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A comparison study on the prevalence of obesity and its associated factors among city, township and rural area adults in China

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ABSTRACT

Objectives: To explore the association of dietary behaviour factors on obesity among city, township and rural area adults.

Setting: A stratified cluster sampling technique was employed in the present cross-sectional study. On the basis of socioeconomic characteristics, two cities, two townships and two residential villages were randomly selected where the investigation was conducted.

Participants: A total of 1770 city residents, 2071 town residents and 1736 rural area residents participated in this survey.

Primary and secondary outcome measures: Dietary data were collected through interviews with each household member. Anthropometric values were measured. Participants with a body mass index (BMI) of ≥28.0 kg/m^2 were defined as obesity.

Results: The prevalence of obesity was 10.1%, 7.3% and 6.5% among city, township and rural area adults, respectively. Correlation analysis showed that for adults living in cities, the daily intake of rice and its products, wheat flour and its products, light coloured vegetables, pickled vegetables, nut, pork and sauce was positively correlated with BMI (r=0.112, 0.084, 0.109, 0.129, 0.077, 0.078, 0.125, p<0.05), while the daily intake of tubers, dried beans, milk and dairy products was negatively correlated with BMI (r=−0.086, −0.078, −0.116, p<0.05). For township residents, the daily intake of vegetable oil, salt, chicken essence, monosodium glutamate and sauce was positively correlated with BMI (r=0.088, 0.091, 0.078, 0.087, 0.189, p<0.05). For rural area residents, the daily intake of pork, fish and shrimp, vegetable oil and salt was positively correlated with BMI (r=0.087, 0.122, 0.093, 0.112, p<0.05), while the daily intake of dark coloured vegetables was negatively correlated with BMI (r=−0.105, p<0.05).

Conclusions: The prevalence of obesity was higher among city residents than among township and rural area residents. The findings of this study indicate that demographic and dietary factors could be associated with obesity among adults. Healthy dietary behaviour should be promoted and the ongoing monitoring of population nutrition and health status remains crucially important.

Strengths and limitations of this study

- The present study is one of the few studies to examine the prevalence of obesity and its associated factors among city, township and rural area adults. Its strengths also include the large sample size and stratification of the analyses by region to observe the difference between a city, township and rural area. We were able to examine the association between a variety of demographic and dietary factors and body mass index. We had data on sociodemographic and dietary behaviour variables with which we were able to comprehensively analyse the difference among city, township and rural area adults.
- One limitation of the study is the cross-sectional design that disallows a sequence of temporality to be established for obesity and dietary behaviour. Residents with obesity may have changed their diet based on their clinician's suggestions. If they then ate a healthy diet, the dietary influence detected may be the result, but not the cause, of obesity. If it is true, then this healthy diet may in some cases drive the association to be null and make our findings under-reported. Future prospective cohort studies are warranted to verify our findings.

INTRODUCTION

Obesity represents a rapidly growing threat to the health of populations in an increasing number of countries. Indeed, they are now so common that they are replacing more traditional problems such as under nutrition and infectious diseases as the most significant causes of ill health. Between 1980 and 2008, the mean global body mass index (BMI) increased by 0.4–0.5 kg/m2 per decade in men and women.[1] Obesity is associated with the incidence of multiple comorbidities including type II diabetes, cancer and cardiovascular diseases.[2] The worldwide prevalence has more than doubled since 1980. A number

of studies have reported that with each surge in weight, there is an increase in the risks for coronary heart disease, type 2 diabetes, cancers (endometrial, breast and colon), hypertension, dyslipidaemia, stroke, sleep apnoea, respiratory problems, osteoarthritis and gynaecological problems.[3] The trend in the rising prevalence of obesity and related morbidity and mortality in developing countries has been attributed to rapid urbanisation, nutrition transition and reduced physical activity.[4]

China has had a history of under-nutrition followed by the most rapid increase in obesity and related diseases worldwide, with differential rates across rural and urban areas.[5] Owing to various factors such as geographical environment, living habits and dietary behaviour, people in different regions have different epidemic characteristics and dietary behaviour, which may be associated with the risk of obesity. The aim of this study was to explore the association between a variety of demographic and dietary behaviour factors and obesity among city, township and rural area adults.

SUBJECTS AND METHODS

Subjects

A stratified cluster sampling technique was employed in this cross-sectional study. On the basis of socioeconomic characteristics, two cities, two townships and two residential villages were randomly selected where the investigation was conducted. The city is defined as the centre area of the big city, and the township is defined as all the district and county cities. The residential village is defined as a county. In every sampling unit, 450 households were selected by the random sampling method according to the household registration information. Then every member of the sampled household was interviewed.

