

# Dietary, Physical Exercises and Mental Stress in A Chinese Population: A Cross-Sectional Study

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## Research Article

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## Abstract

**Background:** Mental health is affected by both genetic and environmental factors. However, previous studies have showed conflict findings about the role of lifestyle. The purpose of this study was to explore the relationship between diet, exercise, and mental health, as well as factors related to mental stress.

**Methods:** We recruited 8160 residents who had health examinations in a public hospital during June 2016 to May 2018. Demographic characteristics, diet, exercises, and mental health status. was collected by a questionnaire. We estimated the association using the odds ratio (OR) and 95% confidence interval (CI) based on Binary or ordinal logistic regression models. A classification and regression tree (CART) demonstrated the prediction of the value of a target variable based on other values.

**Results:** Fried food intake, male, unmarried state, and aged  $\leq 43$  were associated with increased risks of mental stress while consuming more fresh vegetables or fruits showed a protective effect. The ordinal logistic regression model showed that increased consumption of meat (OR=1.50, 95% CI: 1.33-1.68), dessert (OR=1.24, 95% CI: 1.08-1.43) and pickled or smoked food (OR=1.21, 95% CI: 1.08-1.35) in males and increased consumption of dessert (OR=1.20, 95% CI: 1.05-1.38), pickled or smoked food (OR=1.14, 95% CI: 1.01-1.29), quitting smoking (OR=2.99, 95% CI: 1.14-7.85), quitting drinking (OR=2.42, 95% CI: 1.65-3.54), and drinking (OR=1.47, 95% CI: 1.21-1.79) in females are related to mental stress.

**Conclusions:** Our study showed that both diet and behaviors were associated with mental health and affected the degree of stress, which provided novel insights into interventions.

## Introduction

Mental stress refers to the psychological confusion or threat caused by various irritating events and adverse factors in daily life. Mental stress has double effects on physiology and psychology, while moderate stress improves work efficiency and the chronic excessive stress may cause mental disorders, such as depression, bipolar disorder, schizophrenia, or dementia[1–4]. As the pace of modern life is speeding up, the negative impact of mental stress on health has gained much more attention[5, 6]. The WHO estimated that 264 million people suffer from depression, including 45 million having bipolar disorder and 50 million having dementia[7]. There is no way to entirely avoid mental stress altogether, so people try to reduce it through external intervention. Meditation programs and spa therapy can reduce the adverse effects of mental stress to some extent[8, 9]. Nowadays, people pay more and more attention to reducing mental stress through daily life modification.

Mental health is affected by both genetic and environmental factors. Previous studies have shown that environmental factors such as the work system, economic status, and competition can affect mental stress to some extent[10–12], but there are disputes about the role of lifestyle such as eating habits. Lambrinakou et al. found that there was no direct relationship between lifestyle and anxiety[13]. However, Yoshikawa et al. reported a significant positive correlation between the frequency of fried food consumption and depressive symptoms among the Japanese population[14]. In a follow-up study of

psychological distress among middle-aged and elderly Australians, it was found that increased intake of fruits and vegetables may help to reduce psychological pain[15]. Besides, moderate-intensity exercises are proved to decrease tumor necrosis factor-alpha and improve mental health[16].

The purpose of this study was to explore the relationship between diet, exercise, and mental health in a Chinese population and to identify factors related to mental stress for future interventions.

## **Materials And Methods**

### **Study subjects**

We recruited 8160 participants who took part in a routine health examination at the Health Management Center of the First Affiliated Hospital of Nanjing Medical University, China, during June 2016 and May 2018. All of them completed an online survey through the WeChat platform.

### **Data collection**

We designed a 17-items lifestyle questionnaire to collect demographic characteristics, diet, smoking, drinking, and physical activity. For diet, we collected data on the frequency of consuming cereals crop, meat, fish, or other aquatic products, fresh vegetables or fruits, milk or dairy products, eggs, legumes, desserts, fried food, pickled or smoked foods, and nuts. The mental stress was evaluated and classified into four levels as none, mild, moderate, and intense.

