Policy Forum

Challenges Brought about by Rapid Changes in Chinese Diets: Comparison with Developed Countries and Implications for Further Improvement

ZHAO Li Yun[&], LIU Dan[&], YU Dong Mei, ZHANG Jian, WANG Jing Zhong, and ZHAO Wen Hua[#]

Given developments in urbanization, agricultural, and technological practices, the diet and lifestyle of developed countries has changed dramatically over the course of the last century[1]. In England, for example, the per caput consumption of fat and sugar is estimated to have increased by approximately 5-10–old over the last 200 years, while the consumption of complex carbohydrates has decreased dramatically[2].

China's urbanization was implemented relatively late in comparison with that of other countries, but the country has swiftly accomplished what other more-developed countries have done. Over last 30 years, Chinese economic reform policies have accelerated the country's industrial and agricultural development and provided increased incomes and abundant food. China's improved standard of living has brought about significant changes in food consumption, diet, and lifestyle, as well as health and disease patterns, e.g., reductions in diseases of poverty (such as communicable diseases and nutrition deficiency), increases in height, and doubling of life expectancy[3]. The major causes of disease and death in China have shifted from predominantly infectious and diet-related deficiency diseases to obesity and other non-communicable diseases (NCDs), including hypertension, stroke, coronary heart disease, diabetes, and cancer[4].

Rapid changes in diet and lifestyle have occurred with industrialization, urbanization, and economic development over the last several decades, and these developments have exerted a significant impact on the health and nutritional status of many populations, particularly in developing countries and countries in transition, such as China. In China, especially its urban areas, the change from the traditional diet to an 'affluent' one has been more dramatic and rapid compared with that in developed countries.

The objective of this paper is to illustrate long-term trends in Chinese dietary patterns by examining the results of the China Nutrition and Health Survey (CNHS) conducted over the last 30 years. We focus on changes in dietary patterns from a traditional diet to a high-fat, high-energy-density, and low-fiber diet. The benefits and burdens of these changes are also discussed. This article provides readers with food for thought and proposes several ways to address issues related to the current conditions.

Approximately 200-300 years ago, lifestyles in Europe and North America were changed due to the industrial revolution. Since then, animal fat consumption has greatly increased while fiber intake has decreased. The consumption of free sugars also rose, and the consumption of complex carbohydrates declined.

Several scholars have highlighted some of the dramatic dietary changes that have occurred over the last 200 years in the UK[5]. Table S1 (available in www.besjournal.com), for example, shows a substantial drop in the intake of complex carbohydrates (e.g., wheat flour and cereal crude fiber) accompanied by a dramatic rise in fat and sugar consumption. The per caput consumption of fat rose from 25 g/d in 1,770 to 145 g/d in 1970, and sugar intake increased from 10 g/d to 150 g/d over the same period; these consumptions reveal increases of 5.8- and 15-fold, respectively, compared with baseline values. Furthermore, the consumption of wheat flour fell from 500 g/d in 1,770 to 200 g/d in 1970, and cereal crude fiber consumption decreased from 5 g/d to 0.2 g/d over the same period; these numbers indicate decreases of 2.5- and 25-fold, respectively, compared with the original values.

Japan, as a developed country in Asia, underwent a relatively moderate transformation in dietary pattern. Table S2 (available in www.besjournal.com) reveals large increases in total fat and meat consumption since the second half of the 20th century. The per caput intake of total fat rapidly rose

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National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention, Beijing 100050, China

from 20.1 g/d in 1952 to 53.7 g/d in 1975, indicating an increase of 2.5-fold relative to the baseline. Since 1975, the intake of total fat has remained stable and acceptable, ranging from 50 g to 60 g. The change tendencies of animal fat, meat, and milk were similar to that of total fat, and respective intakes of approximately 30, 80, and 120 g per day are generally maintained. Wheat flour consumption presented a moderate increase, while consumption of rice demonstrated a sustained decline in Japan from 1952 onward. The proportions of energy intake from fat, carbohydrates, and protein were maintained over a stable range until the end of the 20th century. Thus, by the end of the 20th century, fat, dietary fiber, and protein intakes were estimated to be within acceptable limits. Japan has since completed its transition of dietary patterns.

