Original Article

Rising food accessibility contributed to the increasing dietary diversity in rural and urban China

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China has undergone a dramatic transition in food consumption in the past few decades. Diet composition has changed significantly because of an increase in food accessibility and lifestyle changes. To investigate dietary changes in China from the perspective of dietary diversity, we assessed the trend of dietary diversity in China by using the following 4 indicators: count index, dietary diversity score, entropy, and Simpson index. Data of 24,542 adults (age ≥18 y) were obtained from the China Health and Nutrition Survey (CHNS) conducted in 2004, 2006, 2009, and 2011. Furthermore, the association between dietary diversity and the number of food facilities was investigated using multivariable regression and local polynomial regression. Results indicate that dietary diversity increased over time and was unequally distributed among regions and families. Urban residents had a significantly more diverse diet compared with their rural counterparts ($p<0.01$). Moreover, dietary diversity was positively associated with food accessibility ($p<0.01$), and it was affected by socioeconomic factors such as the family income, household size, gender, age, education, and region. Taken together, these data suggest that the increase in dietary diversity in China in the past decade can be partially attributed to the increase in food accessibility.

Key Words: dietary diversity, food accessibility, China, urban, rural

INTRODUCTION

Numerous studies have reported that China is experiencing a nutrition transition: consumers' dietary habits are shifting from a low-fat traditional diet, mainly composed of complex carbohydrates and vegetable fibres with few animal products, to a Western diet high in saturated fats, sugar, and proteins, but low in fibre.[1-9] This shift has markedly improved the nutritional conditions of poor people,[8] yet has simultaneously raised concerns regarding excessive nutritional intake among rich people, particularly because of the rapid increase in the overweight population in recent decades.[9-11] Thus, a healthy diet has attracted much attention from both the public and academia.[10,12] Nutritionists generally believe that healthy diets are the most diverse ones, because essential nutrients cannot be obtained from a single type of food.[13] Current studies show that having a diverse diet protects against chronic diseases,[14] reduces the risk of a deficiency or excess of any single nutrient,[15] and improves the utility of consumers by more closely matching their tastes with food characteristics or counteracting diminishing returns to quantity.[16] Moreover, diverse food sources are necessary for safeguarding against climatic and pestilent disasters, which can affect one or more food sources.[17] Therefore, dietary diversity can be used as a proxy for measuring dietary quality and nutritional conditions;[18] many studies have developed several indicators for measuring dietary diversity.[19-26] By contrast, higher food diversity might also promote excess energy intake and further increase obesity, because it can stimulate appetite and increase food consumption by increasing the enjoyability of a meal.[27-29] The diminishing marginal utility indicates that the enjoyability of eating the same food decreases as the quantity increases. However, when people have more diverse food choices, they consume a lower quantity of each food item by substituting with similar food items. Therefore, the enjoyability of eating each food item remains high, which can stimulate appetite and increase total food consumption.

The increasing variety of food can be attributed to various factors such as on-farm production diversity, increasing market access, and decreasing transaction costs from searching, shopping, travelling, and bulk discounting.[9,16,30] Urban citizens generally have higher food accessibility than their rural counterparts, because food facilities (e.g., supermarkets, food markets, and restaurants) are more

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centralized in residential areas. Rich people might also have more diverse diets because they have a higher budget. A comprehensive investigation of dietary diversity is critical for elucidating of the ongoing nutrition transition in China. Thus, in the present study, we adopted several widely used indicators to capture the trend of dietary diversity among various regions in China. Further investigation of the associations of dietary diversity with food accessibility and other factors were also conducted to explain the heterogeneity in dietary diversity.

MATERIALS AND METHODS

Sample

We used data from the China Health and Nutrition Survey (CHNS) conducted in 2004, 2006, 2009, and 2011. This survey was approved by the institutional review board at University of North Carolina at Chapel Hill and the National Institute for Nutrition and Food Safety, China Centre for Disease Control and Prevention. The sample was drawn from 9 provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong; 3 autonomous cities, Beijing, Shanghai, and Chongqing, were included in the 2011 survey) through a multistage random-cluster process. The design of and sampling for the CHNS are detailed in a previous study.[12] The original sample had 45 869 persons after merging variables from different datasets. We focused on all adults aged 18 years and older in China and excluded persons with no consumption report for the 12 major food categories (processed food was not considered in our study) listed in *Chinese Food Composition*,[31,32] the final sample comprised 24,542 persons(16,115 rural citizens and 8,427 urban citizens).