### **Statistical analysis**

We performed statistical analyses using SPSS 25 software. Continuous variables were described as the mean and standard deviation (SD), while categorical variables were expressed in percentages and constituent ratios. The logistic regression model and classification and regression tree (CART) were used to analyze factors related to mental stress. All significance tests were double-tailed, and the difference was statistically significant if  $P < 0.05$ .

## **Results**

After excluding 13 people with missing data on the dietary condition, 8147 subjects were included in the analysis. The average age was  $43.1 \pm 0.1$  years. The ratio of male to female was 1.24:1, and the majority were married ( $n = 6,751$ , 82.8%). The proportion of participants reporting mild, moderate, and intense stress was 17.6%, 35.3%, and 29.8%, respectively.

### **Binary logistic regression analysis on factors related to mental stress**

As shown in Table 1, age, gender, and marital status were significantly related to mental stress. Increased consumption of fish (OR:0.81, 95% CI: 0.72–0.92), fresh vegetables or fruits (OR = 0.69, 95% CI: 0.6–

0.81), and dessert (OR = 0.85, 95% CI: 0.73–0.99), and doing physical exercise > 1 time per week (OR = 0.80, 95% CI: 0.70–0.91) decreased the risk of mental stress. Consumption of fried foods (OR = 1.39, 95% CI: 1.20–1.61), pickled or smoked food (OR = 1.14, 95%CI:0.99–1.30), and milk or dairy products (OR = 1.30, 95% CI: 1.15–1.48) 2–7 days per week were related to an increased risk.

Table 1  
Binary logistic regression analysis of the generation of mental stress.

Terms	Mental stress, n (%)		Z	P	Adjusted OR (95% CI)*	P*
	No	Yes				
Gender						
Female	607(7.45)	3896(47.82)	87.85	< 0.01	1	< 0.01
Male	777(9.54)	2867(35.19)			1.54(1.31–1.80)	
Marital status						
Unmarried/single	100(1.230)	1296(15.91)	115.31	< 0.01	1	< 0.01
Married	1284(15.76)	5467(67.10)			0.59(0.47–0.74)	
Age (years)						
≤43	351(4.31)	3758(46.13)	419.32	< 0.01	1	< 0.01
>43	1033(12.68)	3005(36.88)			0.35(0.30–0.40)	
Cereal crop (day/week)						
0–4	250(3.07)	1636(20.08)	24.24	< 0.01	1	0.30
5–7	1134(13.92)	5127(62.93)			0.92(0.78–1.08)	
Meat (day/week)						
0–4	829(10.18)	3704(45.46)	12.25	< 0.01	1	0.30
5–7	555(6.81)	3059(37.55)			1.07(0.94–1.22)	
Fish or aquatic products (day/week)						
0–2	738(9.06)	3963(48.46)	13.10	< 0.01	1	< 0.01
2–7	646(7.93)	2800(34.37)			0.81(0.72–0.92)	
Fresh vegetables or fruits (day/week)						
0–4	380(4.66)	2915(35.78)	116.76	< 0.01	1	< 0.01

\*: Adjusted for other variables which were significant in the univariate analysis

Terms	Mental stress, n (%)		Z	P	Adjusted OR (95% CI)*	P*
	No	Yes				
5-7	1004(12.32)	3848(47.23)			0.70(0.60-0.81)	
Milk or dairy products (day/week)						
0-1	671(8.24)	2652(32.55)	40.87	< 0.01	1	< 0.01
2-7	713(8.75)	4111(50.46)			1.30(1.15-1.48)	
Eggs or their products (day/week)						
0-2	452(5.55)	2344(28.77)	2.04	0.15		
3-7	932(11.44)	4419(54.24)			-	-
Legumes or their products (day/week)						
0-2	752(9.23)	3837(47.10)	2.69	0.10	-	-
3-7	632(7.76)	2926(35.92)				
Dessert (day/week)						
0-2	1100(13.50)	5166(63.41)	6.19	0.01	1	0.04
3-7	284(3.49)	1597(19.60)			0.85(0.73-0.99)	
Fried food (day/week)						
0-1	982(12.05)	3639(44.67)	137.59	< 0.01	1	< 0.01
2-7	402(4.93)	3124(38.35)			1.39(1.20-1.61)	
Pickled or smoked food (day/week)						
0-1	846(10.380)	3702(45.44)	19.01	< 0.01	1	0.05
2-7	538(6.60)	3061(37.57)			1.14(0.99-1.30)	
Nuts (day/week)						
0-1	675(8.93)	3200(42.34)	0.63	0.43		

