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Diet and nutritional status related to cardiovascular disease risks in contemporary China

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Summary Rapid economic development in China is accelerating the dietary shift towards a ''western diet", which is accelerating the epidemic of obesity and atherosclerotic cardiovascular diseases. This review aims to provide insights into the diet and nutritional status related to cardiovascular diseases and away-from-home food intake behavior, which make a healthy diet hard to control in contemporary China. The data summarized in this review come from the National Survey of Nutrition and Health Status of 2002. In general, the current Chinese diet is characterized as high in sodium, low in fruits and vegetable intake, and low in calcium, potassium, and magnesium intake. In addition, areas of different levels of economic development throughout China show a complex dietary and nutritional distribution. There was no area where the diet and nutritional status would make the residents free of cardiovascular risk. Residents in less developed rural areas, have a higher daily intake of animal oil and dietary sodium, and a lesser intake of calcium. Residents in developed urban areas consume a remarkably higher percentage of calories from fat, e.g., 38.4% in large-sized cities. At present among urban people, the average potassium and magnesium intake is remarkably lower than the recommended levels. In addition, a significantly high proportion of young adults in urban areas eat meals away-from-home, which exposes them to an unhealthy diet of increased calories from fat especially saturated fat, more sodium, and lower in fiber and calcium. To deal with the unhealthy diets, there is an urgent need to develop targeted strategies and measures, that match levels of economic development and local customs.

Introduction

In recent decades, the burden of disease in China has shifted towards noncommunicable diseases (NCDs). One of the major causes of death in China is cardiovascular diseases, accounting for 32% of

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deaths and 13% of DALYs lost in 2005 [1]. In 2006, cerebrovascular disease and heart disease ranked 2nd and 3rd among leading causes of death in urban China, and 2nd and 4th in rural China [2]. The economic consequences of NCDs for China are serious. From cardiovascular diseases alone, Chinese people aged 35—64 years lost 6.7 million years of productive life during the year 2000 at a cost to the country of around US $ 30 billion. Only a quarter of this cost was estimated to be direct health-care costs. If current trends continue, the total number of years of productive life lost in this age range in China is estimated to increase to 10.5 million by 2030 [3].

The causes of the major chronic diseases including cardiovascular diseases are well established and well known. An unhealthy diet and excessive energy intake, together with physical inactivity and tobacco use, are the most important modifiable risk factors. These causes are expressed through the intermediate risk factors of raised blood pressure, raised glucose levels, abnormal blood lipids, and overweight and obesity. The relationship between the major modifiable risk factors and the main chronic diseases is similar in all regions of the world [4].

Multiple elements of the unhealthy diet are related to cardiovascular diseases. Dietary intake of fat, cholesterol, fruits and vegetables, fish and sodium are linked to cardiovascular risk. There is strong observational evidence that reducing intake of total fat (to less than 30% of calories), saturated fat (to less than 10% of calories), and salt (to less than 5 g per day), and increasing consumption of fruits and vegetables (to 400—500 g daily) are likely to be beneficial [5]. Decreased intake of sodium alone, and increased intake of potassium, calcium, and magnesium each alone helps decrease elevated blood pressure. The most pronounced effects are brought about by a combination of several of these dietary factors [6].

In recent decades, rapid economic development in China has accelerated a dietary shift, i.e., universally towards a diet high in saturated fat, foods from animal sources, sugar, refined foods with an increased ''energy density'', and low in fiber, often termed the ''western diet''. This review aims to provide evidence-based insights into the diet and nutritional status related to cardiovascular diseases and away-from-home food intake behavior, which makes a healthy diet hard to control in con-