Measurement of individual food consumption

Individual food consumption data were recorded for 3 consecutive days for all household members. Respondents reported all food consumed at and outside home in a 24-hour recall. Trained field interviewers recorded the code of food (listed in the Food Composition Table of China), amount of food, types of meals, and eating places on the previous day by using food models and images. Detailed information about the survey can be found in a previous study.[12] In the present study, each food code represented an individual food category.

Measurement of dietary diversity

Several indicators have been developed for measuring dietary diversity. In general, these indicators can be classified into 2 groups: count measures, which record the number of food items, and distribution indices, which account for the number and distribution of food items.[9] Here, we selected 2 count indices and 2 distribution indicators to measure dietary diversity.

The first indicator was the count of individual food items (*Count*), which is defined as the number of individual food items based on the food codes. The CHNS lists 1,506 individual food items in 21 categories according to *China Food Composition*,[31,32] of which the first 12 categories (1,067 individual food items) refer to major food groups, and the remaining represent processed foods (e.g., infant foods, cakes, fast food, beverages, and condiments). Our study focused only on staples and excluded other food groups.

The second index used in our study was the dietary diversity score (DDS) developed by Kant et al (1993), which counts the number of food groups consumed daily. To estimate DDS, we followed the method used by Liu et al.[9] by combining the original 12 major food categories into 6 broad groups (grains, vegetables, fruits, meat/poultry/seafood, dairy, and beans/eggs/nuts; relevant details are presented in Supplementary table 1) based on similarities in nutrient composition and dietary function. Following the suggestion of Kant et al,[19] we also excluded food consumed in amounts less than the minimum amount (25 g/d) to avoid including food groups consumed in very small amounts. In addition, Chinese people consume considerably less dairy compared with people from Western countries.[33] Thus, we set the minimum amount of dairy at 10 g/d. Therefore, DDS ranges from 0 to 6, with higher values indicating a more diverse diet.

Following the suggestion of Theil and Finke,[1] the third measure used in this study was entropy (*Entropy*),which is expressed as a function of the consumption share W_i.

$$Entropy = \sum_i^n w_i \log(\frac{1}{w_i}) \quad (1)$$

Because higher *Entropy* values implies greater dietary diversity, the maximum diversity (logn) occurs when consumption shares are equally distributed among different categories. The share W_i was calculated according to the weight of each food group. Therefore, food groups with higher quantities had higher weights.

The final indicator, the Simpson index (*Simpson*), is commonly used in measuring diversity in economic research. *Simpson* is computed using the Herfindahl index, a widely used measure of market concentration.

$$Simpson = 1 - \sum_i^n w_i^2 \quad (2)$$

The value of *Simpson* varies from 0 (only one food group is consumed) to $1 - \frac{1}{n}$ (all food groups have equal share), with higher values indicating greater diversity.

Food facilities

Food facilities refer to places where people can buy or eat food. It is commonly used as a measure of food accessibility.[34, 35] Having adequate food facilities reduces the cost of accessing various foods. In this study, we counted the total number of fast food restaurants, indoor restaurants, food stalls, food carts, bakeries, fruit shops, and supermarkets in the living quarters as the number of food facilities, which reflects access to food markets. A higher density of food facilities implies that the residents have easier access to a diversified diet.

Income

The income variable used in this study was the generated per capita income in the survey, which accounts for both market and nonmarket activities.[36] All incomes were deflated using the consumer price index of 2004 for the purpose of comparison.

Data analysis

All statistical analyses were performed using the statistical software Stata (version 11.0, StataCorp, College Station, Texas 77845 USA). The descriptors illustrate the distribution of diversity indices, gender, income, and food facilities. Moreover, rural and urban residents were compared on the basis of these indicators. In this study, *t* tests were used to analyze continuous variables and chi-square tests were used for binary variables. The level of significance was set at 0.05. Pearson correlation coefficients were calculated to investigate the associations of diversity measurements with income and the number of food facilities. These associations were also investigated through multivariable and polynomial regression. Furthermore, people surveyed more than once or those from the same family may have a similar diet. To eliminate this intragroup correlation, we modified the standard errors and variance-covariance matrix of the estimators using the cluster effect.

