n-3 unsaturated FA	0.551***
RBC n-6 unsaturated FA	–0.210

FA, Fatty acids; DHA, docosahexaenoic acid; RBC, red blood cell.
***: Correlation is significant at the 0.001 level (2-tailed)
Source: Wang *et al.* unpubl. data, 2001.

Table 10. Correlation (*r*) between RBC n-3 unsaturated fatty acid levels and CVD mortality

	MI/CHD	HHD	HHD/MI/CHD	S/HHD/MI/CHD	Stroke
DHA	–0.220	–0.307*	–0.288*	–0.219	–0.173
DHA + 18 : 1	–0.525**	–0.359	–0.474**	–0.364*	–0.289*

CHD, coronary heart disease; MI, myocardial infarction; HHD, hypertensive heart disease; S, stroke.
**: Correlation is significant at the 0.01 level (2-tailed); *: Correlation is significant at the 0.05 level (2-tailed).
Source: Wang *et al.*, unpubl. data, 2001.

Table 11. Correlation (*r*) between CVD mortality rate and plasma lipids, RBC-PC fatty acids, and selected dietary variables in 49 rural counties in China

	CHD	HHD	Stroke
Plasma lipids			
Total cholesterol	0.09	0.02	0.09
LDL cholesterol	0.01	– 0.08	0.09
HDL cholesterol	0.03	0.04	– 0.04
HDL/total cholesterol	– 0.05	0.03	– 0.14
Triglycerides	0.32*	0.36**	0.08
RBC-PC fatty acids			
18:1 n-9 (oleate)	– 0.55***	– 0.40**	– 0.33*
20:1 n-9 (gadoleate)	– 0.23	– 0.50***	– 0.31
20:4 n-6 (arachidonate)	0.32*	0.43**	0.43*
Total n-6	0.41**	0.48**	0.33*
Total MONO	– 0.58***	– 0.52***	– 0.40**
Total PUFAT	0.35*	0.44**	0.27
Dietary factors			
Rice	– 0.54***	– 0.42**	– 0.27
Wheat flour	0.57***	0.48***	0.41**
Legumes	– 0.29*	– 0.28	– 0.32*
Rapeseed oil	– 0.31*	– 0.38**	– 0.21
Steamed bread	– 0.32*	– 0.43**	– 0.33*
Green vegetables	– 0.45**	– 0.39**	– 0.38**
Salt index	0.49***	0.50***	0.43**

LDL, low-density lipoprotein; HDL, high-density lipoprotein; RBC-PC, red blood cell-phosphatidylcholine; MONO, monounsaturated; PUFAT, polyunsaturated fatty acids. *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

flour and salt (measured by a computed index of salt intake and urinary sodium excretion) was significantly positively correlated with all three diseases (CHD, HHD and stroke) mortality. In contrast, the consumption of rice, legumes, rapeseed oil, steamed bread and green vegetables was significantly inversely correlated with CVD mortality. A series of multiple-regression analysis were undertaken to assess the relative importance of phosphatidylcholine (PC) oleate, rice intake, and plasma triglycerides concentration in relation to the mortality rates for CHD, HHD and stroke (Table 12). These three variables were chosen for analysis because of their particularly strong association with these diseases mortality rates. Both oleate and rice intakes were significantly negatively associated with CVD, especially with CHD. Oleate remained positively correlated with CHD after plasma triglycerides was adjusted. When oleate was controlled for, rice intake had a strong negative association with CHD for males. The results also indicate that plasma triglyceride was positively associated with HHD in women, even after oleate and rice were adjusted for.

Dietary anti-oxidant vitamins and CVD

Zhao *et al.* reported the relationships between the incidence of CHD and dietary intake of carotene and other anti-oxidant vitamins (vitamin C and vitamin E).[9] The incidence of CVD was monitored according to the study of monitoring of trends and determinants in cardiovascular diseases

(MONICA) procedure among 100 000 residents in each of 13 population groups from different parts of China in 1991–95. A random cluster sample of 1000 (35–56 years, men and women) was drawn from each population group for a survey of CHD risk factors with a 1/10 subsamples for 3 consecutive days of 24-h dietary interviews (dietary data was available for 13 population groups). The age-standardized (25- to 74-year-old) incidence of CHD was 1–154/100 000 for men and 0–75/100 000 for women among the 13 population groups. Only the mean daily intake of carotene (421–1414 μg/1000 kcal in men, 573–2144 μg/1000 kcal in women) was significantly inversely correlated with the incidence of CHD ($r = -0.4231$, $P = 0.03$) by simple correlation analysis. The major sources of carotene were dark coloured vegetables, which provided 38–91% of carotene intakes. The results of multiple linear regression showed that mean daily intake of carotene and the intake ratio of dark coloured vegetables to total vegetables were significantly negatively associated with the incidence of CHD (b = – 0.0389, $\beta = -0.3556$, $P = 0.01$, $R^2 = 0.80$; b = – 55.501, $\beta = -0.2734$, $P = 0.03$, $R^2 = 0.88$, respectively) after adjustment for sex, body mass index (BMI), serum total cholesterol and diastolic blood pressure (DBP). It was concluded that a higher intake of carotene, which mainly comes from dark coloured vegetables in the Chinese diet, may decrease the risk of CHD in the Chinese population.

