

Dietary patterns and lifestyles in Tibet and southeastern China in relation to the prevalence of certain chronic diseases

Qiwen Yan*

Faculty of sciences, Autonomous University of Madrid, Madrid, Spain

*Corresponding author email: qiwen.yan@estudiante.uam.es

Abstract. The prevalence of diseases such as hypertension, overweight, and obesity, type 2 diabetes and dyslipidaemia has increased in China. Studies have found that many chronic diseases are related to lifestyle and dietary habits. However, China is a vast country with a complex topography and 56 ethnic groups. These factors lead to significant differences in diet and lifestyle habits among different populations in China. This paper compares the dietary structure and the incidence of chronic diseases between Tibet and southeastern China and finds that differences in dietary habits between ethnic groups and their geographical factors can affect the prevalence of specific chronic diseases. Therefore, the prevention and control of chronic diseases in China should not be generalized. It is recommendable to consider particular factors such as different cultures and habits among regions and ethnic groups to provide adequate nutrition education.

Keywords: Tibet, Southeastern China, Dietary Pattern, Chronic diseases.

1. Introduction

With the development of the economy, the prevalence of chronic diseases such as hypertension, overweight and obesity, diabetes, and dyslipidemia has increased in China. In addition to their harmful effects, these diseases are also high-risk factors for cardiovascular disease. Although the specific causes of these four diseases vary, they all have in common that they are influenced to some extent by lifestyle and dietary patterns.

China covers an area of 9.597 million km² and has almost all kinds of terrain such as plateaus, mountains, hills, plains, basins, etc. Besides, the population consists of 56 ethnic groups. So different geographical environments and cultural habits among ethnic groups lead to significant inter-ethnic and inter-regional differences in diet and lifestyle.

Since it is more common in previous studies to study either the epidemic prevalence in China as a whole or in a single region, it is relatively rare to compare prevalence differences and influencing factors between different areas and ethnic groups simultaneously. Therefore, two regions, Tibet and southeastern China, were selected for this article to conduct inter-regional and inter-ethnic comparisons of diet and lifestyle to examine whether they are associated with differences in the incidence of specific chronic diseases.

Tibet is located on the Qinghai-Tibet Plateau in western China. It covers an area of 1,228,500 square kilometers. It is the second-largest autonomous region in China. 85.1% of its area is located above 4,000 meters above sea level, which is the highest altitude in the world. According to the official data from the Bureau of Statistics of Tibet Autonomous Region, the region's total population in 2020 is 3,648,100, of which 3,137,901 are Tibetans, accounting for 86%; Han Chinese population is 443,370, accounting for 12.1%. Southeastern China studied in this paper mainly includes Guangdong, Guangxi, Fujian, Zhejiang, Jiangxi, Anhui, Jiangsu, and Shanghai. The total land area is 1,054,900 square kilometers, with an average elevation of 36.8 meters above sea level. According to the data published in the 7th National Census, the region's total population is 498 million people, of which the majority are Han Chinese residents. So, these two regions were chosen because they are representative, as they satisfy both the significant geographical differences and the different ethnic composition of the population.

2. Diet patterns in Tibet and southeastern China

The 2016 edition of the Dietary Guidelines for Chinese Residents classifies foods into the following six categories: (1) cereals and tubers, (2) vegetables and fruits, (3) livestock and poultry meat, fish and eggs, (4) milk and dairy, soybeans and nuts, (5) salt and oil (6) water. Of these, cereals and tubers include whole grains, other legumes and tubers. This classification is mainly referred to in this paper when comparing the dietary patterns of Tibet and southeastern China.

2.1 Dietary patterns in Tibet

Although urban modernization and the increase in the non-Tibetan population have increased the diversity of the Tibetan diet, the traditional Tibetan diet still dominates [1, 2]. The traditional Tibetan diet is greatly influenced by geographical factors and cultural practices. From Table 1, tsampa, rice, wheat flour were the primary staple food sources. Their per capita daily intake was 274.0g, 157.5g, and 300.3g, respectively. Besides, Tibetans also consumed potatoes with high frequency. The average daily intake per capita was 117g.

Tibetans exceed the recommended dietary intake for Chinese residents for meat, eggs, legumes and nuts. The overall meat consumption is high, but the consumption structure is very monotonous, dominated by beef and lamb, with less consumption of pork and poultry [2, 3]. The intake of other food groups, such as fruits and vegetables, dairy and fish, was insufficient due to the geographical conditions. Since water-soluble vitamins and potassium are mainly found in fruits and vegetables, low fruit and vegetable intake could lead to a deficiency in these micronutrients. In terms of fatty acids intake for Tibetans, it mainly came from mustard oil, yak meat, and local dairy products.