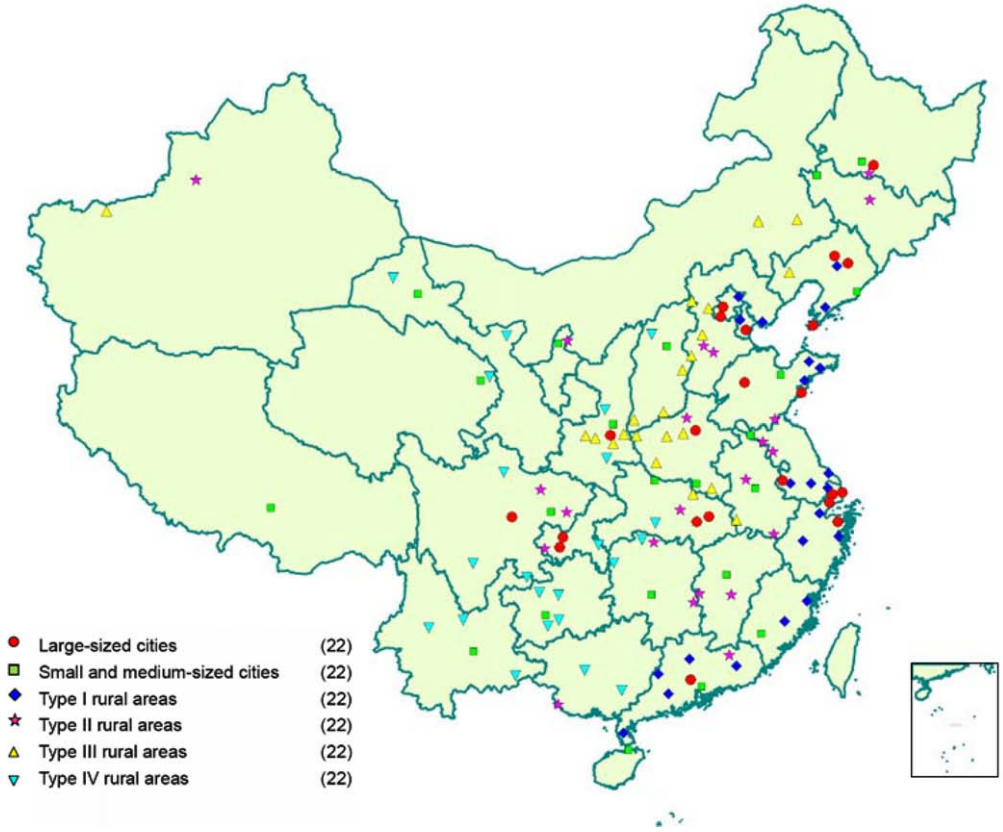

Figure 1 Schematic diagram for the geographical location of sampled counties (or cities not divided into districts and municipal districts).

temporary China, and helps understand the potential cardiovascular risk among Chinese.

Methods

The data derive from the National Survey of Nutrition and Health Status of 2002 [7—9], which was developed by the PRC Ministry of Health, Ministry of Science and Technology and National Bureau of Statistics of China. This survey covered 31 provinces, autonomous regions and municipalities directly under the Central Government throughout China (except Taiwan, Hong Kong and Macao). The subjects were recruited using a stratified multistage cluster sampling design, where equal numbers were sampled across strata. China was divided into six areas i.e., strata according to comprehensive economic power categorized by the National Bureau of Statistics of China. These are: large-sized cities, small- and medium-sized cities, Type I class rural areas, Type II rural areas, Type III rural areas and Type IV rural areas. Their economic development had an order of decreasing rank from most developed areas to less developed areas. At the first stage, 22 counties (or cities not divided into districts and municipal districts) were randomly sampled from each stratum (Fig. 1). In the second stage, three townships (towns and sub-districts) from each selected county were randomly sampled. In the third stage, two villages (resident communities) from each selected township were randomly sampled. In the fourth stage, 90 households from each selected village were randomly sampled. All residents in the selected household completed a questionnaire by interview, underwent a physical examination, and had their haemoglobin measured using fingertip blood. Subsequently 30 households were randomly selected from the 90 households to finish an additional dietary investigation and biochemical testing, including fasting plasma glucose, lipid profile and vitamin A. The field investigations were done from August to October in North China and from September to December in South China.

The dietary investigations included three methods, i.e., 24-h dietary recall on three consecutive days, one-year food frequency questionnaire, and food weighting [7]. Finally, 23,470 households (68,962 persons) completed the dietary investigation, of which 7687 households (21,103 persons) were from urban areas and 15,783 households (47,859 persons) from rural areas.

To facilitate a better understanding of the gap between the status quo and the recommended intake levels, likely to be beneficial to cardiovascular health, we reviewed the dietary recommendations related to cardiovascular health developed by WHO and China [5,10,11]. These are listed in Table 1.

Results

Dietary intake of fat

The daily energy intake among rural people (2296 kcal) was higher than that among urban people (2134 kcal). However, the fat intake increased with higher levels of economic development (Fig. 2). In Chinese urban areas, especially in large-sized cities, the average daily percentage of calories from fat far exceeded the recommended upper limit of 30.0% (Table 2). More than 30% of calories from fat were consumed by 65.3% of urban residents and by 37.2% of rural residents. In Fig. 2,

Table 1 Recommended daily dietary intake [5,10] or adequate intakes (AIs) [11], likely beneficial to cardiovascular health

