Title: Association of dietary patterns with depressive symptoms in Chinese postmenopausal women.

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This peer-reviewed article has been accepted for publication but not yet copyedited or typeset, and so may be subject to change during the production process. The article is considered published and may be cited using its DOI

10.1017/S0007114519001867

The British Journal of Nutrition is published by Cambridge University Press on behalf of The Nutrition Society

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A conflict of interest statement: The authors declared no conflict of interest.

Abstract

Many components in diet have regulated oxidative stress, inflammatory reaction and even balance estrogen levels. Because these factors are closely associated with depressive symptoms in postmenopausal women, it is considered that dietary factors are able to prevent and control depressive symptoms. On the other hand, dietary pattern that considers the correlations and synergies between foods and nutrients, is expected to have a greater impact on disease risk. The aim of this study is to evaluate whether dietary patterns are associated with depressive symptoms in Chinese postmenopausal women.

A cross-sectional study of 2051 postmenopausal women (mean age: 58.8±7.4 years) was conducted in Tianjin, China. Dietary consumption was assessed by a valid self-administered food frequency questionnaire. Principal component analysis was used to derive three major dietary patterns: “healthy”, “sweets” and “ Traditional Tianjin” from 88 food items. Depressive symptoms were assessed using the Zung Self-Rating Depression Scale, and cut-off point of 48 indicating serious depressive symptoms. The associations between quartile of dietary patterns and depressive symptoms were assessed by using multiple logistic regression analysis.

The multivariable-adjusted odds ratios (95% confidence intervals) of having depressive symptoms for increasing quartile of dietary patterns were as follows: “healthy”,1.00, 0.79(0.49-1.28), 0.62(0.37-1.04), and 0.57(0.33-0.97); “sweets”,1.00, 0.75(0.42-1.3), 1.08(0.64-1.81) and 1.66(1.03-2.71); “Traditional Tianjin”, 1.00, 1.02(0.58-1.79), 0.96(0.54-1.71) and 2.53(1.58-4.16), respectively.

The present study demonstrated that a healthy dietary pattern was inversely associated with depressive symptoms. On the contrary, greater adherence to sweets and Traditional Tianjin dietary patterns were associated with a higher prevalence of depressive symptoms.

Introduction

Globally, about 350 million people suffer from major depression [1]. Depression, the most common of all the psychiatric disorders, caused high rates of morbidity and mortality and was reported as the second leading cause of years lived with disability [2]. Moreover, negative influences have been occurring in individuals with depressive symptoms such as attempting suicide [3]and sleep disturbance [4].Meanwhile, about 90% of individuals with mental disorders in China had never sought any type of professional help [5].Women are nearly twice as likely, by contrast with men, to suffer from an episode of depression [6],with an increased prevalence among those postmenopausal [7].Thus, preventing high depressive symptoms-risk population like postmenopausal women from depressive symptoms is urgent and significant.

Accumulated evidence suggested that dietary exposures are related to depressive symptoms with biological processes such as inflammation [8] and oxidative processes [9].The most frequently investigated nutrients and foods are B vitamins (including folate, riboflavin, pyridoxine, and cobalamin), vitamin C, vitamin D, omega-3 fatty acids, fish, fruits and vegetables [10].Moreover, reduced endogenous estrogens are considered as a risk factor for postmenopausal depression [11], and dietary phytoestrogens modulate sex hormone levels in postmenopausal women [12].

Considering the correlations and synergies between foods and nutrients, it is difficult to identify associations for single items [13].A dietary pattern is a compositive variable that integrates consumption of several foods or food groups, and is expected to have a greater impact on disease risk than any single nutrient or food [14]. Thus, we hypothesized that dietary patterns may have a potentially beneficial effect on the prevention of depressive symptoms in postmenopausal women. However, although a few studies have investigated the relationship between dietary patterns and depressive symptoms in middle aged women [15; 16], only one

Chinese Hong Kong study has investigated the relationship between dietary patterns and depressive symptoms in postmenopausal women [17]. However, previous study indicated that food culture, and dietary habits are substantially different among different regions in China [18]. We therefore designed a cross-sectional study to investigate how dietary patterns are related to depressive symptoms among postmenopausal women living in northern China.