RESULTS

Table 1 presents the distribution results for dietary diversity and food facilities, showing that, on average, 25.7 types of food (3.93 food groups) were consumed by the respondents on the survey days. The average values of *Entropy* and *Simpson* were 1.17 and 0.64, respectively. These values accord with those in previous studies[9,10] that have reported that most people had a diverse diet with only one or two groups missing from their dietary record. On average, approximately 35 food facilities (including fast food and indoor restaurants, food stalls, food carts, bakeries, fruit shops, and supermarkets) were in each community but with considerable variation (SD=47.1). More than 40% of the respondents lived in communities with fewer than 10 food facilities, and 25% of the respondents lived in an area with more than 50 food facilities. Table 2 presents the descriptive statistics and definitions of the socioeconomic variables. Results show that the average per capita income was RMB32,053, and the average family size was 2.10 members. The average age and number of years of education were 49.86 and 7.60 years respectively. In addition, our sample contained more female respondents (54%) and rural citizens (66%) (Supplementary table 2). Our sample was almost equally distributed in 2004, 2006, 2009, and 2011, with a higher share in 2011 (32.3%).

Figure 1 shows the distribution and trend of food diversity stratified by year. All 4 indicators vary considerably, indicating that food diversity varies at the individual level.

Table 1. Distribution of dietary diversity and food facilities

Indicators	Number	Share	Mean/SD
Count			25.73 (7.16)
<11	143	0.58%	
11-30	18651	76.0%	
>31	5748	23.4%	
DDS			3.93 (0.97)
<3	1618	6.59%	
3-5	21540	87.7%	
6	1400	5.70%	
Entropy			1.17 (0.25)
<0.8	1907	7.77%	
0.81-1.4	4701	19.2%	
>1.4	17934	73.1%	
Simpson			0.64 (0.10)
<0.5	2073	8.45%	
0.5-0.7	15083	61.5%	
>0.7	7386	30.1%	
Facility			34.92 (47.1)
<10	10065	41.0%	
10-50	8465	34.5%	
>50	6012	24.5%	

Count: count number; DDS: dietary diversity score; Simpson: Simpson index; SD: standard deviation (shown in parentheses).

Moreover, the distribution density curves of *Count*, *Entropy*, and *Simpson* all shifted to the right over time; higher values were also obtained for DDS in more recent years. These changes provide strong evidence of an increasing trend in dietary diversity, indicating that food variety in China improved during the study period. We also observed significant regional disparity in dietary diversity. Urban residents had significantly more diverse diets than did their rural counterparts for all 4 indicators ($p<0.05$; Table 3). Figure 2 shows a clearer regional comparison, with the distribution density of the diversity indicators for 2 regions plotted simultaneously in one graph. The distribution density curves of *Count*, *Entropy*, and *Simpson* were more concentrated on the right for the urban residents compared with the rural residents. The fraction of DDS also indicated that more urban people had a highly diverse diet.

We mapped the association between dietary diversity and the number of food facilities by using local polynomial regression (Figure 3). The curves of all 4 indicators show a positive relationship between dietary diversity and the logarithm of the number of food facilities, indicating that food variety steadily increased with the number of

Table 2. Descriptive analysis and definition of socioeconomic factors

Variables	Mean	SD	Min	Max	Definition
Income	32053	43617	1	1044811	Per capita household income
Hhsize	2.10	0.89	1	6	Number of household members
Mrn	0.46	0.50	0	1	1 if male and 0 if female
Age	49.9	15.2	18	100	Respondent's age
Education	7.60	4.33	0	18	Year of formal education
Urban	0.34	0.47	0	1	1 if urban and 0 if rural
y2004	0.22	0.42	0	1	1 if 2004 and 0 if other years
y2006	0.21	0.41	0	1	1 if 2006 and 0 if other years
y2009	0.24	0.43	0	1	1 if 2009 and 0 if other years
y2011	0.32	0.47	0	1	1 if 2011 and 0 if other years

