

## Original Article

# Dietary choice and health behaviors in eastern Chinese women: a descriptive, population-based survey and review of public health data

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**Background and Objectives:** Urbanization in China has increased the prevalence of high-fat and low-fiber diets, and of adverse health behaviors associated with an increased risk of diet-related, non-communicable diseases (DR-NCDs) in eastern Chinese women. This study aimed to characterize the dietary intake and health behaviors in eastern Chinese women. **Methods and Study Design:** Retrospective data of 122,058 women aged 25 to 70 who completed a multi-staged, stratified, cluster sampling epidemiological survey in eastern China in 2008, including self-report of diet and lifestyle information (sleep, physical activity, work, etc.). The survey included food groups (on a 4-point scale from daily to rarely) and health behaviors. **Results:** Of 122,058 surveyed women, 2008 (1.6%) smoked tobacco, 4326 (3.5%) consumed alcohol, 10,274 (8.4%) reported insomnia, and 38,305 (31.4%) exercised regularly. Consumption was most commonly reported as daily for vegetables/fruits (68.1%); 3-4/week for garlic (31.7%); 1-2/week for bean products (39.4%), red meat (40.8%), corn (36.6%), and carrots (41.9%); and rarely for milk products (46.4%), fried food (42.1%) and charcuterie (55.8%). **Conclusions:** This study suggests some overall positive lower rates of tobacco use, alcohol consumption and insomnia than reported previously, but physical exercise was also decreased. Dietary habits were relatively healthy.

**Key Words:** survey, diet, nutrition, Chinese women, diet-related non-communicable disease

## INTRODUCTION

Urbanization and economic growth in China have altered nutrition and health behaviors, increasing the occurrence of high fat diets, smoking, alcohol consumption, and physical inactivity, which are all associated with obesity and chronic diseases.<sup>1,2</sup> Although issues of malnutrition and nutritional deficiency are still present in some regions of China, there is an increasing focus on the burden of diet-related, non-communicable disease (DR-NCD) in developed China, which is the eastern part of the country, with the largest part of the population and the most rapid economic development.<sup>3</sup>

Changes in diet and health behaviors pose significant challenges to Chinese healthcare systems. According to the World Bank, the burden of DR-NCDs in both genders can be expected to increase dramatically from 2010 to 2030.<sup>4</sup> With the growing economy, urbanization and corresponding availability of high-fat foods has shifted many individuals away from classical Chinese diets of cereals, vegetables and few animal products.<sup>5</sup> This shift in diet is the defining characteristic of the most recent of the six widely recognized phases in modern Chinese nutritional history.<sup>5-7</sup> In most urban areas of China, diets are less likely to follow the classical high-carbohydrate patterns and now contain relatively high proportions of fat, mainly from increased use of animal products and edible oil.<sup>2</sup>

Altered nutrition and health behaviors affect a spectrum of dietary and health issues for women in eastern

China including increasing incidence of and mortality related to chronic diseases.<sup>2</sup> Compared with men of similar age, Chinese women have been demonstrated to have generally worse overall health scores and higher levels of chronic diseases including angina, arthritis (particularly with increasing age), obesity, diabetes and depression.<sup>2,8,9</sup> There is also new evidence that low-fat and high-fiber diets may be weakly protective against prominent women's health issues such as breast cancer (and its recurrence) and postmenopausal diseases.<sup>10,11</sup>

Despite compelling evidence of the health risk that diet and health behaviors pose to women in China, a recent report indicated that up to 90% of people in China lack basic health knowledge.<sup>12</sup> Improvements in health education are necessary to fight poor public health choices. Improved diet and health behaviors are critical components of the success of American Heart Association (AHA) programs.<sup>13</sup> Though research has investigated

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women's health issues in China, few practical resources exist to guide the diet and health behaviors of Chinese women.

This study was conducted to generate a comprehensive picture of the epidemiological distribution of risk factors for DR-NCDs among women in eastern China. The specific objective was to examine the prevalence of selected dietary components and health behavior factors for DR-NCDs based on self-report surveys completed by women in eastern China. This region of the country was selected because it represents the largest proportion of the Chinese population, and is the part of the country that has shown the most important economic growth.

## MATERIALS AND METHODS

### *Participants*

Participants' data were collected from a previously reported multi-stage, stratified, cross-sectional, cluster sampling survey conducted from July 15, 2008 to Sept 15, 2008.<sup>14-16</sup> The original purpose of collecting these data was to carry out a cross-sectional analysis in order to study the association of breast cancer with various demographic, socioeconomic and dietary factors in women living in eastern China.<sup>15</sup> The survey included Chinese Han women aged between 25 and 70 years who resided in eastern China (Shandong, Jiangsu and Hebei provinces and the city of Tianjin) for at least 2 years, excluding long-term emigrants. Respondent counties or regions and, within these, rural villages or urban communities were randomly selected (multistage cluster sampling). All survey participants were eligible to participate in the study, and provided voluntary written informed consent to participate in the study. Of 147,538 potentially eligible women, 124,758 completed the survey. The study was approved by the Ethics Committees of the Second Hospital of Shandong University and all collaborating institutions in the selected regions.