METHODS

During home visits spanning 3 d, dietary data were collected through interviews with each household member, including rice and its products, wheat flour and its products, tuber, bean products, dark coloured vegetables, light coloured vegetables, pickled vegetables, pork, poultry, milk and dairy products, eggs, fish and shrimp, vegetable oil, sugar and starch, salt, chicken essence, monosodium glutamate and sauce. The questionnaire was administrated face to face by trained staff through door to door interview. Information about other covariables was also collected including educational level, physical activity level, smoking, drinking and lifestyle. All subjects provided written informed consent after the research protocols were carefully explained to them.

Anthropometric measurements

Height was measured without shoes to the nearest 0.2 cm using a portable SECA stadiometer, and weight was measured without shoes and in light clothing to the nearest 0.1 kg on a calibrated beam scale. Waist circumference was measured at a point immediately above the iliac crest on the midaxillary line at minimal respiration to the nearest 0.1 cm.[6] BMI was calculated by weight (kg)/height(m)^2. Participants with a BMI of ≥28.0 kg/m^2 were defined as obese.[7]

Statistical analysis

As continuous variables were not normally distributed, they were described as the median, 25th and 75th centiles. The differences between rural residents and urban residents were evaluated by nonparametric test (Mann-Whitney test). The distributions of potential influencing factor proportions were compared by the χ^2 test. Spearman correlations were used to explore the correlations between dietary factors and BMI. Spearman's r was used to describe the strength of the relationship between two variables. Data processing and statistical analyses were performed using the SAS 9.2 software. All tests were two sided and the level of significance was set at $p<0.05$.

RESULTS

Demographic and dietary intake characteristics

A total of 1770 city residents, 2071 town residents and 1736 rural area residents participated in this survey. The prevalence of obesity was 10.1%, 7.3% and 6.5% in city, township and rural area adults, respectively (χ^2=15.656, p=0.000). The median value (25th, 75th centile) of BMI was 23.0 (20.2, 25.3), 22.2 (19.6, 24.7), 21.6 (19.1, 24.1) among adults in the three types of region, respectively (H=97.749, p=0.000).

The demographic and dietary intake characteristics are presented in table 1. When the demographic and dietary intake variables were stratified by region, there were significant difference on BMI, weight, waist circumstance among city, township and rural area adults with the same direction ($p<0.05$). Among city residents, the intake of rice and its products and pickled vegetables was higher in obese adults than in non-obese adults ($p<0.05$). Among township residents, wheat flour and its products, salt and monosodium glutamate were higher in obese adults than in non-obese adults ($p<0.05$). There were no significant differences in dietary intake among rural area adults.

Demographic characteristics and dietary behaviour distribution are presented in table 2. Among city residents, the distributions of education level, number of family members living together, drinking high alcohol liquor and drinking Yellow Wine were significant between obese adults and non-obese adults ($p<0.05$). Among township and rural area residents, there were no significant differences in the distribution of these covariables ($p>0.05$).

Correlations between dietary factors

Correlation analysis showed that for adults living in cities, the daily intake of rice and its products, wheat

Table 1 Demographic characteristics and dietary intake from a reported 24 h dietary recall in adults, Zhejiang province, China

