



**Conference on ‘The future of animal products in the human diet: health and environmental concerns’**  
**Public Health Nutrition Lecture Concurrent Symposia 1: Challenges of global meat consumption**

**Consumption of meat and dairy products in China: a review**

Yuna He, Xiaoguang Yang, Juan Xia, Liyun Zhao and Yuexin Yang\*

National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention, 29 Nan Wei Road, Beijing 100050, China

The objective of the present paper was to review the consumption status of meat and dairy products among Chinese residents. The research topics included production, consumption and health implications of dairy and meat, and the data sources included reports of national surveys, research papers and data from the National Bureau of Statistics of China. The average intake of meat, especially pork, has continued to increase in China. Pork intake increased from 37.1 g/d in 1992 to 64.3 g/d in 2012. There was a much higher margin in rural regions; pork intake of rural residents increased from 25.0 g/d in 1992 to 59.9 g/d in 2012, which resulted in a narrowed gap between urban and rural areas. Although the average intake of dairy products increased from 14.9 g/d in 1992 to 24.7 g/d in 2012, the overall level was still lower. There was a significant difference of dairy consumption between urban and rural residents. The gap of per capita consumption of milk between urban and rural households was 3.5 kg/year in 1990, reached the maximum of 16.9 kg/year in 2003, then decreased to 8.7 kg/year in 2012. In conclusion, the finding of this review sheds light on some problems with food consumption patterns in China. Effective strategies need to be adopted in order to change the consumption patterns. The consumption of milk and replacing pork with poultry or fish or other health foods should be encouraged.

**Meat: Dairy: Chinese dietary pattern**

China has been undergoing rapid economic and epidemiological transitions in recent decades, and at the same time, people’s dietary patterns have changed significantly. Although the majority of Chinese residents still keep a plant-food-based dietary pattern, the proportion of energy contributed by animal foods has been increasing<sup>(1)</sup>. According to data from the China Health and Nutrition Survey in 2002, animal food comprised an important part of the Chinese diet, contributing about 12.6 % to daily energy intake, 25.1 % to daily protein intake and 39.2 % to daily fat intake<sup>(2)</sup>. In the animal food dietary pattern, the proportion of meat and dairy was 37.9 and 16.7 % respectively, and of other animal food such as fish or shellfish, eggs, poultry was 45.4 % in total<sup>(2)</sup>.

Meat contains about 20 % protein and is rich in micro-nutrients such as zinc, iron, selenium, vitamins B<sub>6</sub> and vitamin B<sub>12</sub>, which make it as an important food item for human nutrition, especially in poor rural areas<sup>(3)</sup>. Nevertheless, excessive meat consumption leads to high intakes of saturated fat, dietary cholesterol and other substances associated with negative impacts on health<sup>(4)</sup>. Therefore, meat consumption had been identified as a dietary risk factor for CHD<sup>(5,6)</sup>, obesity<sup>(7)</sup>, diabetes<sup>(8)</sup>, colorectal cancer<sup>(9)</sup> and stroke<sup>(10)</sup>.

Dairy products are rich in nutrients such as protein, minerals (calcium, phosphorus, magnesium, calcium, sodium, zinc, iron) and vitamins (A, B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub>, C, D)<sup>(11)</sup>. Numerous epidemiological studies indicated that

\*Corresponding author: Y. Yang, email [xyyang@263.net](mailto:xyyang@263.net)

consumption of dairy products decreased levels of systolic blood pressure<sup>(12–14)</sup>, risk of type 2 diabetes and insulin resistance<sup>(15–17)</sup>, colorectal cancer<sup>(18)</sup>, as well as stroke and heart disease<sup>(16,17)</sup>.

The aim of the present paper was to review the consumption of meat and dairy products and the impact on people's health in China. Relevant data were derived from the National Bureau of Statistics of China, National Nutrition Survey and relevant publications up to July 2015. Keywords used to identify relevant articles were 'meat', 'dairy products', 'consumption', 'health' and 'China'.

### Dietary measurements

The food consumption data from the National Bureau of Statistics of China were collected through family recording methods in urban and rural household sample surveys. The dietary intakes of meat and dairy products were assessed by using three consecutive days of 24 h dietary recall in the Chinese National Nutrition Surveys. The average intakes of meat and dairy products were described as daily intake per reference man (estimated average requirement is 10041.6 kJ (2400 kcal)).