### *Data collection*

Data were originally collected prospectively using face-to-face interview techniques based on a self-designed, structured questionnaire. The collected data represented the previous year. The data collected included demographic characteristics (age, living environment, education, occupation, household income, height and body weight), dietary information, health behaviors (cigarette smoking, secondhand cigarette smoke exposure, alcohol consumption, physical exercise and sleeping), and history of DR-NCDs (hypertension and diabetes mellitus). The education groups were defined as follows: primary school education (6 years total education) or lower; middle school education (9 years total education); senior high school education (12 years total education); or higher education (university/college; 15 years total education). Alcohol drinkers were defined as those who drank alcohol at least once per week. Occasional or regular cigarette smoking was defined as the smoking of one or more cigarettes/day.

Respondents living or working with smokers were defined as secondhand cigarette smokers. Dietary information consisted of ratings of how frequently the respondents ate different types of food on a 4-point ordinal

scale, where 1=almost every day (5 to 7 days per week), 2=3 to 4 days per week, 3=1 to 2 days per week, and 4=rarely. The types of food were originally selected based on their regular consumption in China and the significance of their nutritional value (e.g., carrots are the main dietary source of vitamin A). This list of food types was influenced by a variety of previous studies and resources, including household survey data collected and provided by the China's National Bureau of Statistics (NBS), and Chinese dietary guidelines provided by the Chinese Nutrition Society.

### *Bias controls and data quality*

The questionnaire was based on numerous previously published articles and discussions with experts in epidemiology, statistics, psychology and nutrition. A preliminary investigation was performed to assess the practicality and effectiveness of the questionnaire. Except for the demographic information, all questions had yes/no or multiple-choice answers. The team of interviewers underwent specific training. This questionnaire has been used in previous studies.<sup>15,16</sup> After the initial investigation, a secondary sampling study was performed in a district of the Shandong Province to check sampling accuracy, resulting in a concordance of 92.2%.

To limit bias and ensure data quality, the original survey data were collected by qualified investigators in each surveyed region. A written explanation was provided for all items in the questionnaire. The study participants were selected consecutively according to prospective sampling conditions. Throughout the study, the investigators administering the surveys were overseen by members of the study staff, who randomly selected completed questionnaires for rigorous quality checking. Data entry was performed independently from data collection by trained study staff, and the data were checked twice before entry into a database using Epidata 3.1 (Epidata Association, Odense, Denmark).

### *Statistical analysis*

Descriptive statistics were used to describe general subject characteristics. Continuous data are presented as the mean±standard deviation (SD). Categorical dietary and health behavior data are expressed as frequencies and percentages. Group comparisons were carried out using the independent samples t-test. Categorical variables were compared using Pearson's chi-squared test. Associations between dietary habits and demographic data were analyzed using linear correlations. All analyses were performed using SPSS 16.0 (IBM, New York, USA). Statistical significance was set at a two-sided *p*-value of 0.05.

## RESULTS

### *Characteristics of the participants*

Of 147,538 potentially eligible women, 124,758 completed the surveys (15.4% loss rate). Among them, 1,037 were aged <25 years and 1629 were aged >70 years; they were excluded. An additional 34 questionnaires were excluded due to missing information. Finally, 122,058 women aged 44.2±11.6 years were included in the surveyed population (concordance rate of 97.8%), including 61,104 (50.1%) from the Shandong Province, 20,921

**Table 1.** Mean participant ages by region and location

Characteristics	Participants (%)	Mean±SD	<i>p</i>
<b>Regions</b>			
Shandong	61104 (50.06)	43.5±11.6	<0.01
Jiangsu	20921 (17.14)	46.3±11.7	
Hebei	19741 (16.17)	42.8±10.9	
Tianjin	20292 (16.62)	45.6±12.0	
Total	122058 (100.0)	44.2±11.6	
<b>Location</b>			
Urban	33696 (27.61)	43.2±11.5	<0.01
Rural	88362 (72.39)	44.6±11.7	
Total	122058 (100.0)	44.2±11.6	

Differences were assessed by ANOVA.

(17.1%) from the Jiangsu Province, 19,741 (16.6%) from the Hebei Province, and 20,292 (16.2%) from Tianjin city. The mean ages of the subjects from Shandong, Jiangsu, Hebei and Tianjin were 43.5±11.6, 46.3±11.7, 42.8±10.9 and 45.6±12.0 years, respectively (Table 1). Of the included subjects, 88,362 (72.4%) were from rural areas, and 33,696 (27.6%) from urban areas (rural: urban ratio=2.62:1). Mean age differed significantly between locations and between urban vs. rural ( $p<0.01$ ).