		WHO	China
Fat	Percentage of calories from fat	<30%	<30%
	Saturated fats	<10%	<10%
	Monounsaturated fats	15%	—
	Polyunsaturated fats	up to 10%	—
Vegetables			400—500 g
Fruits		>400 g	100 g
Salt		<5 g	<6 g
Sodium		—	2200 mg
Calcium		—	800 mg (for age 18 to 49 years) 1000 mg (for age 50 + years)
Potassium		—	2000 mg
Magnesium		—	350 mg

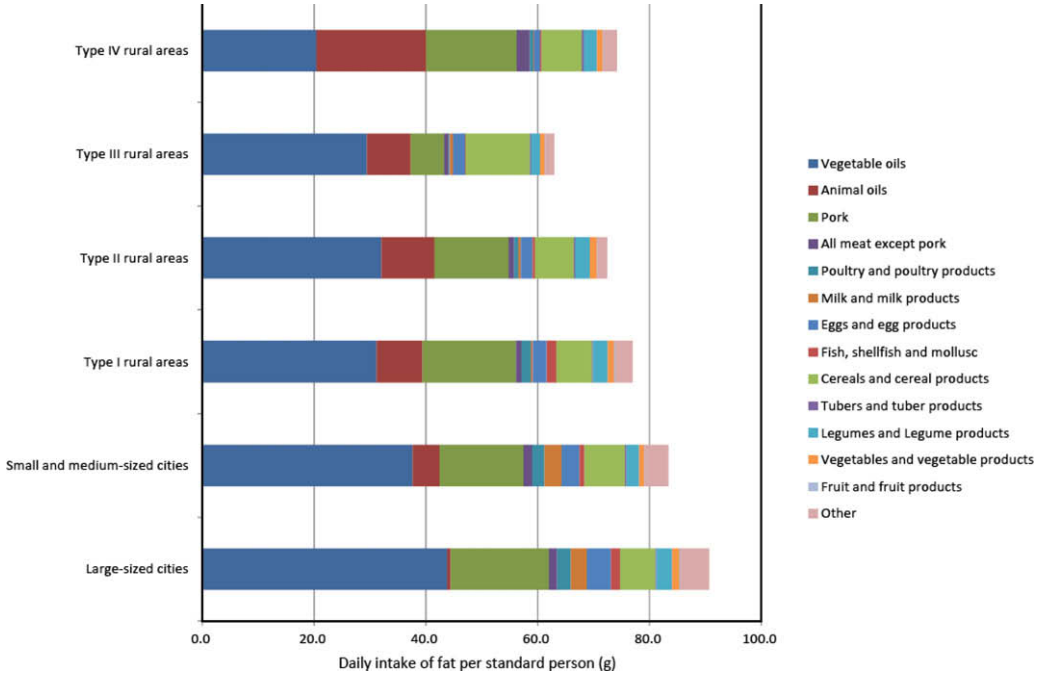

Figure 2 Daily intake of fat and its food sources by areas of economic development, China, 2002.

Table 2 Daily intake of major foods and nutrients by areas of economic development, China, 2002

	Urban			Rural				
	Total	Large-sized cities	Small and medium-sized cities	Total	Type I rural areas	Type II rural areas	Type III rural areas	Type IV rural areas
Daily energy intake (kcal)	2134	2098	2148	2296	2298	2288	2304	2312
Percentage of calories from fat (%)	35.0	38.4	33.7	27.5	29.2	27.6	23.7	27.4
Vegetables (g/day)	251.9	276.7	242.1	285.6	264.0	299.1	253.8	291.2
Fruits (g/day)	69.4	82.9	64.0	35.6	57.9	31.6	36.8	19.1
Salt (g/day)	10.9	10.0	11.2	12.4	12.0	12.1	14.7	12.6
Sauce (g/day)	10.6	12.9	9.8	8.2	11.3	7.3	7.7	7.2

we can see that edible oil and meat were the major food sources of fat among Chinese people.

Vegetable oil was the most widely consumed oil in China (91.4% urban residents versus 74.0% rural residents) (Fig. 3). The use of animal oil was associated with less developed economy. In the poorest areas of China (i.e., Type IV rural areas), 47.9% of the daily intake of oil was animal oil, in contrast to 1.7% in the large-sized cities. The most commonly used vegetable oils included rapeseed oil, peanut oil, soybean oil, and salad oil.

Pork accounted for 55.6% of animal food in the poorest areas of China (Fig. 4). In areas with higher economic development, the intake of animal food showed more diversity. Pork accounted for about one third of animal food. The intake of eggs, fish, and poultry increased significantly.

Intake of fruits and vegetables

Chinese rural people ate more vegetables than urban people (Table 2). On the contrary, urban people ate more fruits than rural people. None of the six areas reached recommended intake levels. Less than 15% of Chinese people ate recommended average daily amounts of vegetables and fruits.