Materials and Methods

Participants

Tianjin Chronic Low-grade Systemic Inflammation and Health (TCLSI-Health or TCLSIH) Cohort Study is an ongoing large prospective dynamic cohort study concerning association between chronic low-grade systemic inflammation and health status of a population living in Tianjin, China [19; 20]. Female participants in this cross-sectional study were recruited annually during their health examinations at the Health Management Center of Tianjin Medical University General Hospital-Health Management Center.

This cross-sectional study used baseline data from TCLSIH during 2013 to 2016. Participants completed an examination including evaluation of anthropometric parameters and biochemical blood examination. And they were asked to finish a self-administered questionnaire consisted of demographic and socioeconomic characteristics, physical health status, lifestyle and health habits, depressive symptoms, and food frequency questionnaire.

During the study period, a total of 2621 participants with absence of a period for at least 1 year were sampled. We excluded participants who did not complete data collection on food frequency questionnaire or depression scale (n=516), or those with a history of cardiovascular disease or cancer (n = 54). Thus, 2051 participants (mean age 58.8, SD 7.4 years) were included in this analysis. The protocol of this study has been approved by the Institutional Review Board of Tianjin Medical University, and each participant provided written informed consent for analysis of their data.

Identification of dietary patterns

The participants filled out a food frequency questionnaire (FFQ) with guidance. The FFQ consists of 100 items, including 7 frequency categories as follows: (1) almost never eat;

(2) less than once per week; (3) once a week; (4) 2–3 times per week; (5) 4–6 times per week; (6) once a day; (7) twice or more per day for foods and 8 frequency categories as follows: (1) almost never drink; (2) less than once per week; (3) once a week; (4) 2–3 times per week; (5) 4–6 times per week; (6) once a day; (7) twice or three times per day; (8) four or more times per day for beverages during last month. Factor analysis was applied to find out major dietary patterns and factor loadings on all 100 food items and beverages. The reproducibility and validity of the questionnaire were assessed in a random sample of 150 participants living in Tianjin by comparing the data from repeat measure approximately 3 months apart and 4-day weighed dietary records (WDRs). Spearman's rank correlation coefficient for energy intake between two FFQs was 0.68 ($p < 0.0001$), for food items (fruits, vegetables, fish, meat and beverages) ranged from 0.62 to 0.79, for energy intake by the WDRs and the FFQ was 0.49,and for nutrients (vitamin C, vitamin E, polyunsaturated fats, saturated fats, carbohydrate and calcium) by the WDRs and the FFQ ranged from 0.35 to 0.54.

The FFQ was designed to measure foods intake of the participants in the last month. Because the reproducibility and validity of the questionnaire have been assessed, the FFQ represents the long-term foods intake of the participants. Moreover, seasonal foods intake in the questionnaire includes the intake in the last month and in natural mature season.

Factor analysis (principal-components analysis) was used to derive dietary patterns and to determine factor loadings for each of food and beverages subgroups (in g/day) . Factors were rotated with varimax rotation to maintain uncorrelated factors and enhance interpretability. A combined evaluation of the eigenvalues, scree plot test, and factor interpretability was used in determining the number of retained factors. The distinctive dietary patterns of the study population were well described by the 3 factors. Factors were named descriptively according to the food items showing high loading (absolute value≥0.30) with respect to each dietary pattern as follows: healthy dietary pattern (factor 1), sweets

dietary pattern (factor 2), and Traditional Tianjin dietary pattern (factor 3) (**Table** 1). In the present study, there was no components of which factor loadings score ≤-0.30. We calculated a factor score by summing the consumption from each food item weighted by its factor loading. A higher factor score indicates greater conformity to the dietary pattern. Variables unrelated to a given dietary pattern are weighted close to zero. For further analysis, factor scores were categorized into 4 equal groups by using quartile cutoffs.

Assessment of high depressive symptoms

Depressive symptoms were evaluated by the Chinese version of the Zung Self-Rating Depression Scale (SDS). There were 20 items on the scale, which was defined as either positive or negative. Participants were required to grade on 1 to 4 points for each items. Summary scores of 20 items ranged from 20 to 80, with higher values indicating greater depressive symptoms. Since a previous study indicated that a cut-off point at 48 best matched clinical judgment [21], and a cut-off point of 48 was also used to define depressive symptoms in other studies [22; 23], this cut-off point is used in the present study; scores higher than the cut-off indicate moderate depressive symptoms.