#### General health behavior characteristics

Health behavior data revealed that 2,008 (1.6%) participants reported occasional or regular cigarette smoking, 4,326 (3.5%) reported regular alcohol consumption, and 10,274 (8.4%) reported insomnia symptoms. Only 38,305 (31.4%) reported that they engaged in regular physical activity (Table 2).

**Table 2.** Overall diet and lifestyle characteristics

Characteristics	No (%)	Yes (%)	Missing (%)	Total
Smoking	120050 (98.4)	2008 (1.6)	-	122058
Alcohol consumption	117731 (96.5)	4326 (3.5)	1 (0.0)	122058
Physical exercise	83753 (68.6)	38305 (31.4)	-	122058
Insomnia	111777 (91.6)	10274 (8.4)	7 (0.0)	122058

**Table 3.** Smoking and alcohol consumption in the survey participants

	Smoking		<i>p</i>	Alcohol consumption		<i>p</i>
	No (%)	Yes (%)		No (%)	Yes (%)	
<b>Age</b>						
25-34	27057 (22.6)	169 (8.5)	<0.01	26305 (22.4)	920 (21.3)	<0.01
35-44	40424 (33.7)	408 (20.5)		39237 (33.4)	1595 (37.0)	
45-54	26627 (22.2)	465 (23.3)		26065 (22.2)	1027 (23.8)	
55-64	19097 (15.9)	544 (27.3)		19084 (16.2)	557 (12.9)	
65-70	6696 (5.6)	409 (20.5)		6893 (5.9)	212 (4.9)	
Missing	149 (0.1)	13 (0.6)		147 (0.1)	15 (0.3)	
<b>Location</b>						
Urban	32859 (27.4)	837 (41.7)	<0.01	30818 (26.2)	2877 (66.5)	<0.01
Rural	87191 (72.6)	1171 (58.3)		86913 (73.8)	1449 (33.5)	
<b>Education</b>						
Primary sch.	47667 (39.7)	1083 (53.9)	0.599	47845 (40.6)	905 (20.9)	<0.01
Middle sch.	42208 (35.2)	275 (13.7)		41444 (35.2)	1039 (24.0)	
Senior high sch.	18843 (15.7)	343 (17.1)		17908 (15.2)	1277 (29.5)	
Higher ed.	11332 (9.4)	307 (15.3)		10534 (8.9)	1105 (25.5)	

Statistical comparisons were made using the chi-squared test. Primary sch.: primary school education (6 years total education) or lower; Middle sch.: middle school education (9 years total education); Senior high sch.: senior high school education (12 years total education); Higher ed.: higher education (university/college; 15 years total education).

#### Tobacco use

Tobacco use was positively associated with increasing age ( $p=0.002$ ) and urban residency (837/33696 [2.5%] of urban residents vs 1171/88362 [1.3%] of rural residents;  $p=0.003$ ). Furthermore, age at first tobacco use ranged from 14 to 70 (mean 30.8±11.9) years, and duration of tobacco use ranged from 1 to 60 (mean 20.6±14.3) years. Excluding 27,507 participants with missing data, 66,304 (70.1%) reported being around secondhand smoke at home or work. Tobacco use was not associated with educational level ( $\chi^2=0.276$ ,  $p=0.599$ ; Tables 2 and 3).

#### Alcohol consumption

Excluding 163 participants with missing data, of the remaining 121,895 women, 4,326 (3.5%) reported regular alcohol consumption, and 67,362 (54.5%) reported never drinking. Alcohol consumption was most commonly observed in women aged 35-44 years, who accounted for 37.0% of all positive responses, and was negatively associated with increasing age ( $p=0.007$ ). Length of time of consuming alcohol ranged from 1 to 51 (mean 11.5±9.5) years, and age at first consuming alcohol ranged from 12 to 70 (mean 29.3±10.6) years, with 6.2% reporting first drinking as a minor (below 18 years). Alcohol consumption was significantly different between urban (2877/33695, 9.3%) and rural (1449/88362, 1.7%) residents ( $p<0.01$ ). The proportion of women regularly consuming alcohol increased with educational level ( $p<0.01$ ; Table 3).

#### Insomnia symptoms

Excluding seven participants with missing data, 10,274 (8.4%) reported frequent insomnia symptoms. The age