Due to religious and cultural traditions, Tibetans drink little water. Their primary type of beverage is buttered tea and barley liquors. The consumption of buttered tea was 141.1 g/day/adult, which provides a substantial source of protein, fat and sodium for the Tibetan diet.

2.2 Dietary patterns of Han population in southeastern China

Southeastern China comprises many different provinces, but their diets all share the same regional characteristics. Rice was the main staple [6-8]. Its average intake per capita was 399.6 g/day. This diet pattern also included a large consumption of vegetables, beans, fish and shrimp. Their average daily intake per capita was 357.9 g, 9.9, and 23.7, respectively [7, 9, 11].

Regarding the meat intake, people in southeastern China preferred pork and poultry, the average daily consumption per capita was 47.8 g and 23.7 g, respectively. In contrast, the consumption of beef/lamb was only 2.1 g/day/capita. Another notable feature of this diet pattern was the deficient intake of dairy products, it was 6.6 g/day/capita, which was way lower than the recommended intake for Chinese residents. In southeastern China, the principal cooking oil was plant oil, mainly canola oil, and sometimes lard was used to add more flavor to dishes.

With rapid economic development, the diet in southeastern China has changed in recent years, especially among the younger age groups [6, 8], but still dominated by traditional diets. The consumption of staple foods has shifted from the conventional rice-based forms to a diversified pattern of rice, wheat, and tubers. The intake of beef, lamb, eggs, milk, and fruit is also increasing compared to the traditional diet. At the same time, the intake of animal fats is decreasing. However, not all dietary changes were positive, as previous studies have found that cakes, juices, beverages, and other processed foods were also increasing, while the vegetable intake has decreased.

2.3 Comparison of dietary patterns between Tibet and southeastern China

While the inhabitants of southeastern China are more homogeneous in their choice of staple foods, with rice being the mainstay, the Tibetan region is more diverse. Wheat flour and the culturally distinctive tsampa are the primary sources of staple foods for Tibetans, but rice and potatoes are also consumed.

Regarding the intake of soybeans, nuts, milk, and dairy products, Tibetans have higher consumption than Southeast China residents and higher than the national average. As for vegetable and fruit and seafood consumption, Tibetans have a much deficient intake than those located in southeastern China due to their geographical location. The use of butter is rarely seen in traditional Han Chinese cuisine. However, in the Tibetan diet, buttered tea is their daily drink, therefore, the consumption of butter is relatively high, at 95.8g per person per day.

Table 1. Selected Nutrient Intakes in Tibet and Southeast China Region and a whole China

Food groups (g/day)	Tibetan	Han in southeastern China	Overall
Cereals and tubers			
Rice	157.5	399.6	177.7
Potatoes	117	-	35.8
Tsampa	274.0	-	-
Flour	300.3	-	142.8
Soybeans and nuts	42	11.2	14.2
Vegetables and fruits	187	357.9	310.1
Meat and egg	138.0	223.5	114.4
Milk and dairy	114.0	96.4	24.7
Seafood	2.0	23.7	23.7
Salt	4.0	7.6	10.5
Oil	20	35.5	42.1
Butter	95.8	-	-

3. Prevalence of hypertension, overweight and obesity, type 2 diabetes and dyslipidemia in Tibet and southeastern China

3.1 The prevalence of hypertension in Tibet and southeastern China

Hypertension is the most common chronic disease and the most significant risk factor in cardiovascular disease. The 2010 edition of China's guidelines for preventing and treating hypertension defines the diagnostic criteria for hypertension as a systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

According to the 6th China Hypertension Survey conducted in 2015, hypertension among Chinese residents over 18 years old was 27.9%, with about 420 million population. The awareness rate and control rate were 45.8% and 16.8%, respectively. Although the number of people was large, there were significant differences between ethnic groups. In Tibet, the incidence of hypertension was 62.5%, while in southeastern, it was 30.7% (Table 1).

Hypertension can be classified as primary hypertension, which accounts for 90-95% of all the patients, and secondary hypertension, which has known causes and accounts for 5-10%. The common causes of secondary hypertension are usually renal parenchymal disease, endocrine problems, and sleep apnea syndrome. When these causative factors are controlled, the patient's hypertension symptoms can be cured or at least relieved. While the primary hypertension is often clustered with other syndromes like abnormal insulin secretion, metabolic abnormalities and sympathetic overactivity. Its exact cause cannot be determined, but it is generally believed to be related to genetic and environmental factors., including diet, obesity, and alcohol intake. Many studies in recent years have found that the prevalence of hypertension is higher in people who live and work at high altitudes for a long time, the lack of oxygen at high altitudes may be one of the risk factors for hypertension [20, 21].