Dietary protein, salt, minerals and CVD

Chen *et al.* found that the intake of salt was positively correlated with the mortality of CVD ($r = 0.3$, $P < 0.05$).[6] Yang *et al.* assessed the relationship between stroke mortality and mean daily intake of sodium, potassium and protein in an ecological study.[10] The study was a part of the China Multi-Center Study on Cardiovascular Epidemiology. In 1991–95, 13 target populations in different parts of China were monitored with around 100 000 residents. The age-standardized acute phase mortality of stroke events (25–74 years old) ranged from 26 to 165/100 000 in men, and 12 to 131/100 000 in women. The mean daily intake of animal protein, total protein, sodium (Na), potassium (K) and relevant factors were obtained from a survey in a cluster sample of each population. The results of multiple linear regression analysis on the relationship of nutrients to stroke mortality adjusting for BMI and DBP showed that mean daily intake of animal protein (g/1000 kcal) and ratio of animal protein/total protein were significantly inversely associated with stroke mortality. The mean daily intake of sodium (mg/1000 kcal) as well as Na/K ratio were significantly positively associated with stroke mortality. The high intake of animal protein may decrease the risk of stroke mortality, and the high intake of salt and Na/K ratio may increase the risk of stroke mortality in the Chinese population.

Diet, nutrition and hypertension

Dietary mineral (Na, K, Ca and Mg) intake and hypertension

Tian *et al.* studied the relationship between average blood pressure of Tianjin residents and the intake of dietary minerals.[11] The intake of dietary sodium and the Na/K ratio were positively correlated with both SBP and DBP ($P < 0.05$) (Tables 13,14). A high intake of Na and high Na/K ratio were the two major risk factors for hypertension in Tianjin

Table 12. Multiple-regression analysis on RBC oleate CVD mortality

	Unadjusted		Adjusted for TG		Adjusted for rice intake	
	β	$\%R^2$	β	$\%R^2$	β	$\%R^2$
Males						
CHD	0.545***	29.7	0.507**	36.8	0.368**	43.7
HHD	0.278	7.8	0.257	10.0	0.189	11.4
Stroke	0.278	7.7	0.278	7.7	0.291	7.8
Females						
CHD	0.467**	21.8	0.406**	27.5	0.324*	29.8
HHD	0.336*	11.3	0.229	28.6	0.195	19.1
Stroke	0.303	9.2	0.288	9.5	0.204	13.0

RBC, red blood cell; CHD, coronary heart disease; HHD, hypertension heart disease; CVD, cardiovascular disease; TG, triglycerides. *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Table 13. Multiple-regression analysis between DBP and dietary intake of minerals (β, SE)

Dietary intake	Male ($n = 328$)	Female ($n = 335$)	Sum ($n = 663$)
Na	0.026 (0.010)*	0.028 (0.011)*	0.028 (0.008)
K	– 0.142 (0.010)	– 0.063 (0.101)	– 0.112 (0.070)
Ca	0.091 (0.178)	– 0.333 (0.230)	– 0.070 (0.142)
Mg	0.061 (0.336)	0.147 (0.376)	0.079 (0.250)
Na/K	1.165 (0.484)*	0.895 (0.468)	1.040 (0.337)**

DBP, diastolic blood pressure; Na, sodium; K, potassium; Ca, calcium; Mg, magnesium. *$P < 0.05$, **$P < 0.01$, $P < 0.001$.

Table 14. Multiple-regression analysis between SBP and dietary intake of minerals (β, SE)

	Male ($n = 328$)	Female ($n = 335$)	Sum ($n = 663$)
Na	0.014(0.007)*	0.013(0.006)*	0.014(0.005)**
K	– 0.088(0.065)	– 0.056(0.057)	– 0.072(0.042)
Ca	– 0.031(0.116)	– 0.242(0.129)	– 0.111(0.085)
Mg	0.201(0.219)	0.218(0.211)	0.195(0.150)
Na/K	0.661(0.316)*	0.458(0.263)	0.560(0.203)**

SBP, systolic blood pressure; Na, sodium; K, potassium; Ca, calcium; Mg, magnesium. *$P < 0.05$, **$P < 0.01$, $P < 0.001$.

residents. No significant relationships were found between the intake of calcium, magnesium and blood pressure.

Food intake and hypertension

Zhao *et al.* studied the relationships between blood pressure and daily food intake.[12] The study was a part of the China Multi-Center Study on Cardiovascular Epidemiology. In 1991–95, 13 target populations in different parts of China were monitored. Three days worth of dietary information were collected using 24 h food recall in 1670 residents. The results of multiple regression analysis between food consumption and blood pressure adjusting for BMI and sex showed that the mean daily intake of fish and fruits were significantly inversely associated with DBP and SBP, respectively. The mean daily intake of sodium and animal fat were significantly positively associated with DBP and SBP (Table 15).