**Table 4.** Physical exercise and insomnia in the study participants

	Physical exercise		<i>p</i>	Insomnia		<i>p</i>
	No (%)	Yes (%)		No (%)	Yes (%)	
Age						
25-34	19103 (22.8)	8123 (21.3)		26305 (22.4)	920 (21.3)	
35-44	27861 (33.3)	12971 (34.0)		39237 (33.4)	1595 (37.0)	
45-54	18469 (22.1)	8623 (22.6)	<0.01	26065 (22.2)	1027 (23.8)	<0.01
55-64	13578 (16.2)	6063 (15.9)		19084 (16.2)	557 (12.9)	
65-70	4698 (5.6)	2407 (6.3)		6893 (5.9)	212 (4.9)	
Missing	44 (0.1)	118 (0.3)		154 (0.1)	8 (0.1)	
Location						
Urban	12767 (15.2)	20929 (54.6)		31401 (28.1)	2293 (22.3)	
Rural	70986 (84.8)	17376 (45.4)	<0.01	80376 (71.9)	7981 (77.7)	<0.01
Education						
Primary sch.	39675 (47.4)	9075 (23.7)		42969 (38.4)	5776 (56.2)	
Middle sch.	30899 (36.9)	11584 (30.2)		39749 (35.6)	2733 (26.6)	
Senior high sch.	9529 (11.4)	9657 (25.2)	<0.01	18014 (16.1)	1171 (11.4)	<0.01
Higher ed.	3650 (4.4)	7989 (20.9)		11045 (9.9)	594 (5.8)	

Statistical comparisons were made using the chi-squared test. Primary sch.: primary school education (6 years total education) or lower; Middle sch.: middle school education (9 years total education); Senior high sch.: senior high school education (12 years total education); Higher ed.: higher education (university/college; 15 years total education).

group with the highest proportion of insomnia was 35-44 years (3.9%); the proportion with insomnia then decreased with higher age (3.8%, 2.8% and 3.0% for 45-54, 55-64 and 65-70 years, respectively;  $p<0.01$ ), and was less frequent in urban (2293/33694, 6.8%) vs. rural (7981/88357, 9.0%) areas ( $p<0.01$ ; Table 4). Insomnia symptoms decreased significantly with increasing educational level ( $p<0.01$ ; Table 4). Number of hours sleeping ranged from 1 to 22 (mean  $7.9\pm 1.2$ ) hours, with very satisfactory, satisfactory, unsatisfactory and extremely unsatisfactory sleep quality reported by 22,101 (18.1%), 88,804 (72.8%), 10,813 (8.9%) and 340 (0.3%) of the participants, respectively.

#### Physical activity

Excluding 1,469 participants with missing data, 38,305 (31.4%) reported regular physical activity (exercise), 108,286 (88.7%) reported exercising <3 times per week and 12,303 (10.1%) reporting exercising >3 times per week. Excluding 1,410 subjects with missing data, 106,922 (87.6%) reported exercising for <30 min per day, and 13,726 (11.2%) reported exercising for >30 min per day. Frequency and daily duration of exercise differed significantly by age, with the oldest age group having the highest proportion of women taking regular exercise, and the youngest age group the lowest proportion ( $p=0.001$ ). The proportion of women taking regular exercise was much higher in urban areas (20929/33696, 62.1%) than in rural areas (17376/88362, 19.7%;  $p=0.001$ ) and increased with educational level ( $p<0.01$ ; Table 4).

#### Consumption of bean products

Women aged 35 to 44 years most frequently consumed bean products, with all age groups consuming bean products 1-2 days/week, which was the most common consumption level. Bean product consumption was positively correlated with high educational level ( $p<0.001$ ). Consumption of bean products was reported to be rare in 20.6% of the participants, and was most frequent in urban residents (40.8% consumed bean products 3-4 times per week). Bean consumption was significantly different

when compared according to age, location and education ( $p<0.001$ ) (Table 5).

#### Consumption of red meat

A total of 40.8% of the participants reported consuming red meat 1-2 days per week, most commonly in women aged 35-44 years old, and progressively declining after 45 years old. About 13.3% of the participants rarely ate red meat. In this survey, 81.0% of urban women ate red meat nearly every day or 3-4 days per week, while only 7.2% of urban women almost never ate red meat. In contrast, red meat consumption in rural women was most commonly 1-2 days per week (46.6%), and only 14.7% of rural women ate red meat 5-7 days per week. Red meat consumption was positively associated with higher education level, and was significantly different by age, location and educational level (all  $p=0.023$ ; Table 5).

#### Consumption of milk products

Milk and milk products were rarely consumed by the survey participants (46.5%). Only 6.5% consumed milk products daily or 5-7 days per week. Most women (64.4%) living in urban areas had milk products 3-7 days per week. In contrast, 59.6% of rural women almost never consumed milk or milk products, and only 6.6% of rural women drank milk nearly every day. Milk consumption was significantly different when compared according to age, location and educational level ( $p<0.01$ ; Table 5).

#### Consumption of corn

Approximately 36.5% of the participants consumed corn 1-2 days per week, and 21.0% rarely consumed corn. In each age group, the most common consumption level was 1-2 days per week. Corn was consumed by 65.4% of urban women 1-2 or 3-4 days per week. At all education levels, except those with a college/university education, the largest proportion of women consumed corn 1-2 days per week; among those with a university education, the largest proportion of women ate corn 3-4 days per week. Corn consumption was significantly different when compared according to age, location and education ( $p<0.01$ ;

Table 5).