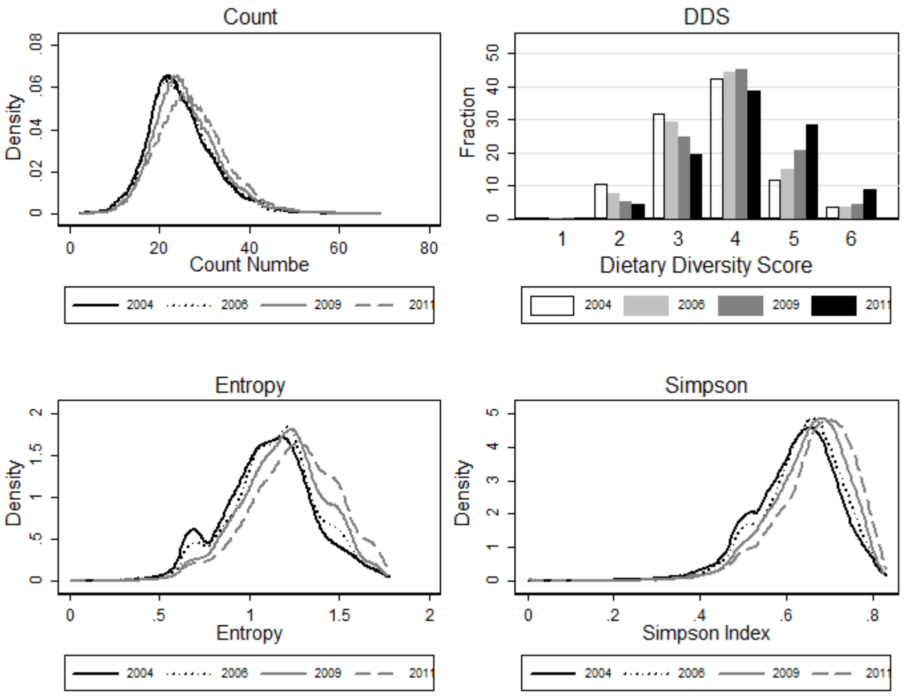

Figure 1. Trends of dietary diversity in China. Count: count number; DDS: dietary diversity score; Simpson: Simpson index. The curves (bars) are the probability density distribution functions.

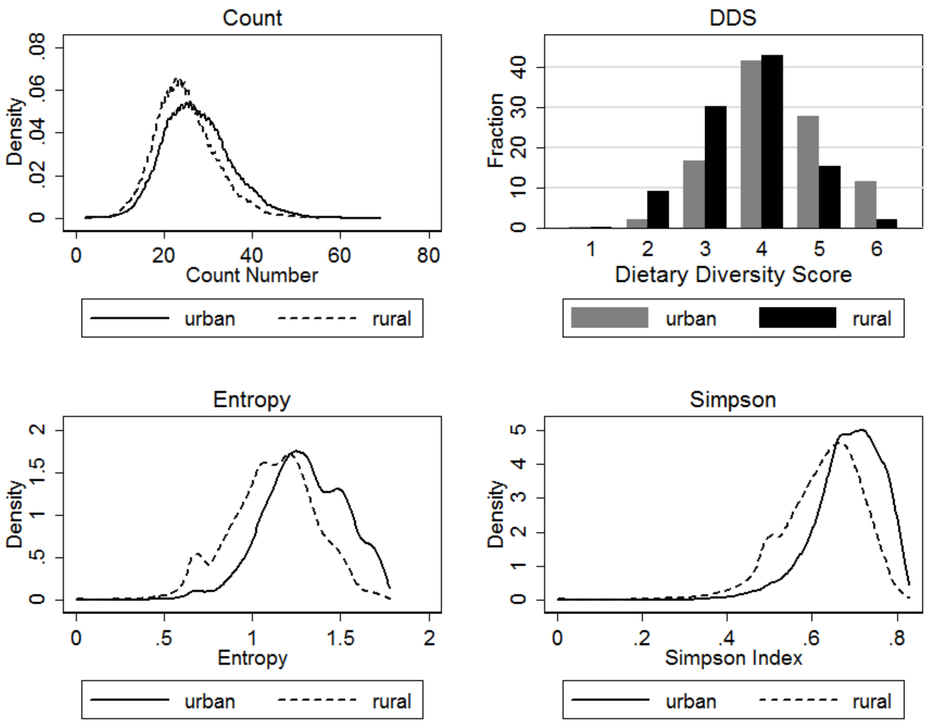

Figure 2. Distribution of 4 dietary diversity indices in rural and urban China. Count: count number; DDS: dietary diversity score; Simpson: Simpson index. The curves (bars) are the probability density distribution functions.