Dietary sodium

The average daily intake of salt was 12.4 g in rural areas and 10.9 g in urban areas. The average daily intake of sauces was 8.2 g in rural areas, and 10.6 g in urban areas. The major source of dietary sodium among Chinese was salt, accounting for

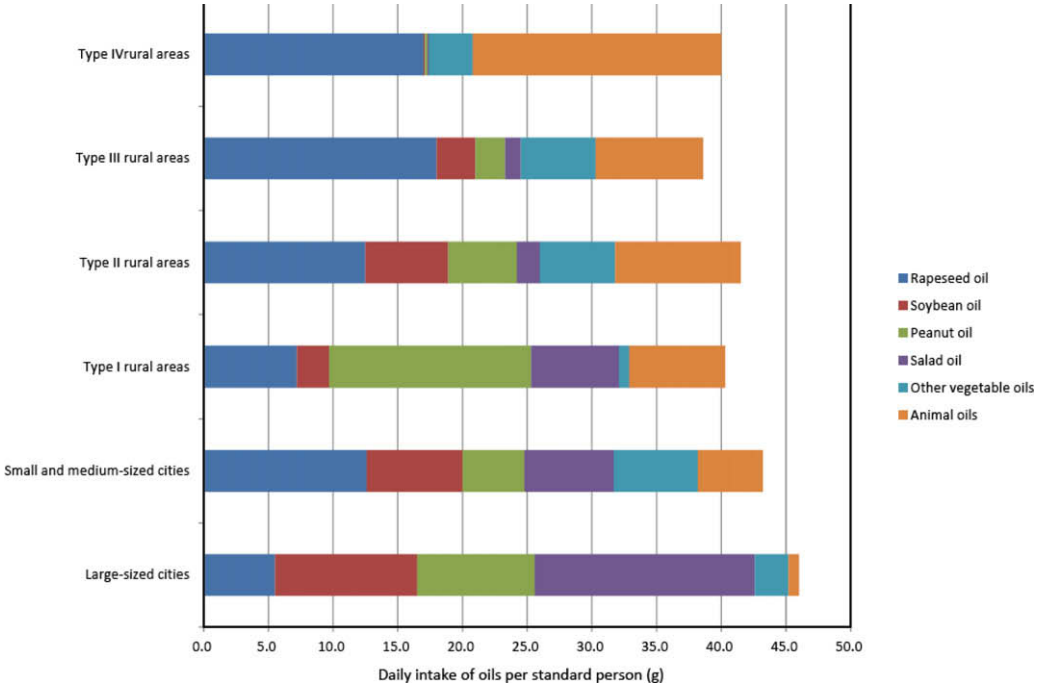

Figure 3 Daily intake of oils by areas of economic development, China, 2002.

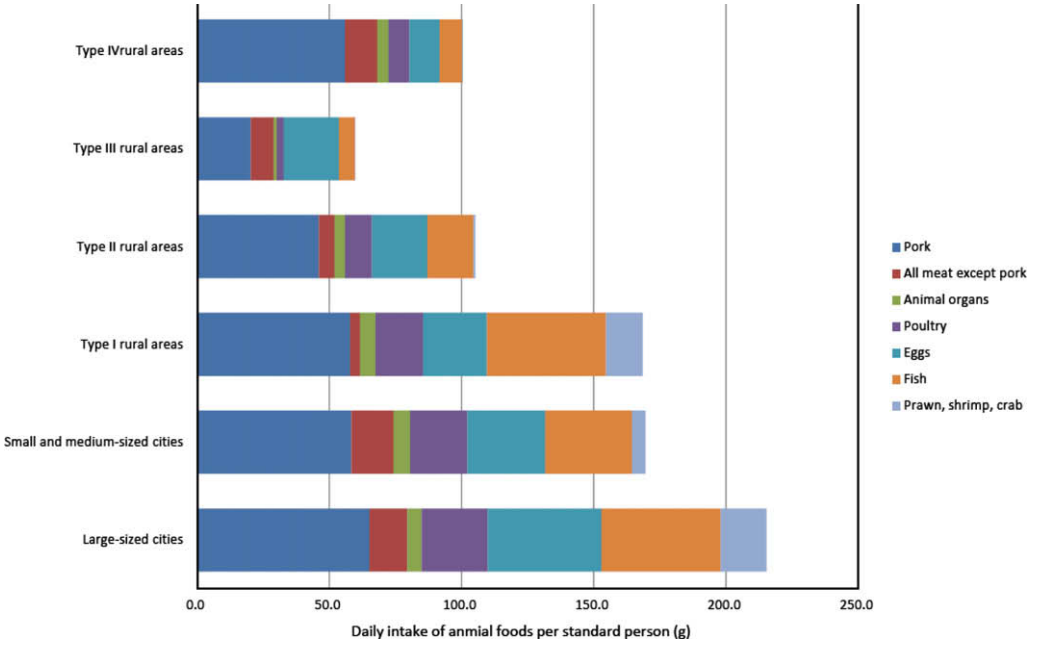

Figure 4 Daily intake of animal foods by areas of economic development, China, 2002.