\*: Adjusted for other variables which were significant in the univariate analysis

Terms	Mental stress, n (%)		Z	P	Adjusted OR (95% CI)*	P*
	No	Yes				
2–7	616(8.15)	3066(40.57)			-	-
<b>Smoking</b>						
Never	1072(13.16)	4870(59.78)	17.27	< 0.01	1	
Quit smoking	42(0.52)	317(3.89)			1.21(0.85–1.72)	0.29
Current smoking	270(3.31)	1576(19.34)			0.84(0.70–1.01)	0.06
<b>Drinking</b>						
Never	959(11.77)	3927(48.20)	60.31	< 0.01	1	
Quit drinking	48(0.59)	405(4.97)			1.54(1.11–2.13)	< 0.01
Current drinking	377(4.63)	2431(29.84)			1.32(1.12–1.55)	< 0.01
<b>Physical exercises (times/week)</b>						
≤1	506(6.21)	2845(34.93)	14.42	< 0.01	1	< 0.01
>1	878(10.78)	3917(48.08)			0.80(0.70–0.91)	

\*: Adjusted for other variables which were significant in the univariate analysis

## CART analysis

We used the CART method to explore the role of different factors in the risk of mental stress. A total of 6 variables were included in the final model, including age, gender, marital status, consumption of fresh vegetables or fruits, meat, and fried foods (Fig. 1). The probability of correctly predicting the mental stress was 82.5%. The first node is age, followed by gender.

## Ordinal logistic regression analysis

We further performed an ordinal logistic regression model to explore factors related to the grade of mental stress stratified by gender. We first conducted a parallel line test, and then variables meeting the hypothesis were further analyzed. As shown in Fig. 2, for males, consumption of cereal crops 5–7 days per week ( $OR = 0.77$ , 95% CI: 0.67–0.88), fish 3–7 days per week ( $OR = 0.87$ , 95% CI: 0.77–0.97), and legumes 3–7 days per week ( $OR = 0.88$ , 95% CI: 0.78–1.00) contributed to a reduced risk of mental stress, while consumption of meat 5–7 days per week ( $OR = 1.50$ , 95% CI: 1.33–1.68), dessert 3–7 days per week ( $OR = 1.24$ , 95% CI: 1.08–1.43) and picked or smoked food 3–7 days per week ( $OR = 1.21$ , 95% CI:

1.08–1.35) could increase the degree of mental stress. For females, consumption of dessert 3–7 days per week ( $OR = 1.20$ , 95% CI: 1.05–1.38), picked or smoked food 3–7 day per week ( $OR = 1.14$ , 95%CI:1.01–1.29), quit smoking ( $OR = 2.99$ , 95% CI: 1.14–7.85), quit drinking ( $OR = 2.42$ , 95% CI: 1.65–3.54) and current drinking ( $OR = 1.47$ , 95% CI: 1.21–1.79) were related to an increased risk of mental health; the consumption of fish 3–7 days per week ( $OR = 0.80$ , 95% CI: 0.71–0.90) and doing physical exercise > 1 time per week ( $OR = 0.69$ , 95% CI: 0.61–0.78) decreased the risk of mental stress.

## Discussion

This study revealed a significant relationship between diet, exercises, and mental stress, providing novel insights into the occurrence and aggravation of mental stress.

In this study, we applied both logistic regression model and classification tree to analyze the factors related to mental stress. The logistic regression model is insufficient to deal with the collinearity of variables, while the CART is not affected by the collinearity problems among variables in the analysis. However, the quantitative explanation of the effect of individual factors is not as good as that of the logistic regression model[17]. Our analysis combines two methods, which are helpful to understand better the potential factors affecting mental health.