Table 3. Comparison of dietary diversity between rural and urban China

Variable	Rural		Urban		Comparison test	
	Mean	SD	Mean	SD	t/chi-square	*p* value
Count	24.7	6.74	27.4	7.58	-28.7	<0.01
DDS	3.72	0.92	4.33	0.96	-47.8	<0.01
Entropy	1.11	0.24	1.29	0.23	-57.6	<0.01
Simpson	0.62	0.10	0.68	0.08	-53.7	<0.01

Count: count number; DDS: dietary diversity score; Simpson: Simpson index.

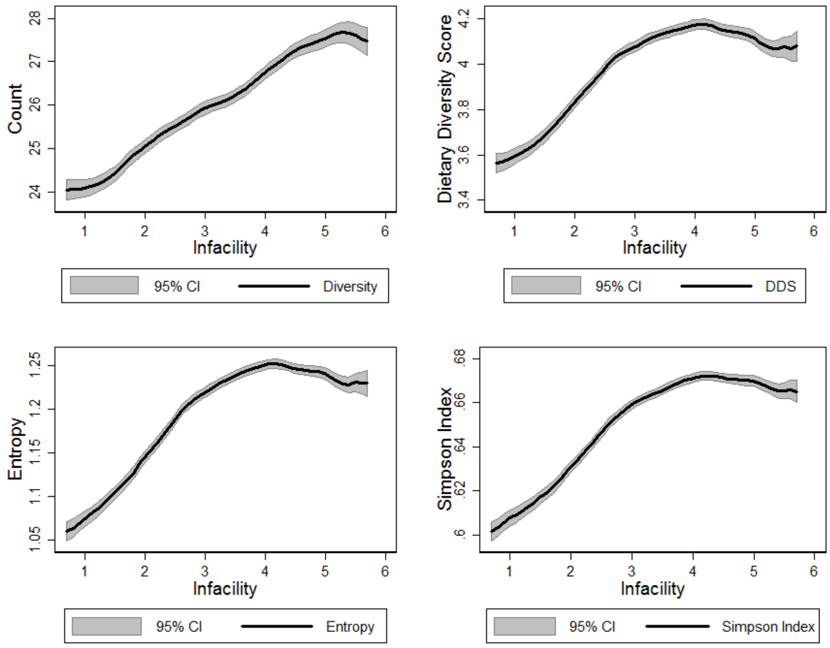

Figure 3. Association between dietary diversity and food facilities. Count: count number; DDS: dietary diversity score; Simpson: Simpson index. The curves are the fitted lines, and the grey regions are the 95% CIs. lnfacility refers to the logarithm of the number of food facilities.

Table 4. Pearson correlations between dietary diversity and food facilities

Indicators	Facility	
	Correlations	*p*
Count	0.147	<0.01
DDS	0.210	<0.01
Entropy	0.256	<0.01
Simpson	0.249	<0.01

Count: count number; DDS: dietary diversity score; Simpson: Simpson index.

food facilities. In particular, these curves show an inverse trend toward the right of the curve, implying that food diversity tended to decline in communities with a high density of food facilities. Table 4 presents the Pearson correlations of the diversity indices with the number of food facilities. All correlations were significantly positive (p<0.05).

However, other socioeconomic factors may also affect dietary diversity and change the associations. To further explore the impact of the increasing number of food facilities on dietary diversity, multivariable regression was employed to control the effect of the other variables, such as income, household size, gender, age, education, as well as regional and time differences, on food variety. Results are presented in Table 5. Our regression analysis confirmed that more food facilities correlated positively with higher food variety (all p<0.05). Specifically, a 10% increase in food facilities resulted in 2 more food items (*Count*), 0.56 more food groups (DDS), and a slight increase in *Entropy* and *Simpson*. Results also reveal that people of higher socioeconomic status had a more diverse diet (all p<0.05), and that people living in larger households consumed a higher number of food items, but their food consumption was unequally distributed, as shown by the negative association of household size with *Entropy* and *Simpson*. Moreover, women, people with a higher level of education, and urban residents had higher dietary diversity. Notably, we also found that elderly people had a more diverse diet; this might be attributable to them having more time to prepare and enjoy different foods.