Assessment of other variables

All participants received standardized physical examinations at the Health Management Center. Waist circumference was measured in standing position at the level of the umbilicus. Blood pressure (BP) was measured twice on the upper left arm in a sitting position and the average used for analysis. Fasting blood sugar (FBS) was measured using the glucose oxidase method. Triglycerides (TG) were measured using the enzymatic colorimetric

method. Low-density lipoprotein cholesterol (LDL) and high-density lipoprotein cholesterol (HDL) were measured with an autoanalyzer (Roche Cobas 8000 modular analyzer, Mannheim, Germany). Metabolic syndrome (MetS) was defined according to the criteria of the American Heart Association Scientific Statement [24].

Anthropometric variables (e.g. height and weight) were measured by using a standard protocol. Body mass index (BMI) was calculated as weight in kilograms divided by height in squared meters. As for socioeconomic variables, educational level was defined by the question "What is the highest degree you earned?" and was divided into 2 categories: <College graduate or ≥ College graduate. Marital status was classified as married or unmarried. The subjects were also classified as living alone or living with others. Occupation was classified as either Senior Officials and Managers or Professionals, while income was classified into two groups using the threshold of 10,000 yuan per month. "Visiting friends" status was assessed by asking the question "Do you contact your friends and relatives often?" and classified as "Yes" or "No."

Information on the smoking ("never," "former," and "current smoking") and drinking ("never," "former," and "current drinking") status of the participants was obtained from a questionnaire survey. Physical activity (PA) in the most recent week was assessed using the short form of the International Physical Activity Questionnaire (IPAQ) [25].The questionnaire asked whether subjects had performed any activities from the following categories during the previous week: walking; moderate activity (household activity or child care); vigorous activity (running, swimming, or other sports activities). Metabolic equivalent (MET) hours per week were calculated using corresponding MET coefficients (3.3, 4.0, and 8.0, respectively) according to the MET coefficient of activity × duration (hours/day) × frequency (days/week). Total PA levels were assessed in terms of weekly MET-h, which was calculated by combining separate hours for different activities. History of physical illness was evaluated

on the basis of response (“yes” or “No”) to questions concerning a history of diseases (including liver diseases, gallstone, gastritis, chronic obstructive pulmonary diseases, pulmonary tuberculosis, gout, rheumatism, cataract, glaucoma, hearing disturbance, cervical spondylosis, and lumbar spondylosis) and physician-diagnosed diseases (including diabetes, hypertension, and metabolic syndrome).

Statistical analysis

Descriptive data were presented as the mean with 95% confidence intervals (CI) or as percentages and examined by analysis of variance and Chi-square test for categorical variables. Quartiles were categorized across the scores of each dietary pattern based on the distribution of the scores for all the participants and used for further analysis. Association between quartile categories of dietary pattern scores and depressive symptoms were examined using multiple logistic regression analysis. Depressed status was used as dependent variable, and factor score was used as independent variable. Odds ratios (OR) and 95% CI were calculated. A linear trend cross increasing quartiles was tested using the median value of each quartile as a continuous variable based on linear regression. For model 1, the analysis was conducted without any adjustment; model 2 was adjusted for age and total energy intake and model 3 was additionally adjusted to physical activity, smoking status, drinking status, education, job, income, marital status, visiting friends, living alone and metabolic symptom. Log-transformation was used when the variables are not subject to normal distribution. *P* values <0.05 were considered statistically significant and all tests presented were two-tailed. All statistical analyses were performed by using the Statistical Analysis System 9.1 edition for Windows (SAS Institute Inc., Cary, NC).

Results

After a varimax rotation, a factor analysis revealed three dietary patterns and the main factor loadings of each pattern (**Table 1**). These 3 patterns explained 20.5% of the variance in dietary consumption (i.e., 8.9% for factor 1, 6.3% for factor 2, and 5.3% for factor 3). According to their contributions to total variation, factor 1was identified as a healthy dietary pattern characterized by a high consumption of vegetables, fruits and soybean products, factor 2 was identified as a sweets dietary pattern typified by a greater consumption of ice-cream, dessert and fruits, and factor 3 was defined as the Traditional Tianjin dietary pattern characterized by a greater consumption of grain, milk, meat, animal blood, animal offal, sausages, preserved egg, seafood and pickles products.