#### Production of meat and dairy products

Meat purchase has been increasing in China, particularly for pork and poultry. Annual global meat production was expected to increase from 218 million tonnes in 1997–1999 to 376 million tonnes by 2030<sup>(19)</sup>. In China, the output of meat was 76.5 million tonnes in 2009; pork, beef and mutton were 48.91 million tonnes, 6.36 million tonnes and 3.89 million tonnes, respectively. Several decades ago, pork contributed 59 % of total meat production; in contrast, beef only accounted for 5 % of meat in China<sup>(20)</sup>. In recent years, the proportion of pork in total meat production increased to 63.9 %, but there had been little change in the proportion of beef (8.3 %)<sup>(21)</sup>.

The production of dairy products was also hugely changing; it varied from 7.36 million tonnes in 1996 to 37.33 million tonnes in 2009, and the proportion of milk was 94.3 % in total dairy products output<sup>(22)</sup>.

#### Consumption of meat and dairy products

Based on data from the National Bureau of Statistics of China, from 1990 to 2012, red meat was increasing with the annual growth rate of 0.65 % in urban (Fig. 1) and 2.05 % in rural regions (Fig. 2), while poultry was increasing with the annual growth rate of 9.90 % in urban and 11.19 % in rural areas (Figs 1 and 2). Traditionally, Chinese diets were high in plant food, but by 2012 the proportion of animal food in Chinese population's food pattern was increased, especially meat. The per capita annual consumption of pork, beef and mutton, poultry was 21.2, 3.7 and 10.8 kg/year

respectively in urban households (Fig. 1), and 14.4, 1.9 and 4.5 kg/year, respectively, in rural households in 2012 (Fig. 2). Compared with 1990, there was a huge increase (Figs 1 and 2).

Milk consumption of urban residents changed in a different pattern as compared with rural residents (Figs 1 and 2). The consumption of milk in urban populations increased from 4.6 kg/year in 1990 to 18.8 kg/year before 2004, and then decreased to 14 kg/year in 2012. Although there was also an increasing trend in rural populations, from 1.1 kg/year in 1990 to 5.3 kg/year in 2012, the level of milk consumption in 2012 was only equal to the consumption level of urban populations in 1992 (Fig. 3). The annual growth rate of dairy consumption was 2.96 % in urban populations, and the annual growth rate of dairy consumption was 14.33 % in rural populations over the past 12 years<sup>(23)</sup>. The gap of per capita consumption of milk between urban and rural households was 3.5 kg/year in 1990 and reached a maximum 16.9 kg/year in 2003, then decreased to 8.7 kg/year in 2012. Although the trends of consumption increased in rural households, it was still at a much lower level. The per capita consumption of milk had a sharp rise before 2004, and then began to drop (Fig. 3).

#### Dietary intake of meat

Data from the Chinese National Nutrition Survey showed that the total average meat intake increased from 58.9 g/d in 1992 to 89.7 g/d in 2012 (Fig. 3). It was higher than the recommended level of Chinese Dietary Guidelines (daily meat recommendation 75 g/d). The total pork intake increased by 73 % from 37.1 g/d in 1992 to 64.3 g/d in 2012 (Fig. 3). Meat intake of rural residents changed more remarkably than urban residents. Pork intake of rural residents increased from 25.0 g/d in 1992 to 59.9 g/d in 2012 (in urban residents from 61.3 g/d in 1992 to 68.6 g/d in 2012; Fig. 3). The poultry intake increased from 5.2 g/d in 1992 to 13.1 g/d in 2012 in rural areas, while it remained stable in urban areas (16 g/d; Fig. 3). The demand for meat in China kept growing as intake of meat increased with available income, which was consistent with other research results<sup>(22,24)</sup> and the per capita purchases of pork increased from 14.39 to 23.85 kg/year. Meat intake per capita in Inner Mongolia, Sichuan, Guizhou, Yunnan, was considerably higher than that in other regions in China, since they were the major areas for animal product production in history<sup>(25)</sup>.