#### **Consumption of carrots**

Only 3.9% of the participants consumed carrots nearly every day, and 35.2% of women almost never consumed carrots. In all age groups, carrots were most frequently consumed 1-2 days per week. Most of the women (77.2%) in urban areas ate carrots 3-4 or 1-2 days per week, and only 8.7% of the women rarely consumed carrots. In rural areas, most women (84.2%) rarely or never consumed carrots, with 2.1% never consuming carrots. Women with only a primary school education rarely consumed carrots, while most women with higher educational levels consumed carrots 1-2 days per week. Carrot consumption was significantly different when compared according to age, location and education ( $p < 0.01$ ; Table 5).

#### **Consumption of fried foods**

Fried foods were most frequently consumed 1-2 days per week (41.5%) or hardly at all (42.1%). Only 3.2% of the participants consumed fried foods nearly every day. Women between the ages of 35 and 44 years consumed fried foods the most frequently. Of urban women, 45.9% consumed fried foods 1-2 days per week, while 50.0% of rural women rarely consumed fried foods. The majority (52.5%) of the participants with a primary school education rarely or never ate fried foods, while 1.5% of women in this educational group ate fried foods every day. In contrast, among women with a higher education degree, 8.8% ate fried foods 5-7 days per week, 15.5% rarely ate fried foods, and the majority ate fried foods 1-4 days per week. Fried food consumption was significantly different when compared according to age, location and education ( $p < 0.01$ ; Table 5).

#### **Consumption of vegetables and fruits**

More than half of the participants (68.2%) consumed vegetables or fruits daily, and only 2.1% of women almost never consumed vegetables or fruits. Most urban (53.2%) and rural (73.8%) women consumed vegetables and fruits every day, while 2.2% and 2.0% of urban and rural women, respectively, almost never consumed vegetables and fruits. Fewer women with higher education levels reported rarely consuming vegetables and fruits, and at all educational levels vegetables and fruits were most frequently consumed every day. Vegetable and fruit consumption was significantly different when compared

according to age and location ( $p < 0.01$ ; Table 5).

#### **Consumption of garlic**

Garlic consumption was relatively homogeneous, with 24.1% of the participants consuming it nearly every day, 31.7% consuming it 3-4 days per week, 31.6% consuming it 1-2 days per week, and 12.7% rarely consuming any garlic. Most urban (68.9%) and rural (61.1%) residents consumed garlic either 3-4 or 1-2 days per week. Garlic was rarely consumed by 10.2% of urban and 13.6% of rural residents, with significantly different consumption frequency reported by educational level ( $p < 0.01$ ). Garlic consumption was significantly different when compared according to age and education ( $p < 0.01$ ; Table 5).

#### **Consumption of charcuterie**

About 55.9% of the women scarcely ate charcuterie, and only 2.7% of women ate charcuterie every day or 5-7 days per week. Of urban women, the most common consumption level was 1-2 days per week (43.1%), while 66.9% of rural women scarcely ate charcuterie. Charcuterie consumption was significantly different when compared according to age, location and education ( $p < 0.01$ ; Table 5).

### **DISCUSSION**

The present study examined the prevalence of dietary habits and health behaviors in Chinese women using data from a prior cross-sectional investigation of women's health conducted in 2008.<sup>15</sup> Healthy eating habits and balanced nutrition can aid in maintaining health, whereas malnutrition, over-nutrition and poor eating habits contribute to detrimental effects of the aging process and can increase the risk for chronic diseases in women.<sup>17</sup> In the past decade, Chinese women have been affected by rapid changes in the availability of certain foods and lifestyle alternatives as a result of industrialization, urbanization, economic development and market globalization.<sup>18</sup> Although the associations between diet, lifestyle and DR-NCDs are well recognized, there have been relatively few studies of the dietary intake and health behaviors of Chinese women.

Non-smoking is arguably one of the most important factors in women's health. A prior study of 84,129 women showed that abstinence from smoking was associated with lower coronary heart disease risk.<sup>19</sup> Tobacco use in the present study was 1.6%, slightly lower than the smok-

**Table 5.** Dietary intake characteristics

Diet	Frequency*				Missing	Total
	1 (%)	2 (%)	3 (%)	4 (%)		
Bean products	12894 (10.6)	35929 (29.4)	48124 (39.4)	25111 (20.6)	-	122058
Red meat	23447 (19.2)	32625 (26.7)	49741 (40.8)	16245 (13.3)	-	122058
Milk products	16719 (13.7)	19861 (16.3)	28832 (23.6)	56646 (46.4)	-	122058
Corn	17486 (14.3)	34345 (28.1)	44619 (36.6)	25608 (21.0)	-	122058
Carrots	4807 (3.9)	23131 (19.0)	51147 (41.9)	42972 (35.2)	1 (0.00)	122058
Fried food	3900 (3.2)	16105 (13.2)	50680 (41.5)	51373 (42.1)	-	122058
Vegetables or fruit	83164 (68.1)	23162 (19.0)	13185 (10.8)	2547 (2.1)	-	122058
Garlic	29362 (24.1)	38667 (31.7)	38548 (31.6)	15481 (12.7)	-	122058
Charcuterie	3324 (2.7)	14207 (11.6)	36411 (29.8)	68116 (55.8)	-	122058

1, food eaten nearly every day (or 5-7 days per week); 2, food eaten 3-4 days per week; 3, food eaten 1-2 days per week; and 4, food rarely eaten.