Dietary pattern and hypertension

An epidemiological study comparing dietary patterns and population means of blood pressure was undertaken in 10 population groups (3 groups of factory workers, 6 groups of farmers and 1 group of fishermen) of adult males and females in north-east, north, south, middle and east China (Zhou *et al.*).[13] Simple correlation and multiple regression (adjusted for age, sex and BMI) and ridge regression analysis were used to analyse the relationship between dietary electrolytes and animal protein intakes and blood pressure. The results show a significant negative association of mean daily intake of Ca and animal protein with mean blood pressure. Excluding the fishermen's group, mean daily intake of Na showed significant positive association with both SBP and DBP (Table 16). The differences in mean blood pressure levels among groups in different areas and occupations are closely associated with differences in dietary patterns and nutrient intake. Mean daily intake of Na was significantly positively associated with blood pressure level. Calcium and animal protein was negatively associated with mean blood pressure (Table 17). It is concluded that a decrease in sodium intake, an increase in Ca intake and a proper increase intake of animal protein in the rural Chinese diet may lower the mean blood pressure level.

Effects of dietary intervention on blood pressure control

A work site intervention program in the Beijing Capital Iron and Steel Company was conducted (Wu *et al.*) to evaluate the feasibility and effects of hypertension prevention and blood pressure control by dietary means.[14] Health education and

Table 15. Multiple-regression analysis between food intake and blood pressure

	SBP			DBP		
	b	β	*P*	b	β	*P*
Fish	– 0.0655**	– 0.5643	0.0035	– 0.0591***	– 0.6431	0.0002
Animal fat	1.2767***	0.6343	0.0006	1.0287***	0.6453	0.0001
Fruit	– 0.0442**	– 0.5616	0.0018	– 0.0397***	– 0.6361	0.0001
Salt	1.0051*	0.4603	0.0129	0.6155*	0.3559	0.0455

DBP, diastolic blood pressure; SBP, systolic blood pressure. **P* < 0.05, ***P* < 0.01, ****P* < 0.001.

Table 16. Correlation between nutrients and blood pressure

No	Variables	SBP	DBP
20	Age	0.5564**	0.5483**
	BMI	0.6133**	0.6001**
	Ca (mg/1000 kcalg/	– 0.6493**	– 0.4725**
	Animal protein (% kcal)	– 0.4273**	*NS*
18	Na mg/1000 kcalmg	+ 0.6228**	0.5841**

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; Ca, calcium; Na, sodium; *NS*, not significant.
**P* < 0.05, ***P* < 0.01, excluding the 2 fishermen groups.

Table 17. Regression analysis of nutrients and blood pressure (BP), adjusting for age, sex and BMI (*n* = 18)

	SBP		DBP	
	β	*P*	β	*P*
Animal protein (% kcal)	–0.4632**	0.0012		*NS*
Na (mg/1000 kcal)	0.4335**	0.0063	0.4719	0.0426*
K (mg/1000 kcal)		*NS*		*NS*
Ca (mg/1000 kcal)	–0.3848*	0.0398		*NS*
Na/K	0.0659*	0.0486		*NS*

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; *NS*, not significant; Na, sodium; K, potassium; Ca, calcium. **P* < 0.05, ***P* < 0.01; excluding the two fishermen groups.

dietary advice, including reducing fat and cholesterol intake and particularly restricting salt consumption, were carried out. A total of 662 males were included in the interviewed factories (IF) and the impact on blood pressure was compared with 542 males in the control factories (CF) in 1987. The number of subjects participated in the program increased to 1176 males in IF and 1014 males in CF in 1995. Dietary data were collected according to a standardized 24-h dietary recall procedure in 3 consecutive days. Mean daily salt intake was reduced from 16.0 to 10.6 g/day (33.7% reduction, $P < 0.05$) in IF, and from 16.9 to 15.4 g/day (8.9% reduction, $P > 0.05$) in CF over 8 years. Meanwhile, the blood pressure of normotensives in IF decreased more significantly than that in CF (net reduction of SBP: 2.5 mmHg, $P < 0.05$; and DBP: 2.2 mmHg, $P < 0.01$ for IF *vs* CF). It was concluded that dietary modification, especially restricting salt consumption in males, is one of the effective measures for hypertension prevention and control at work sites.

Discussion

Most data used in this paper are from cross-sectional studies conducted in various parts of China. While this information is useful in generating hypotheses on dietary and nutritional risk factors for CVD, both prospective studies and population-based intervention trials are needed to further verify these hypotheses.

This review clearly shows that diet and nutrition factors play important roles in the occurrence of CVD and hypertension in the Chinese population. Therefore, dietary means should be an important part of the strategies for the control of CVD and hypertension in China. However, it should be noted that unlike the studies conducted in western countries, animal protein intake showed protective effects on CVD. This may be because these studies are early studies conducted in poor populations. The further study should be conducted to confirm the effect of animal protein on CVD.

Among the various methods for the collection of food consumption data, the 24-h recall method was used in most studies. However, the information collected by the 24-h recall method is not able to reflect long-term food consumption, which is particularly important in studies on diet and chronic disease relationships. The use of food frequency questionnaire in studying diet and CVD relationships in China should be studied further (WH Zhao and JS Chen unpubl. data, 2001).

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