According to a large cohort study from the China Health and Nutrition Survey between 1991 and 2011, total meat intake was 86.7 g/d in 2011 and the proportions of Chinese residents consuming red meat and poultry increased from 65.7 and 7.5 % in 1991 to 86.1 and 20.9 % in 2011, respectively<sup>(22)</sup>. The result also indicated that fresh red meat was the main component of total meat, and the proportion of adults consuming fatty fresh red meat was double the proportion of adults consuming lean fresh red meat in 2011 (75.1 v. 30.8 %)<sup>(22)</sup>. Fatty fresh pork accounted for 54 % of total meat intake,

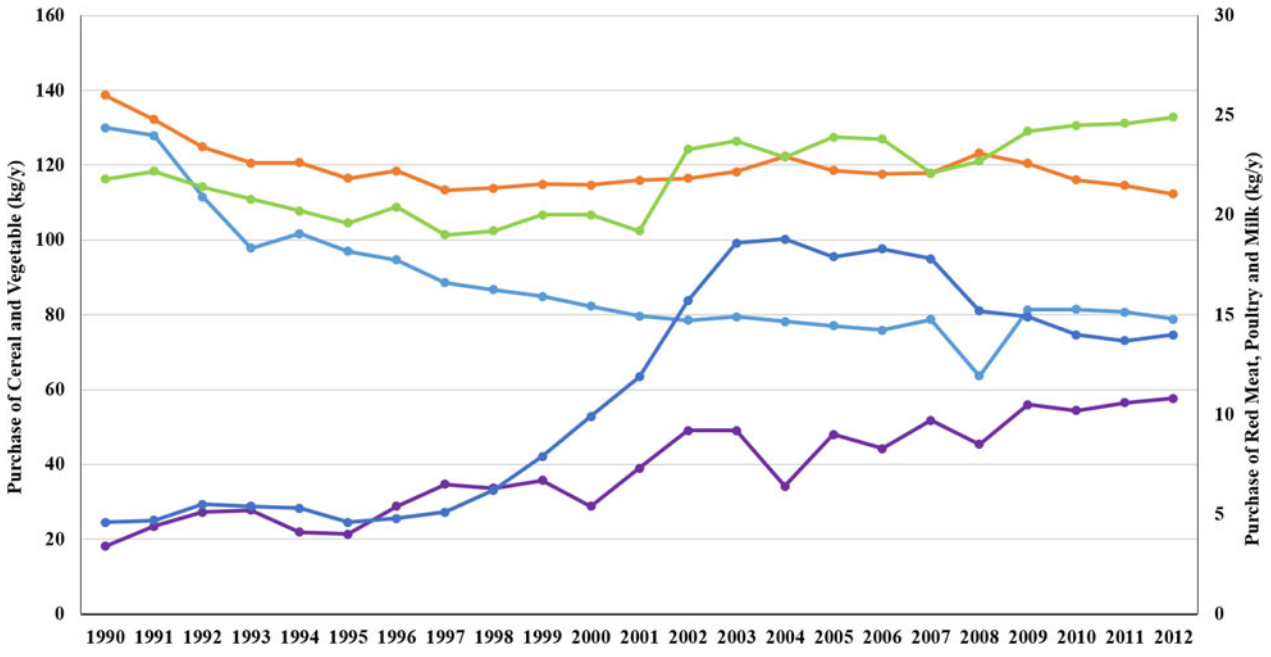


Fig. 1. (Colour online) Trends of food purchase in urban population. Cereal (—●—), vegetables (—●—), red meat (—●—), poultry (—●—), milk (—●—). Data source: National Bureau of Statistics of China.