The participant characteristics according to their depressed status are presented in **Table 2**. Compared with participants without depressive symptoms, participants who had depressive symptoms tended to be younger ($P < 0.01$) and had lower plasma concentrations of TGs ($P = 0.01$), lower systolic blood pressure ($P < 0.01$), lower diastolic blood pressure ($P < 0.05$), decreased physical activity ($P < 0.001$), a lower prevalence of metabolic syndrome ($P < 0.05$), and were less likely to be married ($P < 0.05$).

Associations between dietary patterns and depressive symptoms are shown in **Table 3**. The healthy dietary pattern was inversely associated with prevalence of depressive symptoms. The OR for the extreme quartile was 0.57 (95% CI, 0.33-0.97) and the *P* for trend is 0.03 after adjusted for all confounding factors. In contrast, participants with a high intake of sweets was more likely to report depressive symptoms. The ORs (95% CI) across quartiles were 1.00 (reference), 0.75 (0.42-1.3), 1.08 (0.64-1.81) and 1.66 (1.03-2.71) after adjustments (*P* for trend < 0.01). Participants in the highest quartile of the Traditional Tianjin dietary pattern had a 153% greater risk (OR, 2.53; 95%CI, 1.58-4.16; *P* for trend < 0.0001) of developing depressive symptoms than those in the lowest quartile after adjustments.

Discussion

In this cross-sectional study, we identified three dietary patterns, and all these dietary patterns were associated with depressive symptoms after adjustments for confounding variables. A healthy dietary pattern (vegetables, fruits and soybean products) was associated with the decreased prevalence of depressive symptoms, whereas both greater adherence to sweets (ice-cream, dessert, and fruits) and Traditional Tianjin dietary patterns (animal blood, animal offal, sausages and preserved egg) were associated with a higher prevalence of depressive symptoms. This study examines the relationship between dietary patterns and depressive symptoms in postmenopausal women.

In this study, we have hypothesized that dietary patterns may have a potential correlation with depressive symptoms in postmenopausal women. A number of studies [26] have investigated the relationship between dietary patterns and depressive symptoms in both men and women. A cross-sectional study among postmenopausal women living in Hong Kong China showed that dietary patterns featuring a low intake of processed foods (rich in refined cereals, sweets, preserved food, fried food and semilean animal meet) and/or a high intake of whole plant foods (rich in whole grains, fruits and vegetables), that was similar to the healthy dietary pattern in the present study, were associated with a reduced risk of depression [17]. To the best of our knowledge, no previous studies have assessed an association between dietary patterns and depressive symptoms in non-Chinese postmenopausal women. Only one Australian prospective study examined this association among middle-aged women [16] . This prospective study suggested that a Mediterranean-style' dietary pattern, that was similar to our healthy dietary pattern and was characterized by garlic, peppers, mushrooms, lettuce, onion or leeks, cucumber, pasta, rice, tomatoes, red wine, celery, other beans, avocado, bean sprouts and zucchini, had protective influences against the depressive symptoms [16]. However, no significant associations were observed between the

meat and processed meat dietary pattern, that was similar to the Traditional Tianjin dietary pattern in the present study and was characterized by pork, bacon, sausages and lamb and depressive symptoms. Moreover, we also found that a sweets dietary pattern, which had not been identified in other non-Chinese population, was positively associated with depressive symptoms. Thus, further studies are warranted to illustrate the associations between common and region-specific dietary patterns and depressive symptoms in postmenopausal women.