As a sensitivity analysis, we also conducted separate multivariable regression analyses for people living in urban and rural areas. Results are presented in Table 6. We found that the rural subsample attained similar results to those of the full sample; specifically, an increase in the number of food facilities correlated positively with a more diverse diet (all p<0.05), and the marginal effects were even larger. However, no significant relationship was observed between the numbers of food facilities and dietary diversity in the urban areas. This may be due to the urban areas having more developed infrastructure and the cost of access to food being considerably lower; therefore, urban residents' food purchasing and consumption might not be limited to the community in which they live. We thus substituted the number of community food facilities with the total number of food facilities in the whole city and repeated the regression for the urban areas (see the right part of Table 6). Results show that the number of food facilities had a positive impact on food variety.

DISCUSSION

Numerous studies have developed various indicators for measuring dietary diversity, but only a few studies have focused on Chinese consumers. Kim et al developed the Diet Quality Index-International to compare the dietary quality (including variety) of China with that of the United States, and they found that the diet was more diverse in the United States.[23] Li et al reported significantly higher food variety for urban families than for their rural counterparts.[10] Liu et al. also investigated the impact of food accessibility on dietary diversity.[9] Their results have

Table 5. Association between dietary diversity and food facilities for the whole sample

Diversity	Count	DDS	Entropy	Simpson
ln(income)	0.798	0.109	0.031	0.012
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
ln(facility)	0.195	0.056	0.018	0.007
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Household size	0.619	-0.044	-0.010	-0.004
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Men	-0.417	-0.099	-0.037	-0.013
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Age	0.030	0.003	0.001	0.000
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Education	0.264	0.044	0.012	0.004
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Urban	1.143	0.293	0.088	0.030
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
y2006	0.194	0.095	0.031	0.011
	(0.224)	(<0.01)	(<0.01)	(<0.01)
y2009	0.803	0.245	0.074	0.027
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
y2011	1.40	0.308	0.077	0.024
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Provincial dummy	Yes	Yes	Yes	Yes
Constant	12.1	1.94	0.626	0.443
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Observations	24542	24542	24542	24542
p	(<0.01)	(<0.01)	(<0.01)	(<0.01)
F test	160.96	231.39	323.90	272.31
R^2-adjusted	0.201	0.248	0.312	0.275

p values in are shown in parentheses; ln( ) refers to the logarithm of the variables in brackets; y2006, y2009, and y2011 refer to the year dummy variable.

shown that the higher cost of access to food negatively affected individuals' ability to diversify their diet. Our study investigated this topic more deeply and revealed some new phenomena.

Our results provide strong evidence that food diversity varies across different people and over time, and that the diet is more diverse in urban China than in rural China. Current studies reveal that food variety correlates negatively with the cost of access to food.[9,10,16] Therefore, we further explored the impact of the number of food facilities on the disparity in dietary diversity. Results confirm that people living in communities with more food facilities had a more diverse diet than did those living in communities with few food facilities ($p<0.05$), and this result was robust across different regions (rural/urban) and when using different methods. We thus concluded that higher access to food contributed to the increase in food diversity in China.

Food diversity, which is achieved by consuming biologically distinct foods, has been proven to be the most effective means for people to obtain essential bioactive elements and compounds, and it can also dilute potential adverse food components and contaminants.[17,37,38] Increasing dietary diversity is essential to maintaining the health of the omnivorous human species[17] and contributes to mitigating numerous potentially adverse health outcomes such as diabetes and learning difficulties among lower birth-weight girls.[39,40] Moreover, the increasing demand for a more diverse diet has a considerable impact on the ecosystem. For example, diverse food sources are necessary in protecting against climatic and pestilent disasters, which may affect some food sources, and in providing a rich source of medicinal compounds.[17] Further discussion on the interaction of food diversity with the ecosystem can be found in previous studies.[17,37]

However, higher dietary diversity might also promote excess energy intake, which might increase the rate obesity. We thus investigated the impact of food diversity on BMI by mapping their association in the figures using local polynomial regression (Supplementary figure 1). In general, we found that increasing food diversity is positively associated with higher BMI, particularly for BMI less than 25.