66.6% in urban and 74.2% in rural (Fig. 5). Sauces were the secondary single source of dietary sodium. In more economically developed areas, about one third of dietary sodium came from sauces, other condiments and foods.

The average daily sodium intake of 6007.7 mg by Chinese in urban areas and 6368.8 mg in rural areas was remarkably higher than the recommended adequate intake (AI) of 2200 mg. People living in Type III rural areas had the highest daily intake of sodium (7035.4 mg). There were 78.0% of urban residents and 88.1% rural residents with a 140% AI or greater daily intake of sodium (Fig. 6).

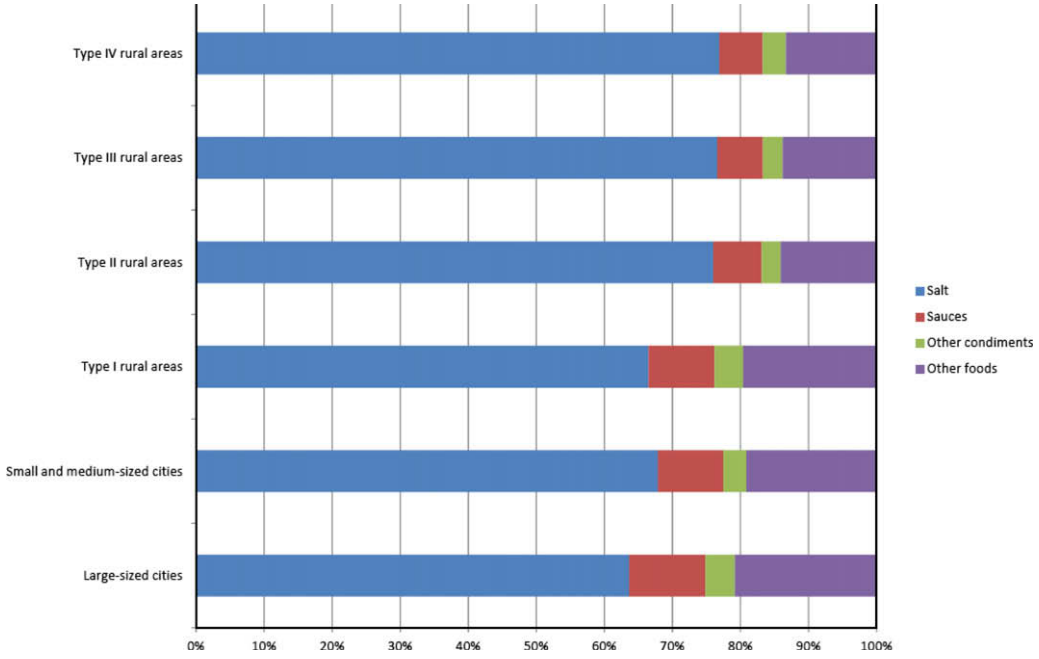

Figure 5 Sources of sodium intake by areas of economic development, China, 2002.