In the present study, the association between a healthy dietary pattern and depressive symptoms has been suggested by a number of plausible mechanisms in recent years. First, the high content of antioxidants such as carotenoids from vegetables and fruits may be an explanation for the protection [27]. Second, the potential protective effect of healthy dietary patterns also could come from large amount of folate, found in cruciferous vegetables, leafy vegetables and dried legumes [28]. Folate is hypothesized to protect brain function by decreasing homocysteine, which has a neurotoxic effect including impaired methylation, excitotoxicity, oxidative stress and hypoxia in the central nervous system[29]. Finally, Chinese is known to consume relatively high intakes of soybean and soy products [30]. Isoflavones, rich in soy beans and soybean products, are effective in reducing depressive and anxiety symptoms among postmenopausal women [31] through selective β estrogenic receptor binding, and interactions with the dopaminergic, serotonergic, and cholinergic systems, and brain regions crucial to higher cognitive function and mood [32].

The present study also suggests that sweets dietary pattern and Traditional Tianjin dietary pattern positively associated with depressive symptoms. The mechanisms that have been suggested to explain the positive association between sweets dietary pattern and depressive symptoms are probably related to the high glycemic load (GL) of the consumed items. The intake of a diet with a high GL has been associated in the short term with rapid and immediate changes in serotonin levels and consequently with a relief of some

psychological symptoms [33]. Increased inflammation and circulating cytokines have already been proven to be associated with depressive symptoms by extensive studies [34]. In fact, previous research shows that a higher intake of refined carbohydrates were associated with a higher levels of C-reactive protein, a marker of pro-inflammatory cytokines [8], which have already been proven to be possible mediators of known environmental risk factors in depression[34; 35]. Traditional Tianjin dietary pattern characterized by preserved eggs, animal blood, animal offal, sausages and seafood, contains a lot of fat. And consumption of a high-fat diet also leads to chronic systemic inflammation [36]. Another plausible mechanism relates to the consumption of a high-Pb-containing food, preserved eggs. Previous study suggested that dietary Pb exposure may increase the risk of mental health problems including depression [37]. This confirmed our previous studies that the sweets dietary pattern and Traditional Tianjin dietary pattern were associated with high depressive symptoms among Chinese adults [38].

Although this large population-based study considered many confounding factors, there are several limitations to our study. First, to confirm the level of depressive symptoms depends on not only total scores on the SDS but also diagnostic interviews. Total scores do not correspond with a clinical diagnosis of depression but rather indicate the level of high depressive symptoms that may be of clinical relevance [39]. Therefore, further studies should conduct a standardized comprehensive structured diagnostic interview in order to measure the depressive symptoms more persuasively. Second, due to the nature of the self-reporting questionnaire, food intake may be not exact with recall bias. Finally, since this is a cross-sectional study, reverse causation cannot examine in the present study. Depressive symptoms may have effect on dietary patterns that remains an alternative interpretation of the observed associations. Therefore, a prospective study or an intervention trial should be undertaken to

confirm the existence of a relationship between the healthy dietary pattern and depressive symptoms.

Conclusion

In the present study, a higher score of the healthy dietary pattern characterized by vegetables, fruits, whole grain food and soybean products was inversely associated with depressive symptoms. On the contrary, adherence to the sweets dietary pattern characterized by ice-cream, dessert, and fruits and Traditional Tianjin dietary pattern characterized by preserved eggs, animal blood, animal offal, sausages and seafood was positively associated with depressive symptoms. The findings suggest that dietary patterns appeared to be related to postmenopausal depressive symptoms. A long-term prospective study or randomized trials are required to clarify this causality.

Acknowledgements

We gratefully acknowledge the participants of the study and Tianjin Medical University General Hospital-Health Management Center for the possibility to perform the study.

Data statement

All data included in this study are available upon request by contact with the corresponding author.

Statement of author contribution

K.L. and Y.G. analyzed data and wrote the manuscript. M.L., J.F., X.W., G.Y., Q.Z., L.L., G.M. and Z.Y. contributed to the discussion and edited the manuscript. H.W., Y.X., X.B., S.Z., S.S., X.W., M.Z. and H.J. contributed to collect the data and interpreted the results. Q.J. and K.S. revised the manuscript for important intellectual contents. Y.W. and K.N. designed the study, reviewed and edited the manuscript. K.N. had full access to all the data and took responsibility for the integrity of the data.