Our study contributes to the literature by providing a comprehensive description of food diversity in China. A major strength is that we adopted several indicators to measure dietary diversity over a long period in both rural and urban areas; thus, we revealed the trend of food diversity and its regional differences. This study provides strong evidence that dietary diversity is positively associated with the number of nearby food facilities, and that increasing food diversity might be attributable to higher food accessibility. These findings have crucial implication for policy makers; lower food diversity in remote areas can be alleviated by enhancing infrastructure investment in food sectors to improve food accessibility. However, this conclusion is not based on a comprehensive investigation, and future research should investigate the causality among these variables.

In conclusion, the primary finding of this study is that

Table 6. Association between dietary diversity and food facilities for rural and urban areas

Region	Rural				Urban				Urban using city restaurants			
Diversity	Count	DDS	Entropy	Simpson	Count	DDS	Entropy	Simpson	Count	DDS	Entropy	Simpson
ln(income)	0.721	0.111	0.033	0.013	0.902	0.097	0.026	0.009	0.889	0.094	0.025	0.009
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
ln(facility)	0.368	0.082	0.026	0.010	-0.136	-0.011	-0.002	-0.001	0.004	0.001	0.000	0.000
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(0.086)	(0.199)	(0.305)	(0.495)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Household size	0.712	-0.023	-0.006	-0.003	0.376	-0.091	-0.019	-0.007	0.351	-0.097	-0.021	-0.007
	(<0.01)	(0.035)	(0.042)	(0.031)	(0.008)	(<0.01)	(<0.01)	(<0.01)	(0.012)	(<0.01)	(<0.01)	(<0.01)
Men	-0.277	-0.065	-0.030	-0.011	-0.627	-0.152	-0.048	-0.016	-0.602	-0.146	-0.046	-0.015
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Age	0.014	0.001	0.001	0.000	0.053	0.006	0.002	0.001	0.049	0.005	0.002	0.001
	(0.001)	(0.052)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Education	0.218	0.037	0.010	0.004	0.319	0.050	0.013	0.004	0.301	0.047	0.012	0.004
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
y2006	0.349	0.123	0.038	0.014	-0.233	0.015	0.012	0.004	-0.088	0.045	0.019	0.007
	(0.065)	(<0.01)	(<0.01)	(<0.01)	(0.431)	(0.670)	(0.171)	(0.154)	(0.768)	(0.214)	(0.023)	(0.027)
y2009	1.23	0.313	0.093	0.034	-0.089	0.102	0.036	0.012	0.041	0.128	0.042	0.014
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(0.771)	(0.004)	(<0.01)	(<0.01)	(0.893)	(<0.01)	(<0.01)	(<0.01)
y2011	2.09	0.383	0.010	0.032	0.079	0.159	0.031	0.005	0.190	0.181	0.037	0.007
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(0.791)	(<0.01)	(<0.01)	(0.110)	(0.526)	(<0.01)	(<0.01)	(0.028)
Provincial dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	12.5	1.93	0.614	0.435	13.8	2.63	0.847	0.528	12.6	2.42	0.793	0.510
	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
Observations.	16115	16115	16115	16115	8427	8427	8427	8427	8427	8427	8427	8427
p	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(<0.01)
F test	100.81	108.95	156.92	137.28	55.53	74.39	96.85	79.27	55.03	77.93	101.45	82.2
R^2-adjusted	0.180	0.179	0.238	0.215	0.184	0.208	0.248	0.215	0.186	0.218	0.261	0.226

p values are shown in parentheses; ln( ) refers to the logarithm of the variables in brackets; y2006, y2009, and y2011 refer to the year dummy variable.

food diversity in China has improved over the past decade, but food diversity varies significantly among different populations. Our results indicate that this disparity might be attributable to higher access to food facilities in some regions, as well as higher incomes and differences in personal characteristics.