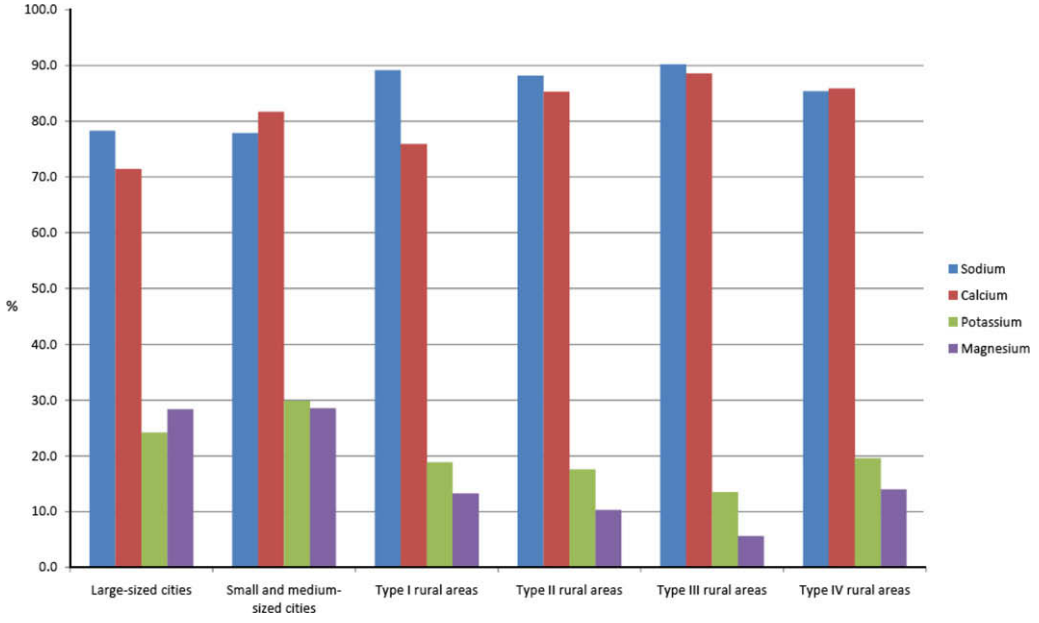

Figure 6 Percentage of people whose daily intake of sodium was ⩾140% AI and calcium, potassium and magnesium intake was <60% AI by areas of economic development, China, 2002.

Other major macronutrients

Chinese people had a generally low intake of calcium, potassium, and magnesium, with an average daily intake of 438.6, 1722.4, and 291.8 mg in the urban areas, and 369.6, 1691.5, and 315.3 mg in the rural areas respectively. None of the six areas reached recommended AI levels of calcium (800 mg/day) and potassium (2000 mg/day) intake. People in large-sized cities had the highest average daily calcium intake of 510.5 mg and potassium intake of 1854.8 mg. Type III rural areas were the only areas where people had an average daily intake of magnesium of 360.7 mg beyond the

recommended AI level (350 mg/day). In addition, people in Type III rural areas had the second highest daily potassium intake of 1757.9 mg. More urban residents had less than 60% of AI intake of potassium (28.3% vs. 17.8%) and magnesium (28.5% vs. 11.0%) than rural residents (Fig. 6). Fewer urban residents had less than 60% of AI intake of calcium (78.8% vs. 83.8%) than rural residents.

Away-from-home food intake

The percentage of people who have meals eaten outside the home was calculated among those who eat three meals daily, which accounted for about 91.5% of the Chinese people. More urban residents had their meals eaten outside the home at least once daily than rural residents (26.1% vs. 8.7%). This percentage increased with higher levels of economic development (Fig. 7). Young adults were more likely to eat outside the home than older people (15—17 years: 30.8%; 18—44 years: 19.5%; 45—59 years: 11.1%; 60 + years: 4.2%), and males more likely than females (18.6% vs. 11.0%) (Fig. 8). Such age and sex differences held when looking within economic development areas. Significantly high proportions of urban people ate breakfast (14.4%) and lunch (16.2%) outside the home. However, the major place for meals was different for breakfast and lunch. More urban people ate at restaurants or open-air street stalls for breakfast (11.5%) and at a workplace canteen for lunch (11.9%) (Fig. 9).

Discussion

The current Chinese diet is generally characterized as high in sodium, low in fruits and vegetable intake, and low in calcium, potassium, and magnesium intake. Pork is the major animal food, which means high in fat, especially saturated fat. The results also show complex distributions in the diet related to cardiovascular disease risk in contemporary China. There was no area of residents where diets and nutritional status stood out as being consistently beneficial or harmful to cardiovascular health. In less developed rural areas, the average daily percentage of calories from fat is still under 30.0% of the recommended upper limit. However, rural residents have a higher daily intake of animal oil and dietary sodium, and a lesser intake of calcium. Very few food varieties or options are available for rural people. In developed urban areas, there is a significant increase in food diversity, including healthy and unhealthy options. Vegetable oil is the dominant edible oil. Increased intake of low-fat high-protein animal foods, e.g., beef, poultry, and fish, lower the proportion of pork consumption. However, due to a higher total daily intake of fat, urban people consume a remarkably higher