Sources of Funding

This study was supported by grants from the National Natural Science Foundation of China (No. 81673166, 81372118, 81372467 and 81302422), the key technologies R&D program of Tianjin (Key Project: No. 11ZCGYSY05700, 12ZCZDSY20400, 13ZCZDSY20200, and 15YFYZSY00020), the National Science and Technology Support Program (No. 2012BAI02B02), 2012 and 2016 Chinese Nutrition Society (CNS) Nutrition Research Foundation—DSM Research Fund (No. 2014-071, 2016-046 and 2016-023), the Technologies development program of Beichen District of Tianjin (No. bcws2013-21, bcws2014-05 and 2015-SHGY-02), the technologies project of Tianjin Binhai New Area (No. 2013-02-04 and 2013-02-06), the Science Foundation of Tianjin Medical University (No. 2010KY28 and 2013KYQ24), the Key Laboratory of Public Health Safety (Fudan

University), Ministry of Education (No. GW2014-5), and the National Training Programs of Innovation and Entrepreneurship for Undergraduates (No. 201510062013), China.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Table 1 Factor loadings scores[a] of primary food groups of dietary patterns

Healthy dietary pattern		Sweets dietary pattern		Traditional Tianjin dietary pattern	
Food groups	Factor loadings	Food groups	Factor loadings	Food groups	Factor loadings
Celery	0.61	Chinese cakes	0.64	Animal offal (exclude animal liver)	0.58
Pumpkin, carrot	0.56	Ice-cream	0.63	Preserved eggs	0.56
Leaf vegetables	0.54	Sweets, candied fruits	0.62	Animal liver	0.55
Potato (exclude sweet potato)	0.53	All kinds of cookies	0.54	Animal blood	0.53
Eggplant	0.53	Pineapple	0.53	Instant noodles	0.53
Cucumber	0.52	Strawberry, kiwi fruit, persimmon	0.53	Pork skin	0.51
Chinese cabbage	0.52	Western-style pastry, cakes	0.52	Wonton	0.47
Mushroom	0.52	Watermelon	0.52	Steamed stuffed bun, dumpling	0.39
White gourd	0.52	Peach	0.49	Freshwater fish	0.39
Tomato (include ketchup)	0.51	Grape	0.47	Miscellaneous sauce noodles	0.39
Radish (exclude carrot)	0.51	Other fruits	0.47	Sea fish	0.38
Bell pepper	0.46	pickle	0.42	Sausage	0.37
Sweet potato	0.46	Salted eggs	0.39	Seafood (shellfish, squid , shrimp)	0.35
Raw vegetables	0.45	Pear	0.39	Pickle	0.34
Apple	0.45	Banana	0.37	Low-fat milk	0.32
Ginger	0.43	Preserved bean curd	0.36	Bread	0.32
Soya bean products	0.43	Sea grass	0.36	Salted eggs	0.31
Garlic	0.41	Chinese chives	0.34	Poultry	0.31
Lotus root	0.40	Nut	0.34	Chilies	0.30
Onion	0.40	Onion	0.33		
Coarse cereals	0.38	Apples	0.31		
Chilies	0.38	Oranges	0.31		
Eggs	0.37	Coffee	0.30		
Leeks	0.36	Walnut	0.30		
Porridge	0.35				
Oranges	0.34				
Pears	0.34				

All types of beans	0.32

[a]The factor loading scores with an absolute value more than 0.30 are shown in bold

Table 2. Baseline participant characteristics by Depressed status [a].