Demographic characteristics	City								Township								Rural area							
	Obese (N=178)			Non-obese (N=1592)					Obese (N=152)			Non-obese (N=1919)					Obese (N=113)			Non-obese (N=1623)			
	Median	25%	75%	Median	25%	75%	Z	p Value	Median	25%	75%	Median	25%	75%	Z	p Value	Median	25%	75%	Median	25%	75%	Z	p Value
Age (years)	57.8	46.5	65.1	57.2	45.1	65.7	0.287	0.774	49.8	41.0	60.0	53.6	42.6	62.6	−2.109	0.035	49.0	41.0	57.0	50.0	42.0	60.0	−1.258	0.209
Weight (kg)	74.9	69.1	84.0	60.0	53.5	66.6	17.002	0.000	77.5	72.2	84.7	58.4	52.2	65.0	17.728	0.000	78.7	69.4	85.7	56.5	50.3	63.2	15.740	0.000
Height (cm)	159.2	153.7	166.7	161.0	156.0	167.0	−2.567	0.010	161.3	155.0	167.6	160.5	155.0	166.4	0.839	0.401	161.0	153.7	168.7	159.4	153.9	165.6	1.137	0.256
BMI (kgm-2)	29.3	28.6	30.5	23.3	21.2	25.1	21.910	0.000	29.5	28.6	30.9	22.7	20.8	24.7	20.551	0.000	29.5	28.6	30.8	22.2	20.2	24.2	17.798	0.000
Waist circumference (cm)	97.0	90.1	101.5	81.9	75.0	88.9	16.354	0.000	98.5	94.2	101.9	80.7	74.9	86.5	18.283	0.000	97.1	92.4	101.2	77.3	71.5	84.1	15.139	0.000
Dietary intakes																								
Energy intake(kcal)	1786.8	1349.4	2197.6	1607.5	1232.0	2144.5	1.126	0.260	2322.2	1742.7	2866.4	2167.7	1743.4	2694.4	1.159	0.246	1837.8	1581.5	2159.1	1829.7	1471.2	2259.7	0.435	0.664
Rice and its products (g)	216.7	164.6	292.9	200.0	135.8	258.3	2.344	0.019	225.7	154.1	309.3	232.8	167.9	317.6	−0.807	0.420	166.7	115.7	243.3	189.0	132.5	266.7	−1.646	0.100
Wheat flour and its products (g)	66.7	36.7	130.8	66.7	30.5	100.0	1.747	0.081	66.3	27.2	109.4	41.8	3.7	82.9	2.463	0.014	42.8	19.5	95.9	53.4	32.8	86.7	−1.131	0.258
Bean products (g)	7.7	0.0	15.6	7.7	1.3	15.8	0.283	0.777	15.4	4.6	28.9	13.1	3.6	26.9	0.716	0.474	13.7	7.7	27.0	16.9	7.7	33.2	−0.525	0.599
Dark colored vegetables (g)	76.1	26.3	147.5	81.7	43.3	133.8	−0.728	0.467	70.0	33.3	130.0	66.7	31.7	108.3	0.751	0.452	56.7	26.7	91.5	66.7	33.3	100.0	−1.729	0.084
Light coloured vegetables (g)	202.9	127.2	255.0	161.7	104.3	236.2	1.859	0.063	140.0	98.3	240.0	146.7	96.7	222.5	0.072	0.943	167.0	99.2	215.0	160.0	106.7	230.7	−0.254	0.799
Pickled vegetables (g)	1.7	1.7	13.3	0.0	0.0	6.7	2.674	0.007	6.7	0.0	11.7	0.0	0.0	11.5	1.215	0.224	18.3	7.9	39.2	16.7	9.7	38.7	−0.106	0.916
Pork (g)	43.3	17.9	96.8	47.3	20.0	86.7	−0.142	0.887	53.1	25.0	75.0	46.7	16.7	83.3	0.579	0.563	95.0	55.4	137.5	73.3	41.0	120.0	1.938	0.053
Poultry (g)	16.7	0.0	50.0	10.0	0.0	40.8	0.663	0.508	6.6	0.0	33.3	10.0	0.0	41.7	−0.836	0.403	50.0	33.3	86.7	53.3	33.3	80.0	0.336	0.737
Milk and dairy products (g)	0.0	0.0	13.9	0.0	0.0	83.3	−1.841	0.066	0.0	0.0	0.0	0.0	0.0	0.0	−0.454	0.650	66.7	136.0	205.3	65.4	86.1	152.9	0.391	0.696
Eggs (g)	21.9	0.0	51.7	20.0	0.0	43.3	0.506	0.613	20.0	3.3	36.8	16.7	0.0	33.3	1.421	0.155	23.3	16.7	37.5	23.3	16.7	40.0	0.021	0.984
Fish and shrimp (g)	68.3	23.8	122.5	68.3	33.7	120.3	−0.431	0.666	18.3	0.0	56.7	22.0	0.0	57.2	−0.663	0.507	76.7	38.3	134.2	60.0	33.3	93.3	1.622	0.105
Vegetable oil (g)	29.9	10.8	43.8	30.0	19.6	44.6	−0.829	0.407	39.0	27.6	69.4	37.9	25.1	56.4	1.062	0.288	37.7	18.5	62.8	32.9	19.5	52.7	0.708	0.479
Sugar and starch (g)	3.1	0.0	13.3	2.4	0.0	7.2	1.094	0.274	0.1	0.0	7.3	1.4	0.0	6.8	−0.614	0.539	2.8	1.2	5.7	3.4	1.5	7.8	−0.997	0.319
Salt (g)	6.6	4.4	11.2	6.3	4.0	10.3	0.652	0.514	9.4	6.4	13.2	7.7	5.1	11.0	2.493	0.013	11.4	6.9	16.4	9.2	5.8	14.3	1.712	0.087
Chicken essence (g)	10.2	2.9	24.6	8.7	3.4	19.4	0.711	0.477	5.9	1.1	19.2	7.1	0.7	15.2	0.616	0.538	3.5	1.8	5.2	2.4	1.3	3.3	1.525	0.127
Monosodium glutamate (g)	1.9	0.0	4.6	1.9	0.0	4.2	0.291	0.771	3.4	1.2	5.5	1.9	0.3	3.8	2.683	0.007	2.5	1.4	5.3	3.0	1.6	5.1	−0.645	0.519
Sauce (g)	5.6	2.4	11.4	7.2	3.4	13.9	−2.283	0.023	9.0	3.8	17.8	6.5	2.2	13.8	2.282	0.023	6.7	3.9	13.4	5.4	2.6	9.6	1.447	0.148