Besides age, gender, and marital status, increased consumption of fried food and fresh vegetables or fruits was found to be related to mental stress by both the logistic regression model and classification tree. Previous studies had shown that gender differences in the susceptibility of mental health [18–20]. Mental stress stimulates the activity of the hypothalamic-pituitary-adrenal axis and regulates mood through cortisol[21]. Aging could increase the basal level of cortisol in the brain[22], explaining why older people produce less stress through earlier negative feedback to hormone levels. Poverty was more likely to lead to mental disorders[23], and both married families and cohabitants benefited from the income of two adult earners, while cohabitants have still fared slightly worse than married families[24]. Reducing the intake of fried foods, which were rich in acrylamide and trans fatty acids, might benefit for mental health[25]. Furthermore, fresh vegetables or fruits could reduce depression by resisting the adverse impacts of oxidative stress[26].

We found that increased dessert and pickled or smoked food was related to an increased risk of mental stress. The benzo[a]pyrene in picked or smoked food is a carcinogen, and incomplete oxidation of glucose in dessert will produce metabolites such as lactic acid when vitamin B1 is insufficient in the body, affecting the activity of the central nervous system[27, 28]. There was, in addition, the small amount of consumption of fish to concern. Fish is rich in omega-3 polyunsaturated fatty acids, and many studies had concluded that proper intake of fish was beneficial to mental disorders[29, 30]. Among the female, quitting smoking or quitting drinking seemed to show more mental stress. It might be explained by the interruption of the way of catharsis aggravated the mental state[31]. Some studies showed that physical activity For males, we observed that eating less cereal and legumes could also increase mental stress. Legumes and cereal contain high levels of B vitamin with antioxidant properties [26]. A follow-up project

supported that the legumes were a protective factor and the randomized clinical trial came out that the intervention focused on the B vitamin could reduce occupational stress[32, 33].

Our study had several limitations. First, self-assessment may not fully reflect the actual state of mental health. Second, the cross-sectional study design limited the ability to verify the causal relationship. Third, recalling bias could also affect the results.

In conclusion, our study showed a significant role of diet habits and behaviors in the risk of mental stress, which might provide novel insights into interventions for mental health.

## Declarations

### Acknowledgements

None

### Authors contributions

Xiaona Li, Jianming Wang and Qun Zhang participated in the study design. Xiaona Li, Qin Pei, Wen Guo, Jing Lu and Wenfang Zhu were involved in the conduct of the study and data collection. Xiaona Li and Dan Tian made contributions to the data analysis and interpretation of the results. Dan Tian, Jianming Wang and Qun Zhang wrote and modified the manuscript and prepared the tables and figures. All authors gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

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### Availability of data and materials

The datasets used and/or analyzed for the current study are available from the corresponding author on reasonable request.

### Ethics approval and consent to participate

This study was approved by the Ethics Committee of the First Affiliated Hospital of Nanjing Medical University (No.2018-SR-175). Written informed consent was obtained from study participants. The study was conducted in accordance with the Declaration of Helsinki.

## **Consent for publication**

Not applicable.

## **Competing interests**

The authors declare no conflict of interest.