**Table 5.** Dietary intake characteristics (cont.)

Level		Bean products				<i>p</i> *	Red meat				<i>p</i> *	Milk products				<i>p</i> *
		1	2	3	4		1	2	3	4		1	2	3	4	
Age	25-34	21.0	23.0	23.0	20.7	<0.01	25.6	23.9	21.2	17.7	<0.01	23.4	24.8	24.4	20.1	
	35-44	33.0	34.3	33.7	31.9		33.9	33.3	34.0	31.5		29.7	32.3	34.8	34.3	
	45-54	23.2	21.6	21.8	23.2		22.7	22.1	21.8	23.1		23.4	21.3	20.9	22.8	
	55-64	16.3	15.3	15.6	18.0		13.4	15.3	16.8	19.5		16.7	15.7	14.5	16.9	
	65-70	6.20	5.59	5.69	6.21		4.26	5.16	6.22	8.17		6.50	5.62	5.32	5.95	
	Missing	0.38	0.18	0.10	0.01		0.15	0.26	0.08	0.02		0.25	0.29	0.18	0.02	
Location	Urban	60.7	38.2	21.5	7.15	<0.01	44.7	41.3	17.3	7.15	<0.01	65.0	54.7	27.9	6.97	
	Rural	39.3	61.8	78.5	92.9		55.3	58.8	82.7	92.9		35.0	45.3	72.2	93.0	
Education	Primary sch.	18.7	29.8	44.6	56.4	<0.01	20.6	27.2	48.8	66.4	<0.01	14.2	18.4	36.5	56.8	
	Middle sch.	29.6	36.1	35.7	34.0		38.0	35.8	35.5	26.2		29.2	33.4	39.2	34.7	
	Senior high sch.	27.0	19.7	13.6	8.33		23.5	21.8	11.2	6.16		29.8	27.4	15.8	7.42	
	Higher ed.	24.7	14.5	6.06	1.31		18.0	15.2	4.56	1.24		26.8	20.8	8.43	1.04	
Level		Corn				<i>p</i>	Carrots				<i>p</i>	Fried food				<i>p</i>
		1	2	3	4		1	2	3	4		1	2	3	4	
Age	25-34	19.7	22.2	22.6	23.8	<0.01	22.7	24.7	22.4	20.9	<0.01	23.6	24.3	23.4	20.5	
	35-44	29.9	33.2	34.2	34.9		31.1	34.7	33.8	32.7		30.8	33.4	34.0	33.1	
	45-54	24.7	22.3	21.5	21.6		24.0	21.1	21.7	23.2		24.1	22.0	21.8	22.5	
	55-64	19.0	16.4	15.6	14.6		16.1	14.3	15.9	17.3		15.7	14.7	15.2	17.5	
	65-70	6.49	5.75	5.96	5.22		6.09	5.14	6.14	5.78		5.56	5.23	5.44	6.40	
	Missing	0.13	0.18	0.16	0.03		0.00	0.04	0.13	0.17		0.28	0.37	0.14	0.04	
Location	Urban	30.8	37.5	27.9	11.6	<0.01	61.3	47.8	29.3	11.0	<0.01	60.9	10.4	30.5	14.0	
	Rural	69.2	62.5	72.1	88.4		38.7	52.2	70.7	89.0		39.2	89.6	69.5	86.0	
Education	Primary sch.	35.5	35.7	38.3	51.4	<0.01	10.8	15.6	20.1	25.6	<0.01	19.1	20.6	38.0	49.5	
	Middle sch.	36.6	31.1	36.4	35.7		17.9	17.0	18.9	18.3		31.9	32.7	34.8	35.7	
	Senior high sch.	16.6	19.2	16.0	9.86		13.5	12.3	8.53	5.43		22.6	24.4	16.9	11.3	
	Higher ed.	11.3	14.0	9.18	3.05		57.7	55.2	52.5	50.6		26.4	22.3	10.3	3.50	

Results are shown as %.

Statistical comparisons were made using the chi-squared test.

1, food eaten nearly every day (or 5-7 days per week); 2, food eaten 3-4 days per week; 3, food eaten 1-2 days per week; and 4, food rarely eaten

Primary sch.: primary school education (6 years total education) or lower; Middle sch.: middle school education (9 years total education); Senior high sch.: senior high school education (12 years total education);

Higher ed.: higher education (university/college; 15 years total education).