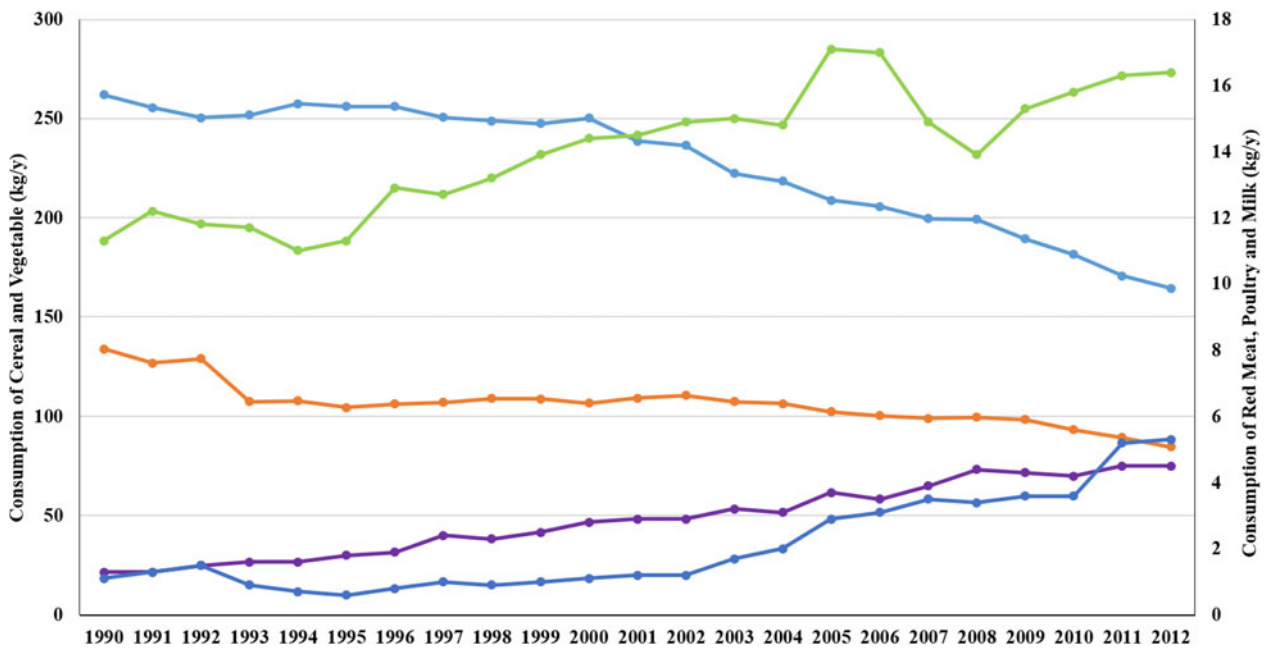
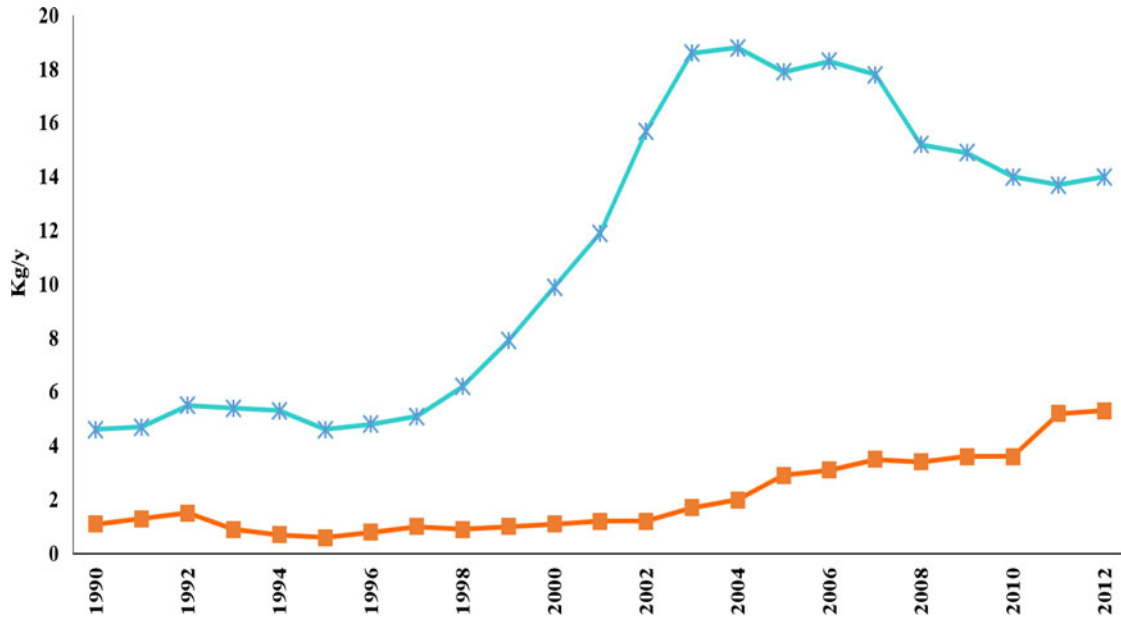


Fig. 2. (Colour online) Trends of food consumption in rural population. Cereal (—●—), vegetables (—●—), red meat (—●—), poultry (—●—), milk (—●—). Data source: National Bureau of Statistics of China.