	SDS score of 48		*P* value [b]
	No	Yes	
No. of subjects	1,819	232	-
Age (y)	58.4 (58.1, 58.8) [c]	56.8 (55.6, 58)	0.01
BMI (kg/m^2)	24.7 (24.5, 24.8)	24.2 (23.7, 24.7)	0.09
Waist circumference (cm)	82.2 (81.8, 82.6)	81.3 (79.8, 82.7)	0.24
TC (mmol/L)	5.36 (5.32, 5.4)	5.37 (5.22, 5.53)	0.90
LDL (mmol/L)	3.16 (3.12, 3.2)	3.19 (3.05, 3.34)	0.69
TG (mmol/L)	1.28 (1.25, 1.31)	1.15 (1.06, 1.25)	0.01
HDL (mmol/L)	1.48 (1.46, 1.31)	1.5 (1.44, 1.25)	0.46
SBP (mmHg)	127.4 (126.5, 128.2)	123 (120.1, 126.1)	<0.01
DBP (mmHg)	77.3 (76.8, 77.8)	75.4 (73.7, 77.1)	0.04
FBG (mmol/L)	5.2 (5.16, 5.24)	5.15 (5.01, 5.3)	0.48
Physical activity (Mets × hour/week) d	13.4 (12.6, 14.3)	8.49 (6.73, 10.71)	<0.001
Total energy intake (kcal/d) d	1931.5 (1906, 1957.4)	2030.8 (1934.5, 2131.9)	0.051
Metabolic syndromes (yes, %)	32	1.8	0.04
Smoking status (%)			
Smoker	2.40	0.20	0.77
Ex-smoker	1.10	0.10	0.78
Non-smoker	89.3	7.00	0.93
Drinker status (%)			
Everyday	1.40	0.10	0.47
Sometime	31.4	2.50	0.63
Ex-drinker	6.10	0.50	0.78
Non-drinker	54.2	4.00	0.67
Marital status (married, %)	92.3	6.8	0.02
Living alone (yes, %)	6	0.3	0.45
Educational level (≥ college graduate, %)	23.8	1.6	0.51
Employment status (%)			
Managers	25.4	2	1.00
Professionals	8.2	0.6	0.79
Other	59.2	4.6	0.88
Household income (> 10,000 Yuan, %)	21.3	1.6	0.98
Visiting friends (yes, %)	69.6	4.6	0.02

[a] BMI, body mass index; TC, total cholesterol; TG, triglycerides; LDL, low density lipoprotein cholesterol; HDL, high-density lipoprotein-cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBG, fasting blood glucose; SDS, Self-Rating Depression Scale.

[b] Analysis of variance or chi-square test.

[c] Adjusted geometric mean (95% confidence interval) (all such values).

Table 3. Adjusted relationships between quartiles of dietary pattern factor scores and depressive symptoms.

	Quartiles of dietary pattern factor score				
	Level 1	Level 2	Level 3	Level 4	*P for trend*[a]
Healthy dietary pattern					
No. of subjects	513	513	512	513	
No. of participants with high depressive symptoms	69	52	58	53	
Model 1	1.00 (reference)	0.83 (0.52, 1.31) [b]	0.73 (0.45, 1.17)	0.73 (0.45, 1.17)	0.18
Model 2 [c]	1.00 (reference)	0.73 (0.46, 1.18)	0.59 (0.35, 0.98)	0.56 (0.33, 0.94)	0.03
Model 3 [d]	1.00 (reference)	0.79 (0.49, 1.28)	0.62 (0.37, 1.04)	0.57 (0.33, 0.97)	0.03
Sweets dietary pattern					
No. of subjects	513	513	512	513	
No. of participants with high depressive symptoms	59	45	51	77	
Model 1	1.00 (reference)	0.76 (0.44, 1.32)	1.11 (0.67, 1.84)	1.83 (1.16, 2.93)	<0.001
Model 2 [c]	1.00 (reference)	0.74 (0.43, 1.28)	1.06 (0.64, 1.76)	1.63 (1.09, 2.77)	<0.01
Model 3 [d]	1.00 (reference)	0.75 (0.42, 1.3)	1.08 (0.64, 1.81)	1.66 (1.03, 2.71)	<0.01
Traditional Tianjin dietary pattern					
No. of subjects	513	513	512	513	
No. of participants with high depressive symptoms	44	51	46	91	
Model 1	1.00 (reference)	1.04 (0.60, 1.82)	0.96 (0.55, 1.69)	2.72 (1.71, 4.43)	<0.0001
Model 2 [c]	1.00 (reference)	1.05 (0.60, 1.77)	0.97 (0.55, 1.72)	2.60 (1.63, 4.24)	<0.0001

Model 3 [d]	1.00 (reference)	1.02 (0.58, 1.79)	0.96 (0.54, 1.71)	2.53 (1.58, 4.16)	<0.0001

[a] Multiple logistic regression analysis.

[b] Adjusted odds ratio (95% confidence interval) (all such values).

[c] Adjusted for age and total energy intake.

[d] Adjusted for age, BMI, smoking status, drinking status, physical activity, marital status, total energy intake, household incomes, employment status, educational levels, visiting friends, living alone, metabolic syndrome.