3.2 The prevalence of overweight and obesity in Tibet and southeastern China

Overweight and obesity are the abnormal or excessive accumulation of fat, the underlying cause is an energy imbalance between calories consumed and calories burned. The World Health Organization defines "overweight" as having a body mass index (BMI) ≥ 25 kg/m² and "obese" as having a BMI ≥ 30 kg/m². They are essential risk factors for many diseases such as hypertension, diabetes and can lead to serious health consequences.

In recent years, the number of overweight and obese people has increased significantly worldwide. The obesity epidemic is usually associated with rapid economic development and urban industrialization, which leads to changes in lifestyle and dietary patterns. China has the largest increase in patients, with about 47.6% of people facing overweight or obesity [24, 25]. In Tibet, the incidence was 34.3%, while it was 43.4% in southeastern China.

3.3 The prevalence of type 2 diabetes in Tibet and southeastern China

Diabetes mellitus is a common chronic non-communicable disease. In clinical practice, diabetes is defined as a group of chronic diseases characterized by chronically elevated blood glucose, metabolic abnormalities, and "secondary characteristic systemic damage" caused by defective insulin secretion or/and defective insulin action.

Diabetes is a significant public health problem worldwide, and it is a substantial cause of death, disease burden, and economic burden on health care. According to the World Health Organization and American Diabetes Association criteria, diabetes mellitus was defined as fasting blood glucose ≥ 7.0 mmol/L and (or) glycosylated hemoglobin $\geq 6.5\%$, and (or) a reported history of previous diabetes mellitus. Type 2 diabetes is the most common type of diabetes, accounting for 90 to 95 percent of people with diabetes. The main risk factors for type 2 diabetes are genetic variants, unhealthy diet, aging, lack of exercise, and smoking. The prevalence of diabetes in China has increased rapidly over the past three decades. Currently, China has the largest number of diagnosed diabetics in the world, approximately 129.8 million people.

The prevalence of diabetes in China, according to the China Health and Wellness Statistical Yearbook, generally was higher in the northern region compared to southern China, and higher in the eastern part compared to the western region of China. In Tibet, the incidence of diabetes was 6.4%, while in southeastern China, it was 9.1%. In general, the prevalence of diabetes in China was much higher among Han than other ethnic groups. The prevention of diabetes is usually related to dietary habits and lifestyle.

3.4 The prevalence of dyslipidemia in Tibet and southeastern China

Dyslipidemia is a common disease that abnormalities the metabolism of lipoproteins in the body, mainly including total cholesterol and low-density lipoprotein (LDL) cholesterol, elevated triglycerides, and reduced high-density lipoprotein (HDL) cholesterol. Dyslipidemia is classified as hypercholesterolemia with hypertriglyceridemia, mixed hyperlipidemia, and hyperlipoproteinemia. Dyslipidemia is one of the crucial factors leading to atherosclerosis and is an independent risk factor for coronary heart disease and ischemic stroke. In China, the prevalence of dyslipidemia increases with age and usually has a higher prevalence in men [28, 29].

There are regional differences in the prevalence and the major types of dyslipidemia. Dyslipidemia is highly prevalent in southeastern China, with an overall incidence of 36.5%. Among them, the incidence of hypertriglyceridemia was 24.9%. In Tibet, the incidence of dyslipidemia was 27.8%, with hypercholesterolemia predominating, unlike in southeastern China. The regional differences between Tibet and southern China are probably due to geographical and environmental factors. Considering that the main groups living in the two places are from different ethnic groups, it is possible that the genetic factors also contribute to this result.

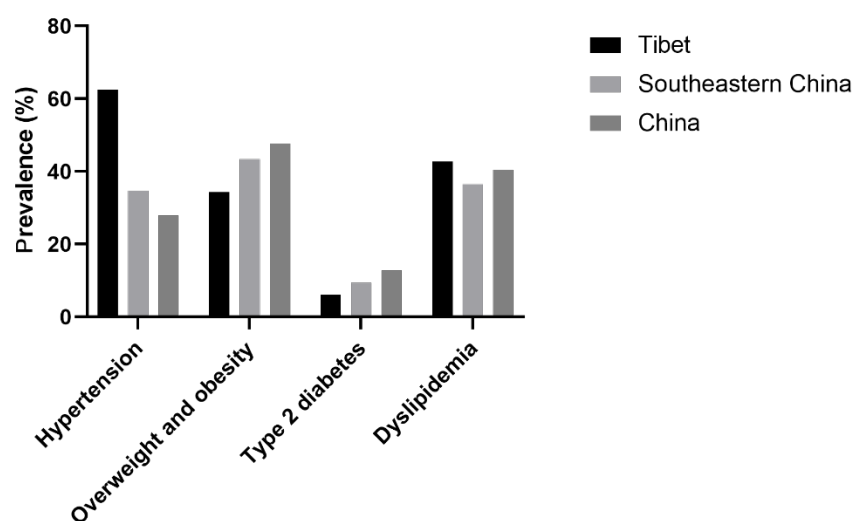


Figure 1. The prevalence of hypertension, overweight and obesity, type 2 diabetes, and dyslipidaemia in Tibet, southeastern China and overall China (Data from [14-16, 27, 29, 31-34])