**Table 5.** Dietary intake characteristics (cont.)

Level	Vegetables or fruit					<i>p</i>	Garlic				<i>p</i>	Charcuterie				<i>p</i>
	1	2	3	4	1		2	3	4	1		2	3	4		
Age	25-34	23.2	21.3	19.1	19.0	<0.01	19.5	23.1	23.1	23.7	<0.01	23.4	27.1	26.5	19.0	<0.01
	35-44	33.3	33.6	33.6	35.3		33.6	33.7	33.4	32.9		31.4	33.5	34.8	32.8	
	45-54	22.3	22.1	22.2	20.4		24.1	22.0	21.4	21.1		25.0	20.9	19.9	23.6	
	55-64	15.5	16.9	17.9	18.6		16.9	15.4	16.1	16.2		14.4	13.2	13.9	18.0	
	65-70	5.66	5.77	6.80	6.44		5.90	5.65	5.87	6.01		5.60	5.00	4.72	6.59	
	Missing	0.05	0.29	0.34	0.31		0.05	0.15	0.18	0.13		0.27	0.30	0.22	0.04	
Location	Urban	21.5	40.5	42.8	29.6	<0.01	24.0	31.0	29.2	22.2	0.94	69.8	55.5	39.8	13.2	<0.01
	Rural	78.5	59.5	57.3	70.4		76.1	69.0	70.8	77.8		30.2	44.5	60.2	86.8	
	Primary sch.	43.2	33.0	31.6	40.2		44.5	36.8	37.9	44.4		13.8	17.0	30.0	51.3	
Education	Middle sch.	36.3	31.6	31.6	31.5	<0.01	34.9	35.4	34.7	33.6	<0.01	31.5	35.4	35.6	34.4	<0.01
	Senior high sch.	14.1	19.3	19.9	16.2		13.9	16.6	16.8	14.3		26.0	25.0	20.8	10.6	
	Higher ed.	6.45	16.1	16.9	12.1		6.72	11.3	10.7	7.75		28.8	22.7	13.6	3.71	

Results are shown as %.

Statistical comparisons were made using the chi-squared test.

1, food eaten nearly every day (or 5-7 days per week); 2, food eaten 3-4 days per week; 3, food eaten 1-2 days per week; and 4, food rarely eaten

Primary sch.: primary school education (6 years total education) or lower; Middle sch.: middle school education (9 years total education); Senior high sch.: senior high school education (12 years total education);

Higher ed.: higher education (university/college; 15 years total education).

ing rate of 1.72% observed by the 4<sup>th</sup> National Health Services Survey in 2008.<sup>20</sup> Likewise, the percentage of women who smoked in the present study was also lower than the value of 2.8% observed in a survey conducted by Nechuta et al in 2007.<sup>21</sup> According to studies conducted in the United States, nearly 23% of American adults are smokers, with the highest smoking rates found in American Native women (37.3%) and the lowest rates in Asian women (4.8%),<sup>22</sup> a result nearly three-fold higher than that observed in the present study. These differences may be due to cultural diversity and regional availability of tobacco products. Asian women, compared with women in the United States, are notably less likely to be smokers (7.3% [95% CI, 6.0-8.6%] vs 14.1% [95% CI, 13.1-15.1%]).<sup>23</sup> The present results showed that smoking rates in urban areas of Eastern China (2.5%) were higher than in rural areas (1.3%). In comparison, the 4<sup>th</sup> National Health Services Survey found that 2.8% of urban women and 2.6% of rural women smoked.<sup>20</sup> The reason why the present study observed a higher level of smoking in urban women than in rural women may be related to urban women having higher incomes, higher work-related pressures, higher 'peer' pressures to smoke arising from social interactions with friends/colleagues, and/or less traditional views about women smoking. The results of both our study and the National Health Services Survey demonstrate that regardless of residency, older women are more likely to smoke than younger women.<sup>20</sup> This may be indicative of the effectiveness of recent health education and literacy campaigns intended to discourage smoking. Alternatively, it may be more difficult for older people to give up smoking habits. Notably, the National Health Services Survey showed a regular decrease in the smoking rate in women from 1993 to 2008.<sup>20</sup> Additionally, the results of this survey suggested that the age at which participants started smoking had decreased over time.<sup>20</sup> Furthermore, 70.1% of the women in the present study reported being exposed to secondhand smoke at home or work, a much higher level than that reported by the 4<sup>th</sup> National Health Services Survey (46.5%).<sup>20</sup> Thus, the current high rate of exposure to second-hand smoke is an emergent public health issue, and may reflect an increase in smoking prevalence in men or an increase in the social interactions between women and other smokers.

