



## Research paper

# Adhering to a vegetarian diet may create a greater risk of depressive symptoms in the elderly male Chinese population



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## ARTICLE INFO

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## ABSTRACT

**Background:** A vegetarian diet may be a risk factor for depression, but this relationship was unclear in the elderly Chinese population.

**Methods:** Self-report data were gathered from 1051 elderly persons using the Cohort of Elderly Health and Environment Controllable Factors, which was created in West Anhui, China. The depressive symptoms were set as binary, ordinal, and continuous outcomes, respectively, whereas the dietary structures were computed as an ordinal variable and a dummy variable. Multiple logistic regression, ordinal regression, and linear regression were used to assess the relationship by adjusting the potential confounding variables with  $p$ -values of  $< 0.1$  in univariate analysis.

**Results:** The elderly participants who had a vegetable-based diet had the highest GDS scores of  $8.78 \pm 6.894$  ( $p = 0.001$ ) and the highest rate of depression (32.9%,  $p = 0.003$ ). After adjustment for the potential confounders, elderly men who had a vegetable-based diet had a higher rate of depression (OR[95%CI]: 1.62[1.07–2.46], 4.71[1.38–16.03]), more severe symptoms of depression (OR[95%CI]: 8.85[2.94–34.12]), and higher GDS scores ( $\beta$ [95%CI]: 1.46[0.70–2.22], 2.97[1.28–4.67]) than male participants who had a meat-based diet, but this was not the case in women.

**Limitations:** All data were self-reported. The study lacked quantitatively evaluated dietary intake. The duration of the current dietary structures and comorbidities were not reported. The cross-sectional study made the causal role uncertain.

**Conclusions:** Vegetarian diets may pose a greater risk of depressive symptoms among the elderly Chinese population, especially elderly men. Given the cross-sectional nature of this study, the causal role was uncertain. Further prospective studies, in particular among elderly women, are needed.

## 1. Introduction

China has become an aging society due to the decrease in population growth rates and extended life expectancy. The Sixth National Census of China in 2010 showed that individuals 60 years and older accounted for 13.3% of the total population, and the proportion will reach one third by 2050 (Wang et al., 2017). While many age-related pathologies are presently in the spotlight, one of the most overlooked is elderly depression.

Depression is a serious public health problem in an aging society because of its heavy social burden and association with various adverse outcomes (Yoshimura et al., 2013). In China, the prevalence of

depression in the elderly has risen rapidly during the last 30 years, from 3.86% in the 1980s (Chen et al., 1999) to 39.86% in 2008 (Yu et al., 2012). Depression in late life is associated with suicide, decreased physical performance, cognitive decline, reduced social function, and greater self-neglect, all of which could increase the mortality of the elderly (Blazer, 2003). Many of the risk factors in older adult depression have been identified, such as gender, marital status, education, income (Qiu et al., 2011), social activities, and chronic diseases (Ni et al., 2017). However, it is surprising that vegetarian diets, which have been proven to decrease the risk of many common chronic diseases (Fraser, 2009), may be associated with poor mental well-being (Beezhold et al., 2010).

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Some studies in Western countries have shown that the vegetarian diet may be associated with depression. Michalak et al. (2012) found that in Western cultures a vegetarian diet is associated with an elevated risk of mental disorders, including depression, but the causal role was uncertain. Hibbeln et al. (2018) found that vegetarian men in southwest England have more depressive symptoms, and they also thought that reverse causation probably exists. In an Australian study, semi-vegetarians and vegetarians reported 21–22% depression compared with 15% of nonvegetarians (Baines et al., 2007). However, some scholars hold different opinions; for example, a UK cohort showed the semivegetarian pattern in men was associated with having EPDS scores  $\geq 13$  in unadjusted results, but the association disappeared after adjustment for the confounders (Northstone et al., 2018).

Given the uncertain relationship between the vegetarian diet and depression and the lack of studies exploring this relationship in the elderly Chinese population, we sought to determine whether the dietary structure of a vegetarian diet was associated with an increased risk of depressive symptoms among the Chinese elderly in this study.

## 2. Methods

### 2.1. Setting and sample

The data reported in this article came from the baseline survey of Cohort of Health of Elderly and Controllable Factors of Environment, which was carried out in West Anhui, China, from June to September 2016. This cohort was built by the Department of Public Health of Anhui Medical University and the Lu'an Municipality Center for Disease Control and Prevention. A stratified cluster sampling method was used to identify a sample in West Anhui, China. First, two counties were randomly selected from West Anhui. Then, a rural community and an urban community were randomly selected from the stratifications, which were divided according to the administration partition in the two counties. Finally, all the elderly aged 60 and above in these communities participated in the survey.