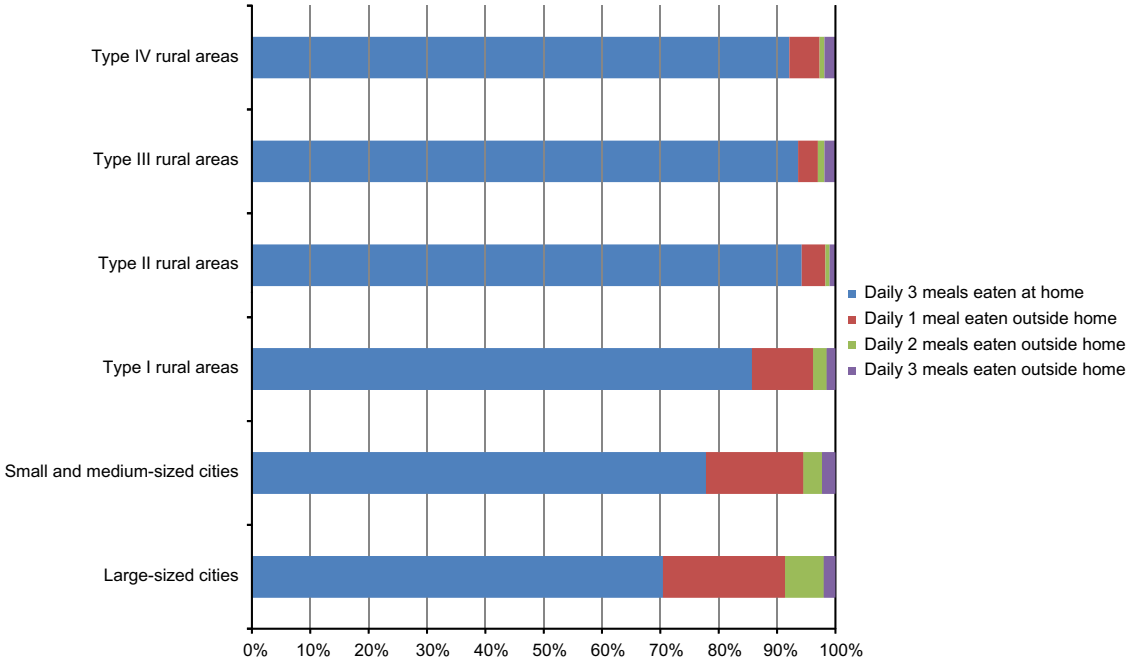

Figure 7 Percentage of people who have meals outside the home by areas of economic development, China, 2002.

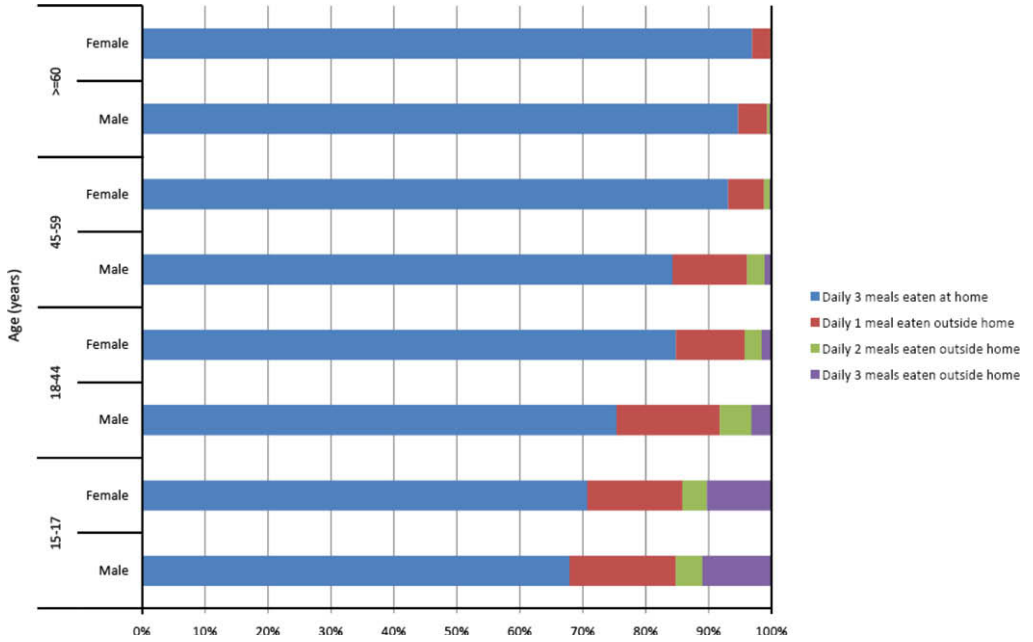

Figure 8 Percentage of people who have meals outside the home by age and sex, China, 2002.