The dietary patterns of the Chinese population have undergone dramatic changes since the 1950s, especially in the last three decades. National food disappearance data has revealed a slight decrease in grain consumption and a significant increase in animal food and oil consumption in recent decades. The second national nutritional survey (NNS) carried out in 1982 showed that the Chinese diet had become richer in fats and calories and lower in fiber than that observed by the first NNS, which was carried out in 1959. Such a change comes with increased risks for obesity and chronic diseases.

The dietary staples in northern and southern China are corn or wheat and rice, respectively. However, improvements in living quality have allowed the Chinese to adopt refined carbohydrates instead of complex carbohydrates. Whole-carbohydrate intake, including that of grain cereals and potatoes, has declined. As previously mentioned, dietary patterns in the UK began to change in the first industrial revolution; in China, dietary patterns began to change about 100-200 years later. Since 1982, the intake of carbohydrates, including wheat flour, rice and other cereals, has continued to decline in China (Table 1). The overall intake of staple food decreased by approximately one third, and the intake of potatoes, which are rich in crude fiber, fell from 180 g/d to 35.8 g/d, a 5-fold reduction over 30 years. The total energy intake has only slightly changed, but the percentage contribution of carbohydrate intake to energy intake has declined dramatically. Thus, the types of macronutrients increasingly consumed over the past 30 years should be analyzed. The intake of total fat increased from 48.1 g/d in 1982 to 79.9 g/d in 2012, while the intake of edible oil rose from 18.2 g/d to 42.1 g/d over the same period; these numbers represent 1.6- and 2.3-fold increases, respectively, relative to baseline values. Meat and poultry intake rose from 34.2 g/d to 89.7 g/d, which was a 2.6-fold increase compared with the original value. The Chinese ate more pork, which has a fat content higher than those of beef, chicken, and fish, than residents in western countries. Fat intake in 2002 among the Chinese also surpassed that of the Japanese in 2010. Considering these findings, to say that Chinese dietary patterns have changed fairly rapidly is not an overstatement.

Changes in dietary patterns are mainly manifested by increases in fat and red meat intake and decreases in whole grain and tuber consumption. We took fat intake as an indicator to show changes in the dietary patterns of different countries (i.e., China, the UK, the USA, and Japan). Figure 1 shows three patterns of fat consumption. First, fat intake in China was relatively low before the 1980s; thereafter,

Table 1. Estimated Per Caput Consumption of Nutrients and Major Groups of Foods in China, 1982-2012 (g/d)

Foodstuff	1982	1992	2002	2012
Total fat	48.1	58.3	76.3	79.9
Wheat flour	189.2	178.7	135.3	142.8
Rice	217.0	226.7	204.7	177.7
Other cereal	103.5	34.5	25.3	16.8
Potatoes	180.0	87.0	49.0	35.8
Meat and poultry	34.2	58.9	78.6	89.7
Milk	8.1	14.9	26.5	24.7
Edible oil	18.2	29.5	41.6	42.1

Note. Data sources: Chinese Nutrition and Health Survey.

fat consumption increased rapidly. Second, the consumption of fat in the UK and USA was relatively high. Third, Japan's fat intake revealed a moderate rising trend. Unlike Japan's moderate rising trend, however, the increasing trend of fat intake is significant in China. China required only three decades to catch up to and even surpass Japan in terms of fat consumption. The main features of China's dietary transition include decreases in whole grain and carbohydrate intake and increases in red meat, poultry, fish, and edible oil/fat intake. The trend of westernization of the diets of the Chinese is quite obvious, especially in urban areas. The above data indicate that the Chinese dietary pattern is shifting toward an 'affluent' diet. Changes in the dietary pattern of the Chinese resemble those of developed countries in many ways. Several, even tens of, generations were required by developed countries to experience changes in dietary patterns[5]. In fact, human beings have had virtually no time to biologically adapt to the rapid changes in their dietary structure. China has spent a much shorter time than western countries in such a transition.