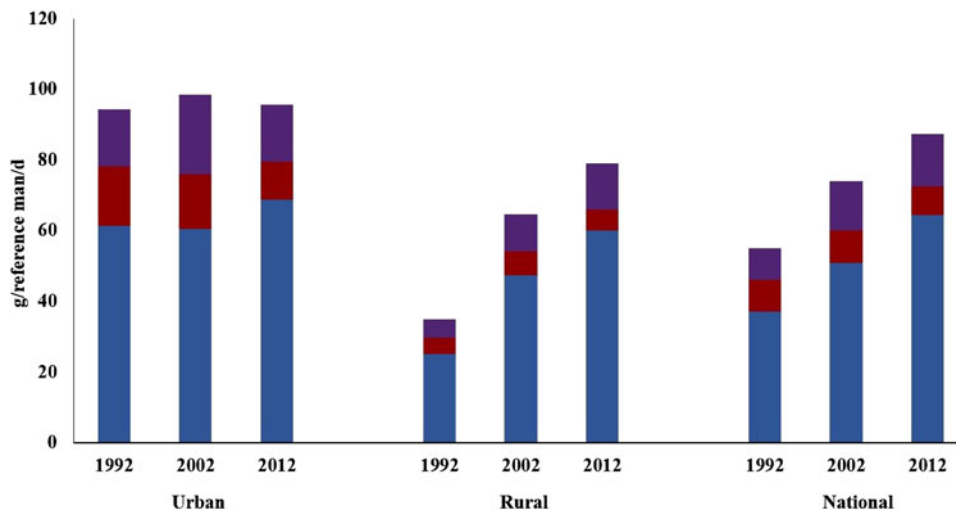
80 % of fresh red meat intake and 98.7 % of fatty fresh red meat intake in 2011<sup>(22)</sup>. It was obvious that fatty fresh pork had already become the main component of total meat intake. However, in contrast, the proportion of fatty and lean fresh red meat of mutton and beef reduced by 6.3 and 2.8 %, respectively. Nevertheless, the proportion of seafood and poultry increased by 2.2 and 6.4 %, respectively (Fig. 4)<sup>(22)</sup>.

### Dietary intake of dairy products

The average intake of milk in big city, small- and medium-sized city, normal rural area and poor rural area in 2012 was 64.3, 24.2, 9.1 and 4.9 g/d, respectively. The frequency of dairy intake among Chinese population decreased with ageing. Compared with other age groups, the population under age 18 years had the highest



**Fig. 3.** (Colour online) Per capita milk consumption of urban and rural households. Urban (—\*), rural (—■). Data source: National Bureau of Statistics of China.

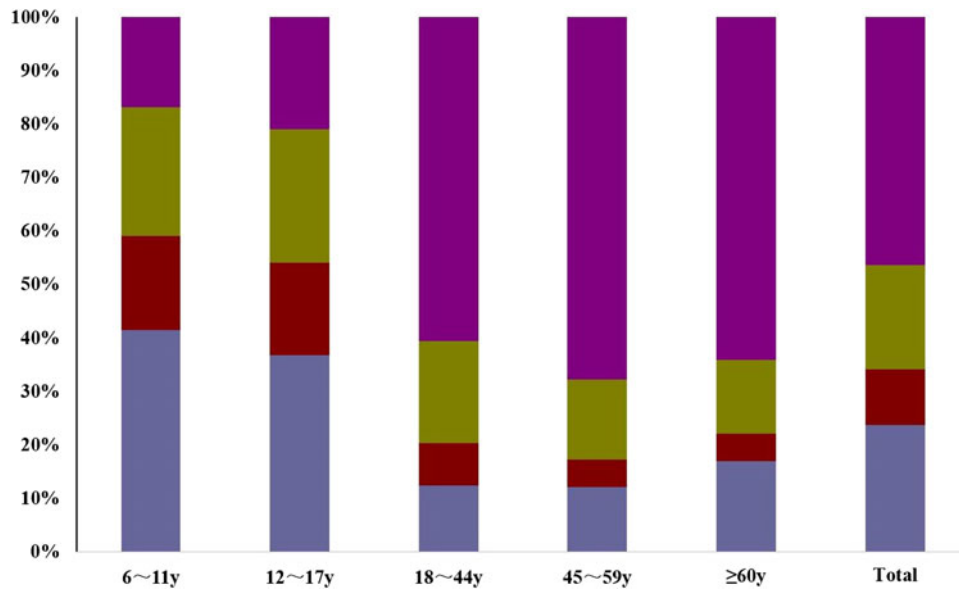


**Fig. 4.** (Colour online) Trends of meat consumption in China. Poultry (■), other meats (■), pork (■). Data sources: 1992 China Nutrition Survey, 2002 China Health and Nutrition Survey, 2010–2012 China Health and Nutrition Surveillance.

frequency of milk intake in China. There were only 23.7 % people who consumed dairy every day (Fig. 5).