The survey was conducted in the community hospitals. To ensure the response rate, community doctors made telephone appointments with the elderly a day in advance. Household surveys were carried out if the elderly did not come to the hospitals at the appointed time. Participating elderly met the following criteria: (1) aged  $\geq 60$ , (2) had lived at the investigation site for at least 6 months before the survey, (3) did not have mental illness that could affect normal communication, and (4) signed an informed consent and voluntarily participated. Finally, a total of 1217 elderly people aged 60 and above were contacted, 1080 of them accepted the survey, and 1051 of them completed the geriatric depression scale (GDS).

### 2.2. Questionnaire survey

Before the survey, all the investigators received the same training to learn proper field investigation skills and explanations of questionnaire content. The research content had been elucidated briefly when the

community doctors made telephone appointments. The details of the research study were explained to the elderly when they came to the community hospitals to provide an informed consent.

A self-designed questionnaire was used to collect control variables, including demographic data (gender, age, occupation, marital status, residence), socioeconomic factors (education, yearly family income), lifestyle factors (living alone, smoking, drinking), and self-rated health. Vegetarianism may be a result of religious motivations (Hibbeln et al., 2018); therefore, religion was included in the analyses as Christian, Buddhist, or none.

Considering the participants of this investigation were older people who could not stick with the investigation for a long period of time, we selected some common foods to investigate after referring to the food frequency questionnaire (FFQ) and considering the real dietary situation in West Anhui. Meat mainly included pork, beef, mutton, chicken, duck, goose, and fish. Vegetables mainly included the pakchoi cabbage, mater convolvulus, amaranth, tomato, and potato and bean products in the local area. We asked the older people, *how often do you eat meat, how often do you eat vegetables*, after explaining the definition of *meat* and *vegetable* to them. We divide the food frequency into three levels, 2 times per week or less, 3–4 times per week, 5 times per week or more. The participants were asked to consider their own actual situation in the past year, and food frequency was based on self-identification. Finally, the dietary structures were grouped as a meat-based diet, a balanced diet, and a vegetable-based diet. People who ate meat frequently were defined as having a meat-based diet; people who ate vegetables frequently were defined as having a vegetable-based diet; and people who ate meat and vegetables with the same frequency were defined as having a balanced diet. However, exceptional cases, such as eating both meat and vegetables maybe 2 times per week or less, may be picked because we only selected some common foods to investigate, so we would continue to ask about the diet for the duration of the interview and then classified the dietary structure according to the person's actual situation.

Depression level was assessed by the 30-item Chinese revision of the geriatric depression scale (GDS) (Yesavage et al., 1982). The GDS has been used globally to assess depression in the elderly; the retest reliability was 0.85, and the convergent validity was 0.82. The participants were instructed to answer the questions according to their actual experiences in the previous 2 weeks. Scores ranged from 0 to 30. The standards of depression were: GDS scores of 0–10 indicated no depression, 11–20 indicated minimal to mild depression, and 21–30 indicated moderate to severe depression (Wang et al., 2017).

### 2.3. Statistical methods

After checking and coding the questionnaires, double entry and validation of the data were processed using Epi Data 3.1 software (Epi Data foreningen [Epi Data Association], Odense, Denmark), and SPSS 10.01 (SPSS Inc., Chicago, IL, USA) was used to analyze data. Depression scores were determined for non-normal distribution by Kolmogorov–Smirnov test. Then, the Kruskal–Wallis H test was used to

**Table 1**  
Distribution of depression in whole sample and in the older with three dietary structures.

	Meat-based	Balanced	Vegetable-based	Overall
N	61 (5.8%)	397 (37.8%)	593 (56.4%)	1051
Mean $\pm$ St Dev <sup>a</sup>	5.95 $\pm$ 5.097	7.43 $\pm$ 5.901	8.78 $\pm$ 6.894	8.11 $\pm$ 6.492
Without depression <sup>b</sup>	49 (83.1%)	291 (75.2%)	392 (67.1%)	732 (71.1%)
With depression <sup>c</sup>	10 (16.9%)	96 (24.8%)	192 (32.9%)	298 (28.9%)
Minimal to mild depression <sup>b</sup>	10 (16.9%)	80 (20.7%)	137 (23.5%)	227 (22.0%)
Moderately to severe depression <sup>b</sup>	0 (0)	16 (4.1%)	55 (9.4%)	71 (6.9%)

<sup>a</sup> K-W: 13.580,  $p = 0.001$  (differences of depression scores among the three dietary structures).

<sup>b</sup> K-W: 14.203,  $p = 0.001$  (depressive symptoms were set as ordinal category outcomes).

<sup>c</sup>  $\chi^2$ : 11.744,  $p = 0.003$  (depressive symptoms were set as binary outcomes).

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