Increasing urbanization will bring about consequences to the dietary patterns and lifestyles of many individuals. Research shows that economic growth is associated with improved nutrition[6]. But not all of the changes are positive, more energy rather than nutrition was consumed[7]. Several examples of changes in malnutrition and overnutrition are provided below to clarify this statement.

Anemia is a prevalent public health problem with many adverse consequences[8]. The incidence and prevalence of anemia increases with advancing age[9]. Anemia is common in the elderly, and its impact on various important health outcomes has recently been clearly demonstrated[10-11]. Since its economic reform, China has achieved dramatic developments in nutrition over a relatively short period of time and demonstrated marked improvements in various health indicators, one of which is related to anemia[12].

The prevalence of anemia in the Chinese elderly is significantly lower today than it was 20 years ago. Figure S1 (available in www.besjournal.com) shows that the prevalence of anemia among the Chinese elderly aged ≥ 60 years declined from 26.2% to 12.4% for urban males and from 31.5% to 12.6% for urban females over the period of 1992-2012. Data from the National Nutrition Survey of Japan show an anemia prevalence similar to that in China, although Japanese females had a lower prevalence of anemia than Chinese females. According to the third National Health and Nutrition Examination Survey (NHANES III, 1988-1994), in the USA, the overall prevalence of anemia among adults aged ≥ 65 years was 11.0% in men and 10.2% in women[9]. Accumulating evidence demonstrates that introduction of food supplements exerts prominent effects on iron deficiency correction[11]. Table 1 shows that pork and poultry intake was 34.2 g/d in 1982 but 89.7 g/d in 2012. Therefore, improvements in anemia levels may benefit from the increase in meat and other food consumption. In other words, anemia in Chinese residents has markedly decreased compared with that observed 20 years ago due to improved nutrition.

Data from the Chinese National Survey on Students' Constitution and Health showed that, in 1985, the prevalence of obesity in children and adolescents was below 1%[13]. Before the economic

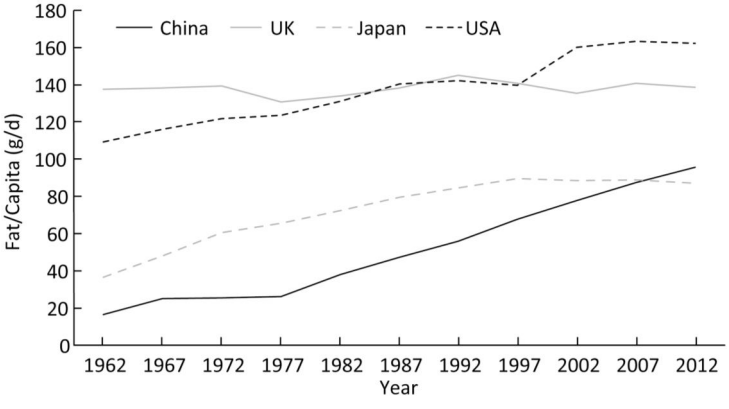

Figure 1. Estimated per caput consumption of total fat among China, UK, Japan, and USA from 1962 through 2012 (g/d). Data sources: FAO, Food Balance Sheets.

reform, no substantial obesity epidemic was recorded in China. Figure S2 (available in www.besjournal.com) shows that obesity prevalence among children and adolescents aged 6-17 years increased from 0.2% to 6.2% between 1982 and 2012. In addition, evidence shows that gender differences influence obesity among the Chinese; in particular, the increase rate of obesity in boys was appreciably higher than that in girls. Among adults, the prevalence of obesity is even worse. Recent data from the CNHS and China Health and Nutrition Surveys show further increases in obesity prevalence among adults[12]. In Figure 2, for example, overweight and obesity rates rose from 9.3% to 42.0% between 1988 and 2012. Remarkably, the prevalence of obesity increased more rapidly among men than among women. A significant rising tendency has also been observed in rural areas. In estimates based on measured data, the prevalence ratio of obesity among the Chinese population was significantly lower compared with that in the USA, but the number of obese in the former was higher than that in the latter[14].