According to the data from the 1991 to 2006 Chinese Health and Nutrition Surveys, the trend in percentage of dairy intake increased. The average percentage of Chinese resident's milk intake went up from 2.2 to 7.6 %. Both urban rural adults showed significant increase in percentage, from 9.7 to 23.7 % in urban and 0.1 to 1.8 % in rural adults. The percentages of adults who drank milk once during three survey days, at the top income level

and bottom income level, increased from 4.7 to 14.6 % and from 0.1 to 2.4 %, respectively. The average daily intake of milk increased from 3.6 g/d in 1991 to 11.8 g/d in 2006. The daily milk intake among top income level adults and bottom income level adults increased from 8.5 to 23.1 g/d and from 0.2 to 3.3 g/d, respectively<sup>(26)</sup>. The results indicated that the intake of dairy products in Chinese residents has been increasing but still remained at a quite low level. Dairy intake in China especially among rural adults required further promotion.



**Fig. 5.** (Colour online) Frequency of dairy consumed among Chinese population. <1 time/week (■), 1-3 times/week (■), 4-6 times/week (■), ≥1 time/d (■). Data source: 2010-2012 China Health and Nutrition Surveillance.

### Discussion

In summary, in China, animal food provided an average of 15.2 % of daily energy intake in 1992 and 17.6 % in 2012 in urban areas; in rural areas, it was 6.2 % in 1992 and 12.5 % in 2012. The contribution to protein by animal food varied from 7.97 % in 1992 to 16.15 % in 2012 in rural areas, with little change in urban areas (23.66 %). Consumption of animal food, especially pork, increased significantly especially in rural areas with the gap between urban and rural areas narrowing. The proportion of protein from animal food increased and the total consumption of protein remained in a stable condition. A moderate increase in meat and dairy products consumption will certainly improve the nutritional adequacy of diets and improve health outcomes<sup>(21)</sup>.

The mean calcium intake in Chinese populations was 366 mg/d. There were more than 90 % populations at risk of inadequate calcium intake<sup>(27)</sup>. Dairy was the primary source of calcium. To improve the intake of calcium and prevent osteoporosis or other diseases caused by calcium deficiency, dairy consumption should be recommended to increase in Chinese populations.

Dietary patterns represent a long-term habit of one's dietary intake, and dietary patterns in China were shifting from the traditional pattern with high consumption of plant food and low consumption of animal food, to the Western pattern characterised by animal foods<sup>(28)</sup>. Previous research among 5267 children in China indicated that the Western dietary pattern with high intake of red meat and other high-energy-dense foods was positively associated with a higher risk of obesity, a higher level of plasma glucose and TAG<sup>(29)</sup>. Healthy dietary behaviour would promote a healthy lifestyle, so it is necessary for researchers to guide Chinese populations to

control their intake of red meat and increase the intake of vegetables, fruit and fish.

Previous reports indicated that a diet high in meat was associated with the growing epidemic of obesity and diet-related chronic diseases<sup>(30)</sup>. In contrast, vegetables decreased risk for hypertension, obesity, diabetes, CVD and some cancers<sup>(31-35)</sup>. Based on considerable research<sup>(36-38)</sup>, the dietary recommendations for prevention of chronic diseases advised limiting the consumption of red and processed meat and to eat mostly plant-based food. Meat consumption among the urban residents was much more than the Chinese dietary recommendation; this should call the attention of the public health professionals to take actions on chronic disease prevention via nutrition education in China.

### Conclusion

In consideration of the higher consumption of meat, especially fatty fresh pork, formulating relevant strategies and taking action as soon as possible are imperative. The research of Andreyeva *et al.*<sup>(39)</sup> and Green *et al.*<sup>(40)</sup> showed that the price of meat can effectively influence consumption. Therefore, the efficient measure of price control could be considered to adjust the consumption structure of meat in China. Conversely, the dietary guidelines for Chinese residents only focus the importance of eating moderate amounts of fish, poultry, eggs and lean meat<sup>(41)</sup>. Hence, considering the health benefits and risks, it may be necessary to recommend consumption of red meat, processed meat and poultry separately, based on the differential influence on health. Most important is to improve the public nutrition education

programme, especially on the dietary guidelines and benefits of increasing vegetable, poultry, fish and seafood consumption.