Table 2 Demographic characteristics and dietary behaviour in adults, Zhejiang province, China

	City						Township						Rural area					
	Obese		Non-obese				Obese		Non-obese				Obese		Non-obese			
Characteristic	N	%	N	%	χ2	p Value	N	%	N	%	χ2	p Value	N	%	N	%	χ2	p Value
Gender																		
Male	73	9.8	672	90.2	0.052	0.820	78	8.0	902	92.0	1.051	0.305	53	6.5	757	93.5	0.003	0.957
Female	105	10.2	920	89.8			74	6.8	1017	93.2			60	6.5	866	93.5		
Education level																		
Not going to school	13	15.3	72	84.7	26.267	0.000	2	2.9	67	97.1	8.413	0.209	5	10.4	43	89.6	5.286	0.508
Illiteracy	13	19.1	55	80.9			23	7.0	305	93.0			13	5.8	211	94.2		
Primary school	59	13.9	365	86.1			52	7.8	613	92.2			40	5.6	678	94.4		
Junior middle school	42	7.7	506	92.3			60	8.6	639	91.4			45	8.1	512	91.9		
Senior middle school	28	8.5	303	91.5			10	4.3	220	95.7			7	4.9	135	95.1		
Junior college	16	10.7	134	89.3			4	7.4	50	92.6			2	8.0	23	92.0		
University or above	7	4.3	157	95.7			1	3.8	25	96.2			1	4.5	21	95.5		
Marital status																		
Single	10	11.1	80	88.9	2.877	0.411	8	10.0	72	90.0	4.536	0.209	3	3.7	81	96.4	4.208	0.24
Has a spouse	152	10.0	1371	90.0			138	7.3	1746	92.7			102	6.6	1443	93.4		
Divorced	1	3.1	31	96.9			2	22.2	7	77.8			0	0.0	15	100.0		
Widowed	15	12.0	110	88.0			4	4.1	94	95.9			8	9.1	84	91.3		
Number of family members living together																		
Less than 4	130	8.9	1332	91.1	12.597	0.000	105	7.0	1395	93.0	0.8	0.387	83	7.2	1084	92.9	2.228	0.136
Equal to or more than 4	48	15.6	260	84.4			47	8.2	524	91.8			30	5.3	539	94.7		
Smoke																		
Do not smoke	148	10.4	1272	89.6	7.636	0.054	117	7.7	1402	92.3	2.025	0.567	81	6.3	1207	93.7	0.787	0.852
Smoke every day	24	8.2	269	91.8			33	6.6	465	93.4			28	7.0	370	93.0		
Not smoking every day	6	18.2	27	81.8			2	3.8	51	96.2			4	8.3	44	91.7		
I do not know	0	0.0	24	100.0			0	0.0	1	100.0			0	0.0	2	100.0		
Drinking low alcohol liquor																		
No	147	9.6	1393	90.5	3.059	0.08	131	7.1	1711	92.9	1.264	0.261	93	6.6	1318	93.4	0.085	0.771
Yes	31	13.5	199	86.5			21	9.2	208	90.8			20	6.2	305	93.8		
Drinking high alcohol liquor																		
No	153	9.4	1484	90.7	11.063	0.001	129	7.0	1716	93.0	2.995	0.084	103	6.5	1471	93.5	0.034	0.854
Yes	25	18.8	108	81.2			23	10.2	203	89.8			10	6.2	152	93.8		
Drinking yellow wine																		
No	161	9.7	1504	90.3	4.092	0.043	131	7.0	1745	93.0	3.714	0.054	108	6.5	1565	93.5	0.042	0.837
Yes	17	16.3	88	83.8			21	10.8	174	89.2			5	7.9	58	92.1		
Drinking beer																		
No	141	9.8	1294	90.2	0.459	0.498	114	7.1	1485	92.9	0.45	0.502	85	7.1	1115	92.9	2.129	0.145
Yes	37	11.1	298	89.0			38	8.1	434	91.9			28	5.2	508	94.8		
Drinking wine																		
No	153	10.0	1386	90.1	0.098	0.755	141	7.3	1783	92.7	0.005	0.946	109	6.5	1567	93.5	0.002	0.961
Yes	25	10.9	206	89.2			11	7.5	136	92.5			4	6.7	56	93.3		