Data from NHANES (Figures 2 and S2) on the USA reveal that, in 2012, the prevalence ratio of overweight and obesity was 75.2% among adults and ratio of obesity 17.2% was among the youth; no significant change compared with ratios obtained in 1999-2000 was observed. The prevalence ratio of obesity in the USA also showed little change over the past 15 years. Data for the US population revealed a period of 40 years (1960-2000) for the obesity prevalence to reach a stable state[15]. If the prevalence of obesity among the Chinese population reaches a stable state, this ratio is speculated to continue to increase over the next few years. Researchers also predict that, if the increase in obesity continues without any effective interventions, China will follow in the footsteps of the USA and face an obesity crisis[16].

The WHO has identified the energy density of diets and fiber content as important factors determining obesity risk[17]. Chinese data show that fat contributed 18.4% of the energy intake in 1982 and 31.5% of that in 2012; the latter value surpasses the upper recommended value[18]. Dietary changes after economic reforms in China were accompanied by an increase in diseases related to affluence, including obesity. An unhealthy lifestyle with poor eating and exercise habits can lead to lifestyle-related diseases and obesity. Increases in obesity rates may, therefore, be expected[19] and could be attributed to increases in energy and fat intake and decreases in physical activity. In Japan (Figures 2 and S2), the prevalence of obesity is plateauing. Obesity rates are falling among children and remaining relative low among adults. This trend may be related to the country's implementation of efforts appropriate to the national situation, including lifestyle intervention, diet therapy, exercise therapy, and group guidance[20]. China must also explore preventive and control measures suited to the characteristics of its own population.

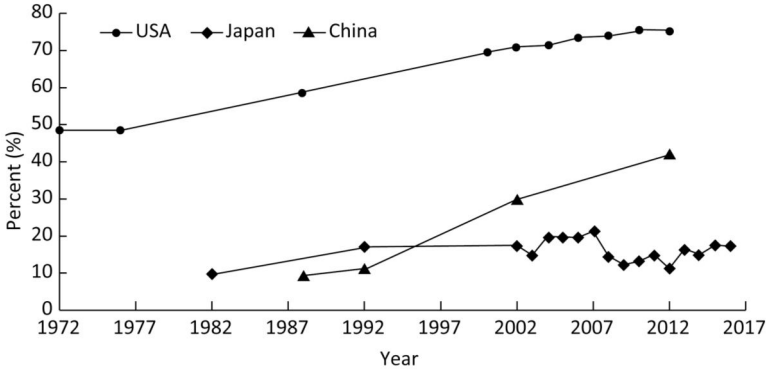

Figure 2. Trends in overweight and obesity prevalence among adults aged 18 and over for Chinese; aged 20 and over (age-adjusted) for American; male aged 20-29 years for Japanese. Data source: China, Chinese National Nutrition and Health Survey, China Health and Nutrition Surveys; USA, CDC/NCHS, National Health and Nutrition Examination Survey; Japan, Ministry of health and welfare of Japan, National Nutrition Survey. Overweight is BMI of 25 or greater but less 30; obesity is BMI greater than or equal to 30 for American and Japanese. Overweight is BMI of 24 or greater but less 30; obesity is BMI greater than or equal to 28 for Chinese.

China's dietary patterns have changed dramatically since the 1980s. The consumption of animal-source foods, e.g., red meat, poultry, milk, and eggs, has steadily increased. This pattern is accompanied by a positive trend of nutrition deficiency. Traditional diets with coarse grains and low fat have shifted toward refined grains and more edible oils. These rapid shifts in dietary patterns have led to an unhealthy westernized dietary pattern. Therefore, new and worrisome issues have emerged, such as increased prevalence of obesity and obesity-related diseases, particularly in urban areas and affluent rural areas. In China, under- and over-nutrition coexist[21-22].