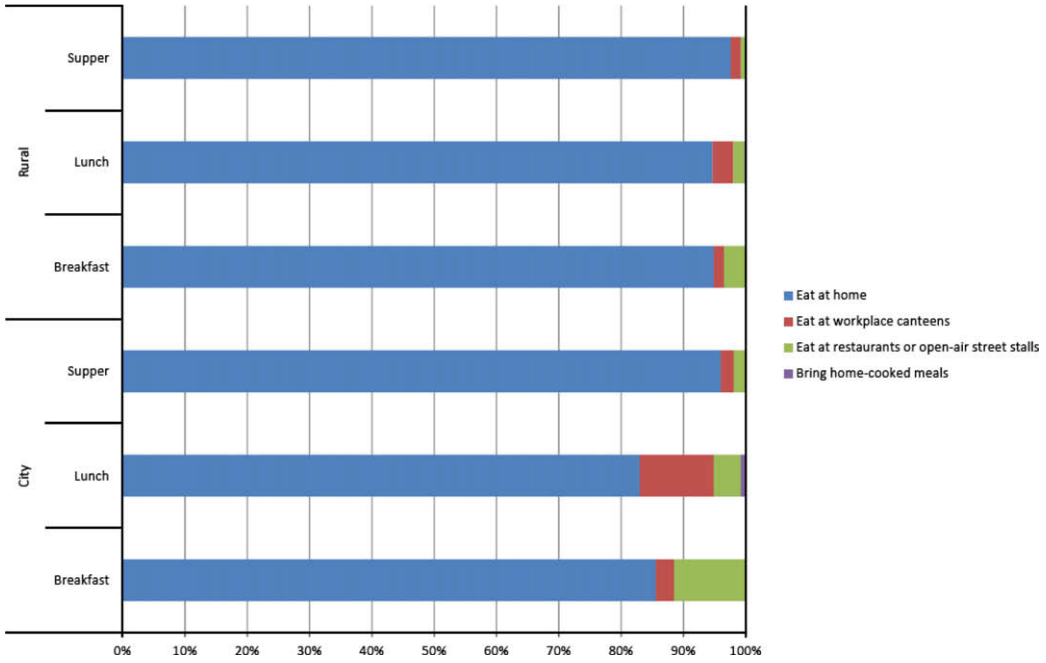

Figure 9 Cumulative percentage of urban and rural people who have meals at different places by type of meal, China, 2002.

percentage of calories from fat, e.g., 38.4% in large-sized cities. In addition among urban people, the present average intake of potassium and magnesium is remarkably lower than the recommended intake levels.

The dietary differences shown among Chinese people can be attributed to not only differences in economic development but also to the geographical location, climate conditions, and available food resources. From Fig. 1, we can see an apparent geographical clustering for the four types of rural areas. Type I rural areas are located along the southeast coast of China. People in Type I rural areas have a similar intake of animal foods as those in small and medium-sized cities and a similar intake of fish as those in large-sized cities. Their

average daily intake of calcium ranks after people in large-sized cities. Type III rural areas are located in the Fen Wei Graben, Dabie mountain area, and Taihang mountain area of central China. People there have a significantly high intake of cereals [7] and a low intake of animal foods and dietary fat. The average daily percentage of calories from fat was the lowest at only 23.7%. Eggs together with pork are the major animal foods. Other impressive characteristics of their diet are a very high sodium intake, high magnesium intake, and a relatively high potassium intake.

Rapid economic development and globalization are driving the Chinese urban population towards a diet high in total energy, saturated fat, salt, sugar, and refined foods and low in fiber — often termed the ''western diet'', which is often accompanied by an increasingly sedentary life and is accelerating the epidemic of obesity and atherosclerotic cardiovascular diseases. In addition, increased income and reduced time to prepare food are inextricably linked to the demand for convenience foods and food away-from-home. As of this decade, urban Chinese are eating away-from-home foods more frequently. However, away-from-home foods deliver more calories in fat and saturated fat and more sodium, and are lower in fiber and calcium than home-cooked foods. It is difficult for consumers to make informed choices regarding the nutritional content of meals. Our results show that young adults constitute the largest proportion of those having meals away-from-home. They are risking their health and add to the future burden of disease. In less developed rural areas, people are not free of cardiovascular risk. Their unhealthy diets are characterized by high sodium intake, high-fat meat and animal oil intake and a low consumption of fruits. Economic deprivation reduces their access to affordable, nutritious foods. Furthermore, poor people are more likely to suffer adverse consequences than wealthier people due to limited access to good-quality health care.

Unhealthy diets are prevalent throughout China. Immediate action must be taken to avoid the consequences, which developed countries are experiencing. Different areas should develop targeted strategies and measures that match levels of economic development and local customs. Health education for individuals remains a critical aspect of health promotion. However, health policy and structure change, such as legislation, taxation and other price incentives to increase the accessibility and affordability of healthy food options, and changes in food production, might be more effective in establishing attitudes and lifestyle changes, especially for those in deprived areas.

Acknowledgments

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