In the present survey, 3.5% of the surveyed women reported alcohol consumption, a rate lower than that of 4.5% observed by the 2002 China National Nutrition and Health Survey.<sup>24</sup> In both the present survey and the prior 2002 survey, alcohol consumption decreased with age, which may be due to greater health consciousness later in life coupled with emergent health issues in older adults. As in the present study, previous research on alcohol consumption in China indicated that the drinking rates were the highest in urban areas.<sup>21,25</sup> Beer was the most popular alcoholic beverage among Chinese women, which is in accordance with the present findings.<sup>26</sup> In the present survey, 6.2% of women reported alcohol consumption before the age of 18 years, a smaller percentage than the 8.8% reported by Ma et al in 2005.<sup>24</sup>

In the present survey, moderate exercise was relatively common in Chinese women. Reeves and Rafferty (2005) reported that approximately 22.2% of surveyed adults

regularly performed physical activity,<sup>27</sup> a slightly lower result than that of the present study. Regular physical activity has been reported to reduce cardiovascular risk factors such as high blood pressure, poor lipid profile, and elevated blood sugar, and also decrease the risk of other chronic diseases such as type 2 diabetes, osteoporosis, obesity, depression, and cancer of the breast and colon.<sup>28</sup> According to our results, only 46.3% of women older than 55 exercised, less than similar studies of women in Shanghai.<sup>21</sup>

In the present study, 8.4% of surveyed women suffered from insomnia, and the rate of insomnia was higher in rural than in urban areas. Only 18.1% of the participants were very satisfied with the quality of their sleep. In a study conducted in Japan, a notably larger percentage of women (50.8%) reportedly suffered from insomnia.<sup>29</sup> Another study in Beijing found a prevalence of 9.7% for insomnia in urban populations, and 8.8% in rural populations.<sup>30</sup> Factors including anxiety, depression and alcohol consumption may contribute to insomnia,<sup>31</sup> suggesting that dietary and health behavior characteristics may be interrelated medical and social issues.

Diet has been proven to be associated with many types of diseases. For example, unbalanced nutrition, foods rich in animal protein, and a lack of vegetables and fruits may increase the risk of colorectal polyps,<sup>32</sup> while a diet rich in fish or prawns, bananas, oranges, and other fruits may decrease the risk of breast cancer.<sup>33</sup> It has been suggested that bean products may also have beneficial effects on overall health and are associated with reduced breast cancer risk, as previously reported.<sup>16</sup> In the present study, the distribution of the dietary intakes of nine types of surveyed food was significantly different, and was closely associated with age, location and educational level. Previous investigations have found that urban women in China have a higher consumption of animal proteins and fats, milk products and legumes, but a lower proportion of root vegetables.<sup>34-36</sup> These data are consistent with our observations that urban women had higher consumption of red meat, milk products, bean products and fried food, and a lower consumption of fruit and vegetables. In addition, the highest consumption of red meat, fried foods and bean products was found to be in the 35-44 year age group and in women with the highest education level. These findings may reflect the increased affluence of women of this age group and education level living in urbanized areas, as well as the better availability of certain food products in urbanized regions. Nevertheless, this investigation was not designed to assess the relation between diet and diseases, and additional studies should be performed to address this issue. Interventions aimed at improving health- and diet-related behaviors could be of importance.

Traditional Chinese diets, as in many Asian countries, are notably different from those found in Western countries. The traditional Chinese diet is rich in vegetables and low in fat. More than 60.0% of the surveyed women consumed vegetables and fruit nearly every day, and most women scarcely ate fried foods or charcuterie. However, it should be noted that the Chinese lifestyle is gradually evolving in the face of rapid economic development and increased urbanization.



Notably, the present study is limited because it focused only on smoking, alcohol consumption, physical exercise, insomnia and diet, and did not investigate other health behaviors that may play a role in DR-NCDs in Chinese women. In addition, the investigation was based solely on select dietary intake factors and is non-comprehensive, leaving room for future study of factors such as the amount of each food consumed and cumulative composition of individual meals and dietary habits. Furthermore, we did not use sampling with probability proportional to size, such that the participant numbers for Shandong province, Jiangsu province, Hebei province and Tianjin city did not reflect the relative population sizes of these regions (with Shandong and Tianjin overrepresented relative to Jiangsu and Hebei). Since we did not utilize sample weighting in the statistical analysis, this may have introduced a degree of bias such that our observations may not have reflected the population of eastern China as a whole. Finally, even if we compare the rates observed in this study with those from previous studies, doing so may be questionable since the rates were not standardized.

In conclusion, this present study suggests some, overall positive findings, including lower rates of tobacco use,<sup>20</sup> alcohol consumption<sup>24</sup> and insomnia<sup>30</sup> than reported previously, but physical exercise was also decreased.<sup>21</sup> Dietary habits were also relatively healthy. Our findings regarding the dietary patterns and health behaviors of women in eastern China can be compared with both previously published and future observations, in order to provide insights into how these dietary patterns and health behaviors (including alcohol consumption, smoking, physical exercise and insomnia) change over time. When integrated with information regarding changes in the disease spectrum over time, this knowledge will allow local and national governments to select and target appropriate public health policies, helping women in China to make healthy lifestyle choices that contribute to disease prevention. Additional studies are necessary to determine new ways of improving these life habits in order to prevent DR-NCDs in Chinese women.

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#### AUTHOR DISCLOSURES

The author declares that there is no conflict of interest.

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