Health problems are related to both specific nutrients and overall meal patterns. Dietary patterns, instead of focusing on individual nutrients or foods, examine the effects of the overall diet, which is regarded as an important factor of chronic diseases[23]. Overall, the important shared features of healthy dietary patterns include high intake of unrefined carbohydrates; moderate protein intake with emphasis on vegetables/legumes, fish, and lean meats; and a healthy fat profile (high in mono/polyunsaturated fats, low in saturated fat; rich in omega-3 fatty acids). The classic Chinese diet includes cereals and vegetables and limits food from animals. Today, however, the Chinese diet has changed to include more energy density and fat and lower fiber content. Evidence from Chinese researchers[24] suggests that modern Chinese diets are independently associated with obesity in Chinese children and adults. In addition to obesity, hypertension and hyperglycemia have increased rapidly over the last decade[4]. Although the nutritional status of the country has significantly improved, the Chinese still face the simultaneous challenges of under-nutrition and over-nutrition. Of these issues, the over-nutrition status may be prioritized.

Multiple complex factors influence dietary preferences. Dietary habits are determined not simply by personal preference but also by familial norms, education, income, nutritional and cooking knowledge and skills, and health status[25]. Lifestyle-related risk behaviors often persist well into adulthood once they are established and are difficult to change without appropriate intervention[26-27]. These complex factors of dietary habits represent a double-edged sword: they may be a potential barrier but could also function as a promising opportunity to encourage healthy diets. Among individuals, focusing on overall dietary patterns is a smart strategy as dietary patterns, not individual foods, permit greater flexibility and personal preferences in diet choices, thereby facilitating improvements in individual behavior and public dietary. In addition, focusing on dietary patterns can lead to health benefits by promoting smaller changes across several dietary factors, rather than major changes in a few factors, and potentially increasing effectiveness and compliance.

Participants in the catering market or food industry, from agricultural producers to food manufacturers, retailers, and restaurateurs, must commit to providing healthier food. The food industry or catering market today is far more diversified than it ever was and has demonstrated marked influences on public dietary preferences over the last few years. This industry must support good nutrition, be informed by modern evidence, and advance their technical expertise to formulate and sell healthier products. More importantly, they must promote consumer education, implement marketing regulations, and maintain stable product pricing to advance dietary health.

Given the key roles of social and environmental factors in shaping dietary habits, population-based policy approaches are crucial to achieve broad success. The environmental impact of food consumption and production should be considered when formulating dietary guidelines and agricultural policies. Population-based preventive interventions are important, and putting weight on group, instead of individual, guidance may be effective[20]. Such policies may also provide promising opportunities to reduce the adverse health and economic impacts of poor diets. Effective strategies can be designed and implemented at the local (e.g., schools, worksites, communities), urban, and rural levels[25]. Research and practices related to health systems could influence and promote policy-making, while policy strategies could complement health systems. In China, major changes in policies and practices are expected.

To address the threat of NCDs (e.g., obesity) to the Chinese population, committed actions with an emphasis on interaction, political engagement, and investment in preventive and treatment services are needed. Sustainable improvements in population-based dietary patterns require close collaboration among individuals and multiple stakeholders, including those at the sociocultural, community, agricultural, industrial, and

governmental sectors. Elucidating the dietary patterns and non-dietary determinants of long-term health homeostasis is crucial. Novel approaches are needed to reduce disease incidence and ease economic burdens across various populations.

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[&]These authors contributed equally to this work and should be considered co-first authors.

[#]Correspondence should be addressed to ZHAO Wen Hua, Tel: 86-10-66237006, E-mail: zhaowh@chinacdc.cn

Biographical notes of the first authors: ZHAO Li Yun, female, born in 1964, Professor, majoring in nutritional epidemiology; LIU Dan, female, born in 1990, PhD candidate, majoring in nutriology, nutritional epidemiology, and chronic disease prevention and control.

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Table S1. Estimated Per Caput Consumption of Nutrients and Major Groups of Foods in UK, 1770-1970 (g/d)

Foodstuff	1770	1870	1970
Total Fat	25	75	145
Sugar	10	80	150
Potatoes	120	400	240
Wheat flour	500	375	200
Cereal crude fiber	5	1	0.2

Note. Data sources: Diet, nutrition, and the prevention of chronic diseases: Report of a WHO Study Group (WHO Technical Report Series 797).