flour and its products, light coloured vegetables, pickled vegetables, nut, pork and sauce was positively correlated with BMI (r=0.112, 0.084, 0.109, 0.129, 0.077, 0.078, 0.125, p<0.05), while the daily intake of tubers, dried beans, milk and dairy products was negatively correlated with BMI (r=−0.086, −0.078, −0.116, p<0.05). For township residents, the daily intake of vegetable oil, salt, chicken essence, monosodium glutamate and sauce was positively correlated with BMI (r=0.088, 0.091, 0.078, 0.087, 0.189, p<0.05). For rural area residents, the daily intake of pork, fish and shrimp, vegetable oil and salt was positively correlated with BMI (r=0.087, 0.122, 0.093, 0.112, p<0.05), while the daily intake of dark coloured vegetables was negatively correlated with BMI (r=−0.105, p<0.05) (table 3).

DISCUSSION

This study employed an analytical approach that provides insight into two types of commonly recognised risk factors for adult obesity—demographic and dietary factors.

In recent decades, the double burden of malnutrition —the coexistence of under-nutrition and over-nutrition in the same population—has become a prominent public health concern in transitional countries. Traditional diet has been replaced by the 'Western diet' and major declines in all phases of activity and increased sedentary activity as the main reasons explaining the rapid increase in overweight and obesity, bring major economic and health costs. [8–10]

According to a study carried out among Chinese urban children and adolescents (aged 7–18 years) in 2000, the prevalence of obesity in boys was 6.5% in Beijing, 4.9% in Shanghai, 4.5% in coastal big cities, and 2.0% in coastal medium/small-sized cities, respectively, while the prevalence of obesity and overweight in girls of the same age group was 3.7% in Beijing, 2.6% in Shanghai, 2.8% in coastal big cities, and 1.7% in coastal medium/small-sized cities, respectively.[11] The China Health and Nutrition Surveys reported that the prevalence of obesity in children aged 7–17 increased from 5.2% in 1991 to 13.2% in 2006, and the most noticeable increase was in children from urban areas and those from higher income backgrounds.[12] In our study, the prevalence of obesity reached 10.1%, 7.3% and 6.5% among city, township and rural area adults in Zhejiang province. The prevalence of obesity in the coastal big cities, followed by that in the township cities, had reached the average level of the developed countries, and the result was consistent with Ji CY's study.[13] Ji CY also reported that the prevalence of obesity was low in most of the inland cities at an early stage of epidemic overweight. The epidemic manifested a gradient distribution in groups, which was closely related to the socioeconomic status of the populations.[13] This was also

Table 3 Correlations between BMI and daily dietary intake among adults living in cities, townships and rural area, Zhejiang province, China

	City		Township		Rural area	
	r	p Value	r	p Value	r	p Value
Food						
Rice and its products (g)	0.112**	0.004	0.028	0.419	−0.070	0.066
Wheat flour and its products (g)	0.084*	0.030	0.008	0.818	0.033	0.567
Tubers (g)	−0.086*	0.027	0.025	0.476	−0.030	0.671
Dried beans (g)	−0.078*	0.044	−0.002	0.951	−0.094	0.374
Bean products (g)	0.039	0.316	0.018	0.606	−0.002	0.973
Dark coloured vegetables (g)	−0.027	0.489	−0.012	0.735	−0.105*	0.011
Light coloured vegetables (g)	0.109**	0.005	0.019	0.582	−0.027	0.474
Pickled vegetables (g)	0.129**	0.001	0.057	0.100	−0.106	0.207
Fruits (g)	−0.024	0.544	0.053	0.121	0.130	0.174
Nut (g)	0.077*	0.046	0.041	0.233	0.023	0.814
Pork (g)	0.078*	0.043	0.018	0.596	0.087*	0.030
Poultry (g)	−0.022	0.575	0.010	0.762	−0.036	0.502
Milk and dairy products (g)	−0.116**	0.003	−0.030	0.381	0.083	0.651
Eggs (g)	0.047	0.228	−0.010	0.770	0.047	0.360
Fish and shrimp (g)	0.060	0.123	0.062	0.071	0.122*	0.014
Vegetable oil (g)	−0.036	0.347	0.088*	0.011	0.093*	0.019
Sugar and starch (g)	0.002	0.969	0.035	0.304	−0.063	0.330
Salt (g)	0.002	0.966	0.091**	0.008	0.112**	0.004
Chicken essence (g)	0.020	0.608	0.078*	0.024	0.124	0.165
Monosodium glutamate (g)	−0.009	0.813	0.087*	0.011	0.049	0.268
Sauce (g)	0.125**	0.001	0.189**	0.000	0.052	0.237