4. Discussion

4.1 Relationship between environmental and dietary factors and disease in Tibet

Since Tibet is located in the highest average altitude region in the world, someone suspected that elevated blood pressure might be a result of the body's efforts to adapt to the low oxygen environment at such a high altitude [15, 35]. A study of the prevalence of hypertension at high altitudes in Nepal found that the risk of elevated blood pressure in high-altitude populations may be increased. Meanwhile, after summarizing 3375 previous related studies, an article concluded that the direct association between high prevalence and high altitude was weak in Tibetan populations and still needs to be supported by more robust evidence.

In the Tibetan diet, meat consumption is dominated by red meat such as yak beef and lamb. Studies have found that the high intake of red meat in the daily diet, especially processed red meat, is associated with an increased risk of various chronic diseases. Considering that the fat content of yak meat is higher than the amount of fat contained in typical beef, and at the same time, the daily intake of buttered tea also provides considerable dietary fat, it can be assumed that there was a significant intake of animal fat in the Tibetan diet, which means, high saturated fatty acids intake. The higher prevalence of hypercholesterolemia in Tibet may be related to this.

Deficient seafood intake in Tibet can adversely affect the dietary intake of DHA and EPA. Adequate intake of these unsaturated fatty acids has a positive effect on hypertension. Therefore, the chronic insufficient intake of these fatty acids may negatively affect the prevalence of hypertension in Tibet. In addition to seafood, Tibetans' consumption of vegetables and fruits is also lower than the national average, leading to insufficient fiber intake and deficiency in some water-soluble vitamins and trace elements such as vitamin B and potassium. These deficiencies increase the risk of developing various chronic diseases in Tibet.

4.2 Relationship between environmental and dietary factors and disease in southeastern China

The adverse effects of a high-salt diet on blood pressure have been well studied. The common presence of preserved foods, such as salted fish and meat, in the diet of southeastern China, may be one of the reasons for the leading causes of hypertension in the southeast.

However, the prevalence of overweight and obesity, type 2 diabetes, and dyslipidemia in southeastern China is lower than the overall value. This may be because the traditional southern Chinese diet is relatively healthy. The intake of vegetables and fruits is higher than the national

average, and the protein sources are primarily pork and seafood. Fats are mainly derived from vegetable oils rich in unsaturated fatty acids such as canola oil. But with rapid economic development, dietary habits have changed. The increasing intake of sugary beverages and junk food has increased chronic disease risk in the region. Aging is one of the risk factors for the prevalence of chronic diseases. The aging trend in this area, brought about by improved health care, has also led to an increase in the incidence of various chronic diseases.

5. Conclusion

Of the four common chronic diseases studied in this paper, Tibet and southeastern China were both above the national average in the prevalence of hypertension. In particular, the Tibetan region has a much higher prevalence of hypertension, with 62.5%, than the other two values. From the previous dietary analysis of the two areas, it can be speculated that the prevalence of hypertension in southeastern China may be associated with a high-salt diet, whereas in Tibet, the influence of high-altitude factors on the prevalence of hypertension needs to be considered.

The prevalence of dyslipidemia is higher in Tibet than in southeastern China and is dominated by hypercholesterolemia, which is probably due to a diet rich in animal fat. In contrast, the predominant type of dyslipidemia in southeastern China was hypertriglyceridemia, which was possibly due to a high intake of refined foods and sugary beverages resulting from economic development in the region [26, 39].

The prevalence of overweight and obesity and type 2 diabetes is relatively low in Tibet, probably because the nomadic culture is still prevalent, therefore they have a higher level of physical activity compared to southeastern China. And moderate physical activity can help prevent such chronic diseases. At the same time, people living in southeast China consumed more refined foods and sugary drinks than Tibetans, which also contributes to the higher prevalence of various chronic diseases in this region.

In summary, it can be concluded that there are regional and ethnic differences in the prevalence of hypertension, overweight and obesity, type 2 diabetes, and dyslipidemia. These differences are mainly caused by different dietary habits, lifestyles, and environmental factors. It is necessary to analyze the population characteristics and cultural traditions to develop targeted countermeasures for disease prevention and control.

On the other hand, this paper also notes that the increased intake of sugary drinks and refined foods in the southeastern part of China due to a more developed economy can have a negative impact on the prevalence of chronic diseases. Such phenomena need to be prevented in the economic development of Tibet.

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