Table S2. Estimated Per Caput Consumption of Nutrients and Major Groups of Foods in Japan, 1850-2010 (g/d)

Foodstuff	1850[a]	1952[b]	1965[b]	1975[b]	1985[b]	1995[b]	2010[b]
Total fat (g)	< 10	20.1	36	52	56.9	59.9	53.7
Animal fat (g)	< 5	17.0	15.4	38.9	40.1	29.8	27.1
Rice	< 350	352	349.8	248.3	216.1	167.9	-
Wheat flour	-	68	60.4	90.2	91.3	93.7	-
Meat (g)	< 5	10.6	29.5	64.2	71.7	82.3	82.5
Milk (g)	0	10.6	57.4	98.4	116.7	144.4	117.3

Note. Data sources: [a]From an old book referring to the Edo area; [b]Ministry of health and welfare of Japan, National Nutrition Survey.

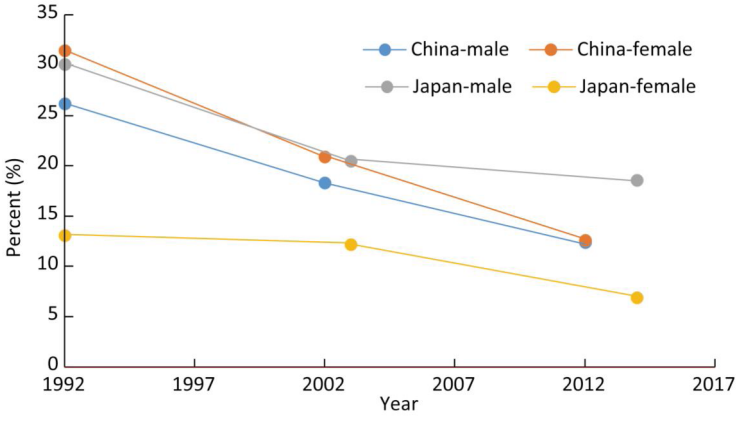

Figure S1. Trends in anemia prevalence of Chinese urban male/female aged 60 and above, 1992 through 2012 and Japanese male/female aged 60-69, 1992 through 2014. Data sources: Chinese Nutrition and Health Survey; Ministry of health and welfare of Japan, National Nutrition Survey. Excludes pregnant females. Anemia cutoff is 130 g/L for male and 120 g/L for female in China; and 140 g/L for male and 120 g/L for female in Japan.

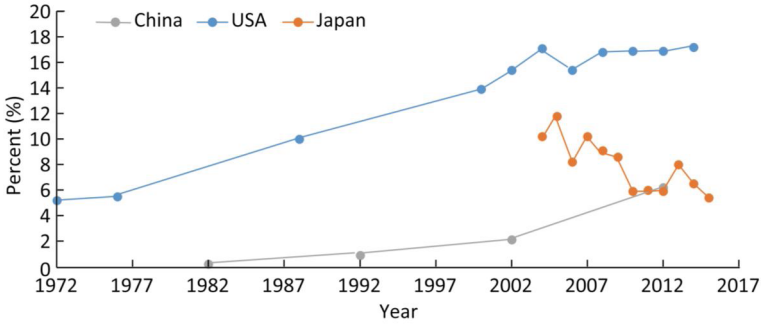

Figure S2. Trends in obesity prevalence among youths aged 6-17 years for Chinese, 1982 through 2012; aged 2-19 years for American; aged 6-14 years for Japanese. Data source: China, Chinese National Nutrition and Health Survey, China Health and Nutrition Surveys; USA, CDC/NCHS, National Health and Nutrition Examination Survey; Japan, Ministry of health and welfare of Japan, National Nutrition Survey. Note: Excludes pregnant females. For Chinese youths, aged 6 years with International Obesity Task Force standards[9] and aged 7-17 years using the China's standards[10]. For American youths, obesity is BMI greater than or equal to the 95th percentile from the 2000 CDC Growth Charts. For Japanese youths, obesity is measured body weight greater than or equal to 20% degree of obesity. Degree of obesity (%) = (measured body weight- standard body weight)/standard body weight ×100.