### Acknowledgements

Most of the data presented in this article were based on the China Statistical Yearbook, 1992 China Nutrition Survey, 2002 China Health and Nutrition Survey and 2010–2012 China Health and Nutrition Surveillance. We thank the National Bureau of Statistics of the People's Republic of China for their annual reports. The national surveys of nutrition were supported by National Health and Family Planning Commission (Ministry of Health), the Ministry of Science and Technology and the Ministry of Finance in China. We would like to thank all participants and team members from thirty-one provinces who participated in the national surveys for their valuable contributions.

### Financial Support

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

### Conflicts of Interest

None.

### Authorship

Y. H., J. X. and L. Z. collected data and wrote drafts of the manuscript under the supervision of Y. Y. and Y. X. All authors contributed to the interpretation of the systematic review, commented on drafts of the manuscript and approved the final version.

### References

- Zhang J, Zhang B, Wang HJ *et al.* (2011) Trends in the energy intake among Chinese aged 50–79 years in nine provinces (1991–2009). *Acta Nutrimenta Sin* **33**, 335–339.
- He YN, Zhai FY, Wang ZH *et al.* (2005) The status and trend for dietary pattern of energy, protein and fat in Chinese residents. *Acta Nutrimenta Sin* **27**, 358–365.
- Yang YY, Wang GY & Pan XC (editor) (2009) *The 2009 China Food Composition Table*, 2nd ed., pp. 86–99. Beijing: Medical Publishing House of Beijing University.
- Carvalho AM, Ce'sar CLG, Fisberg RM *et al.* (2013) Excessive meat consumption in Brazil: diet quality and environmental impacts. *Public Health Nutr* **16**, 1893–1899.
- Denke MA (1994) Role of beef and beef tallow, an enriched source of stearic acid, in a cholesterol-lowering diet. *Am J Clin Nutr* **60**, Suppl. 6, 1044S–1049S.
- Hu FB, Stampfer MJ, Manson JE *et al.* (1999) Dietary saturated fats and their food sources in relation to the risk of coronary heart disease in women. *Am J Clin Nutr* **70**, 1001–1008.
- Vergnaud AC, Norat T, Romaguera D *et al.* (2010) Meat consumption and prospective weight change in participants of the EPIC-PANACEA study. *Am J Clin Nutr* **92**, 398–407.
- Steinbrecher A, Erber E, Grandinetti A *et al.* (2011) Meat consumption and risk of type 2 diabetes: the Multiethnic Cohort. *Public Health Nutr* **14**, 568–574.
- World Cancer Research Fund & American Institute for Cancer Research (2007) *Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective*. Washington, DC: AICR.
- Micha R, Wallace SK & Mozaffarian D (2010) Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus: a systematic review and meta-analysis. *Circulation* **121**, 2271–2283.
- Camfield DA, Owen L, Scholey AB *et al.* (2011) Dairy constituents and neurocognitive health in ageing. *Br J Nutr* **106**, 159–174.
- Wang L, Manson JE, Buring JE *et al.* (2008) Dietary intake of dairy products, calcium, and vitamin D and the risk of hypertension in middle-aged and older women. *Hypertension* **51**, 1073–1079.
- Toledo E, Delgado-Rodríguez M, Estruch R *et al.* (2009) Low-fat dairy products and blood pressure: follow-up of 2290 older persons at high cardiovascular risk participating in the PREDIMED study. *Br J Nutr* **101**, 59–67.
- Engberink MF, Geleijnse JM, De Jong N *et al.* (2009) Dairy intake, blood pressure, and incident hypertension in a general Dutch population. *J Nutr* **139**, 582–587.
- Unal G, Akalin AS & Akbulut N (2008) Importance of dairy products in metabolic syndrome-cardiovascular disease, insulin resistance and diabetes, and hypertension (Part 2). *Agro Food Ind HiTech* **19**, 32–34.
- Elwood PC, Givens DI, Beswick AD *et al.* (2008) The survival advantage of milk and dairy consumption: an overview of evidence from cohort studies of vascular diseases, diabetes and cancer. *J Am Coll Nutr* **27**, 723S–734S.
- Elwood PC, Pickering JE, Givens DI *et al.* (2010) The consumption of milk and dairy foods and the incidence of vascular disease and diabetes: an overview of the evidence. *Lipids* **45**, 925–939.
- Pufulete M (2008) Intake of dairy products and risk of colorectal neoplasia. *Nutr Res Rev* **21**, 56–67.
- World Health Organization (WHO) (2003). *Diet, Nutrition, and the Prevention of Chronic Disease*. WHO Technical Report Series no. 913. Geneva: WHO.
- Gill M (1999) Meat production in developing countries. *Proc Nutr Soc* **58**, 371–376.
- National Bureau of Statistics of China (2010) *China Statistical Yearbook*, vol **29**, p. 492. Beijing: China Statistics Press.
- Walker P, Rhubart-Berg P, McKenzie S *et al.* (2005) Public health implications of meat production and consumption. *Public Health Nutr* **8**, 348–356.
- Wang ZH, Zhai FY, Wang HJ *et al.* (2015) Secular trends in meat and seafood consumption patterns among Chinese adults, 1991–2011. *Eur J Clin Nutr* **69**, 227–233.
- Speedy AW (2003) Global production and consumption of animal source foods. *J Nutr* **133**, 4048S–4053S.
- Pan YG (2006) Panorama and trend analyze of Chinese meat consumption. *Chi J Anim Sci* **42**, 18–21.
- Liu AD, Zhang B, Du WW *et al.* (2011) Milk consumption and its changing trend of Chinese adult aged 18–44 in nine provinces (autonomous region) from 1991 to 2006. *Chin J Prev Med* **45**, 304–309.