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AUTHOR DISCLOSURES

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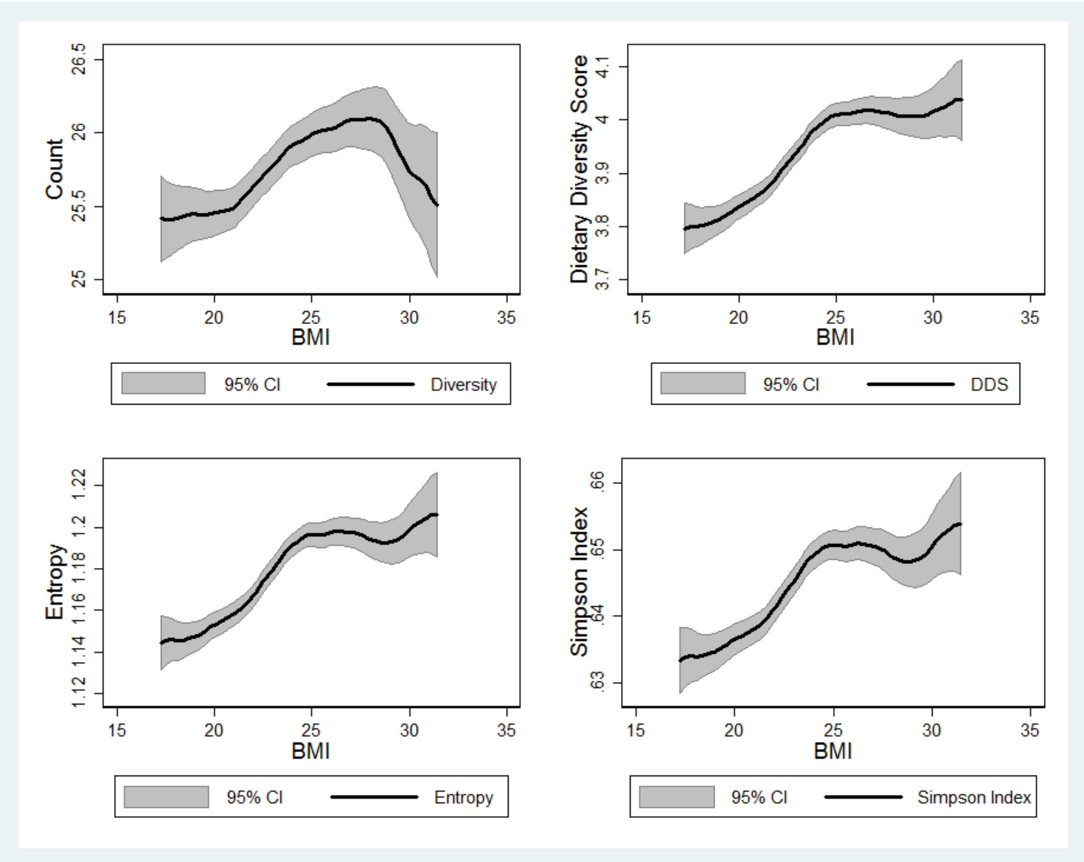

Supplementary figure 1. Association between BMI and dietary diversity. Count: count number; DDS: dietary diversity score; Simpson: Simpson index. The curves are the fitted lines, and the grey regions are the 95% CIs.

Supplementary table 1. List of food groups

Food groups	Contents	Food code	Mean consumption (g)
Grain	cereals and cereal products; tubers, starches and products	10000-19999, 20000-29999	357
Vegetable	vegetables and vegetable products; fungi and algae	40000-49999, 50000-59999	292
Fruits	fruit and fruit products	60000-69999	42.0
Meat/poultry/seafood	meat and meat products; poultry and poultry products; fish, shellfish and mollusc	80000-89999, 90000-99999, 120000-129999	107
Dairy	milk and products	100000-109999	14.8
Beans/eggs/nuts	dried legumes and legume products; nuts and seeds; eggs and egg products	30000-39999, 70000-79999, 110000-119999	75.4

Supplementary table 2. Sample distribution

Category	Observations	Share (%)
Gender		
Women	13179	53.7
Men	11363	46.3
Region		
Rural	16115	65.7
Urban	8427	34.3
Year		
2004	5496	22.4
2006	5255	21.4
2009	5874	24.0
2011	7917	32.3
Total	24542	100