*p<0.05; **p<0.01.
BMI, body mass index.

consistent with the previous report that a higher prevalence of obesity was observed in the more educated, urban, high income and high social status segments of society.[14–17] Recently, in Drewnowski A's study, census tract level home values and college education were more strongly associated with obesity than household incomes. For each additional $100 000 in median home values, the census tract obesity prevalence was 2.3% lower. The three socioeconomic status factors together explained 70% of the variance in census tract obesity prevalence.[18]

There was a pattern that the risk of obesity was greater among city residents with higher education. It seems possible that the education level may be complicating the relationship between dietary behaviour and obesity. On the one hand, residents with a higher education level are more likely to endorse health ideals such as a more healthy diet or physical activities to preserve a good body image,[19] and linked to a lower prevalence of obesity among city residents, and the result was consistent with previous studies. [20–21] On the other hand, a higher education level may be associated with clerical work or increased sitting time among township residents and rural residents, which one might expect would increase the risk of obesity; thus, we could not find the effect of education level on the risk of obesity in a township and rural area. In addition, this inconsistency between city and township residents and rural area residents was similar to the opinion that an initial increase from low social economic status to mid-level social economic status was associated with worse health outcomes and behaviours; however, the continued increase from mid-social economic status to high social economic status saw returns to healthy outcomes and behaviours.[22]

The major finding of dietary factors among city residents was that residents with obesity have a higher daily intake of rice and its products and pickled vegetables. BMI increased with the daily intake of rice and its products, wheat flour and its products, light coloured vegetables, pickled vegetables, nut, pork and sauce and decreased with the daily intake of tubers, dried beans, milk and dairy products. In a township, residents with obesity have a higher daily intake of vegetable oil, salt, chicken essence, monosodium glutamate and sauce. The major finding among rural area residents was that BMI increased with the daily intake of pork, fish and shrimp, vegetable oil and salt, but decreased with the daily intake of dark coloured vegetables. The differences in relationship between dietary factors and BMI among city, township and rural area residents may be due to the different dietary patterns, as reported in the literature,[23] but a daily intake of salt and foods high in salt and sugar such as sauce, chicken essence and pickled vegetables was associated with high BMI. This was consistent with the ecological study of the UK and other previous studies.[24–26] Also, a Swiss study found a positive association between obesity and salt intake.[27] This was also consistent with the policy and action on nutrition and health promotion in many countries. In the UK, a wide range of policies are in place, including support for breastfeeding and healthy weaning practices, nutritional standards in schools, restrictions on marketing foods high in fat, sugar and salt to children, schemes to boost participation in sport, active travel plans, and weight management services.[28–29] In recent years, there has been increased interest in the public health benefit of small changes to behaviours. The developing world needs to give far greater emphasis to addressing the prevention of the adverse health consequences of this shift to the nutrition transition stage.

Among city residents, the daily intake of milk and dairy products was associated with low BMI; this result was similar to the results of a random-sample population-based study in Córdoba, Argentina.[30] Among rural residents, the daily intake of dark coloured vegetables was associated with low BMI, while the daily intake of vegetable oil was associated with high BMI. The obesity problem needs to be tackled differently in the city, township and rural area as their correlated dietary factors are not the same.

In conclusion, this study extends our understanding of demographic and dietary influencing factors on obesity among city, township and rural area residents. Obesity is still highly prevalent among Chinese adults. The prevalence of obesity was higher in city residents than in township and rural area residents. Our results call for urgent action to educate people in diet style modifications and the need for effective preventive and educational strategies on obesity.

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