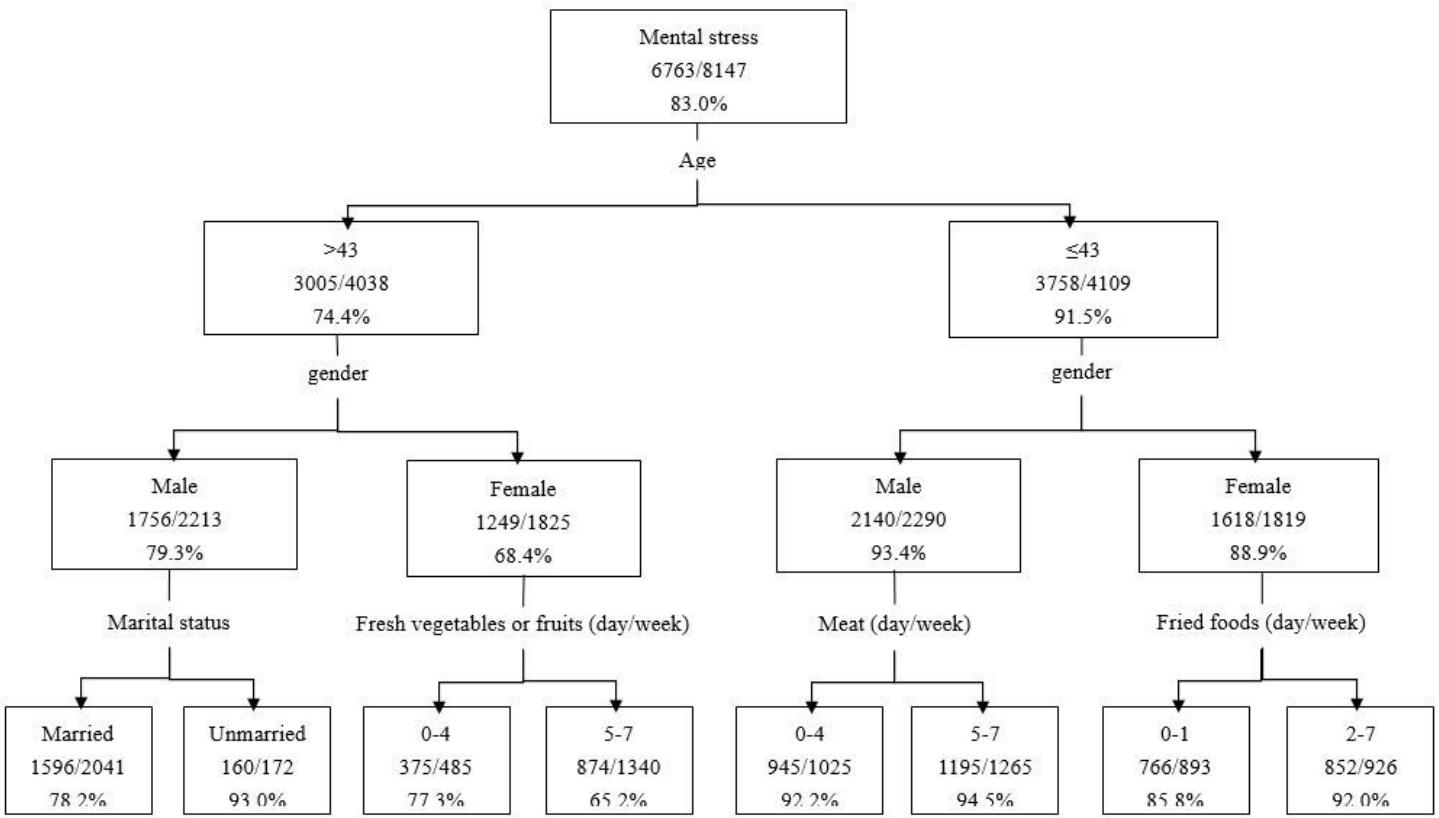
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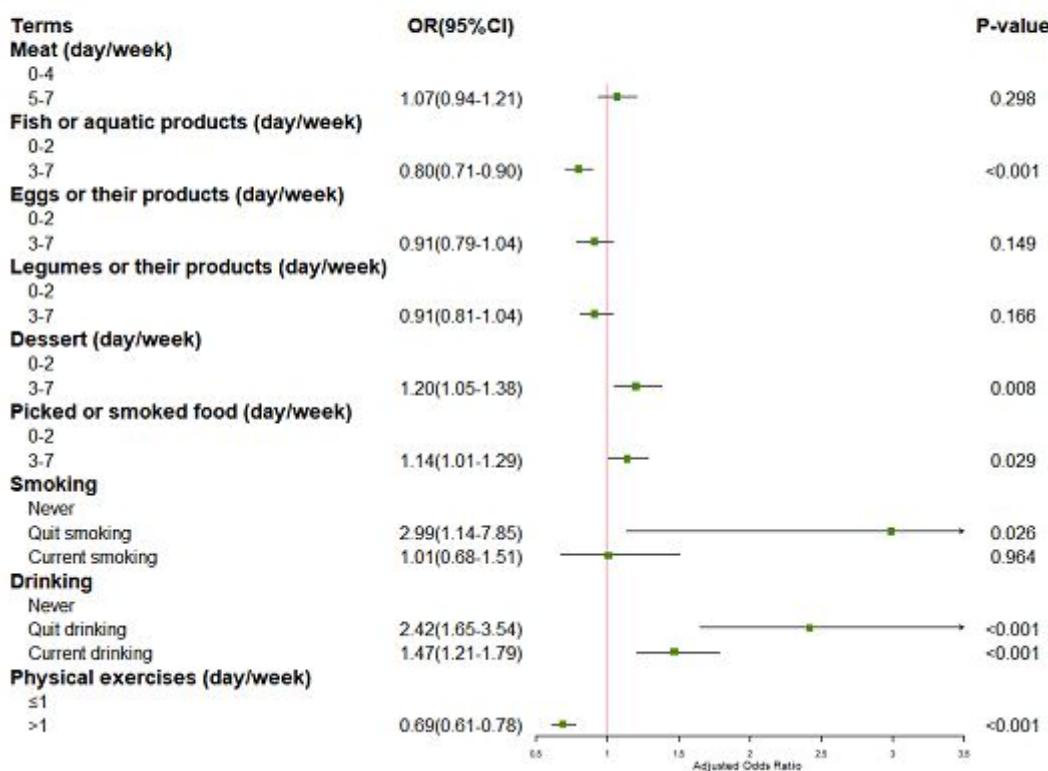
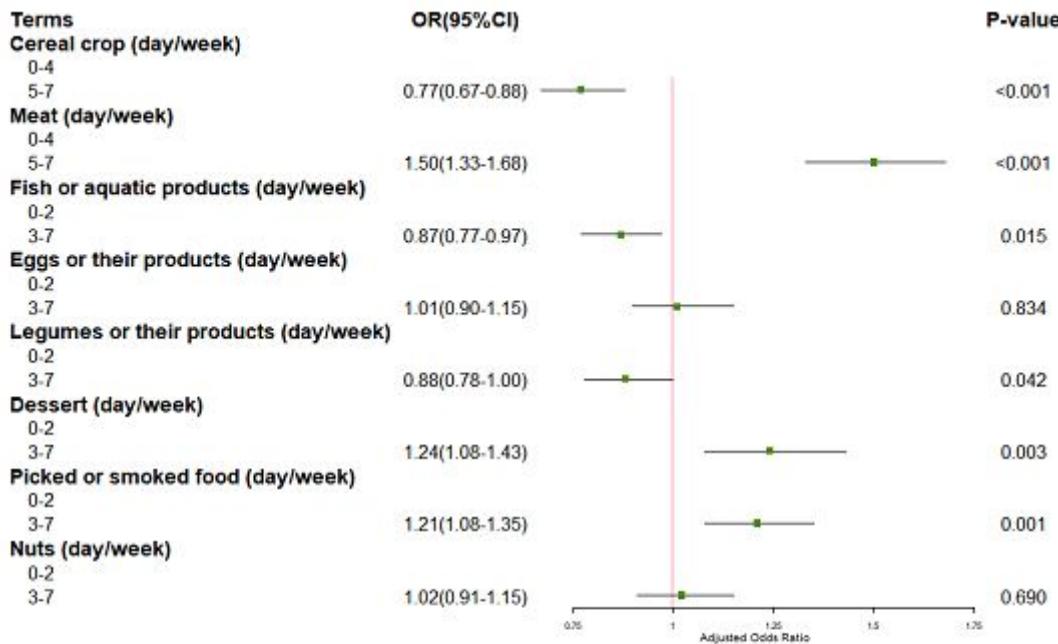
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## Figures



**Figure 1**

Classification and regression tree analysis on factors related to mental stress.



**Figure 2**

Ordinal logistic regression analysis on factors related to mental stress.