27. National Health and Family Planning Commission of People Republic of China (2015). *China Nutrition and Chronic Disease Report 2015*. People's Medical Publishing House.
28. Zhai F, Wang H, Du S, He Y *et al.* (2009) Prospective study on nutrition transition in China. *Nutr Rev* **67**, S56–S61.
29. Shang X, Li Y, Liu A *et al.* (2012) Dietary pattern and its association with the prevalence of obesity and related cardiometabolic risk factors among Chinese children. *PLoS ONE* **7**, e43183.
30. Mente A, de Koning L, Shannon HS *et al.* (2009) A Systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. *Arch Intern Med* **169**, 659–669.
31. Fraser GE (2009) Vegetarian diets: what do we know of their effects on common chronic diseases?. *Am J Clin Nutr* **89**, 1607S–1612S.
32. Szeto YT, Kwok TC & Benzie IF (2004) Effects of a long-term vegetarian diet on biomarkers of antioxidant status and cardiovascular disease risk. *Nutrition* **20**, 863–866.
33. Key TJ, Appleby PN, Spencer EA *et al.* (2009) Cancer incidence in British vegetarians. *Br J Cancer* **101**, 192–197.
34. Key TJ, Appleby PN, Spencer EA *et al.* (2009) Mortality in British vegetarians: results from the European Prospective Investigation into Cancer and Nutrition (EPIC-Oxford). *Am J Clin Nutr* **89**, 1613S–1619S.
35. Key TJ, Appleby PN, Spencer EA *et al.* (2009) Cancer incidence in vegetarians: results from the European Prospective Investigation into Cancer and Nutrition (EPIC-Oxford). *Am J Clin Nutr* **89**, 1620S–1626S.
36. Krauss RM, Eckel RH, Howard B *et al.* (2001) Revision 2000: a statement for healthcare professionals from the Nutrition Committee of the American Heart Association. *J Nutr* **131**, 132–146.
37. Kushi LH, Byers T, Doyle C *et al.* (2006) American Cancer Society guidelines on nutrition and physical activity for cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. *CA Cancer J Clin* **56**, 254–281.
38. Reedy J & Krebs-Smith SM (2008) A comparison of food-based recommendations and nutrient values of three food guides: USDA's MyPyramid, NHLB's dietary approaches to stop hypertension eating plan, and Harvard's healthy eating pyramid. *J Am Diet Assoc* **108**, 522–528.
39. Andreyeva T, Long MW & Brownell KD (2010) The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food. *Am J Public Health* **100**, 216–222.
40. Green R, Cornelsen L, Dangour AD *et al.* (2013) The effect of rising food prices on food consumption: systematic review with meta-regression. *Br Med J* **346**, f3703.
41. China Nutrition Society (2010) *Dietary Guidelines for Chinese Residents*, 1st ed. Lhasa, China: Tibet People's Publishing House.