



Tea consumption is inversely associated with depressive symptoms in the elderly: A cross-sectional study in eastern China



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ABSTRACT

Background: Epidemiological studies suggest that higher tea consumption was associated with lower risk of depressive symptoms, but this has not been found consistently. Moreover, the effect of different types of tea on depressive symptoms needs to be further explored. This study aimed to examine the association between tea consumption and depressive symptoms in Chinese elderly.

Methods: We analyzed the baseline data from Zhejiang Major Public Health Surveillance Program including 9371 participants. Depressive symptoms was assessed through the application of Patient Health Questionnaire-9 scale (PHQ-9). Logistic regression models, controlled for an extensive range of potential confounders, were generated to evaluate the association between tea consumption and risk of depressive symptoms.

Results: The black tea drinkers had a significantly decreased risk of depressive symptoms ($p < 0.01$), whereas no association was found in green tea drinkers. Compared with non-drinkers, the adjusted ORs (95% CIs) were 0.48 (0.23, 0.99) and 0.35 (0.17, 0.72) for participants consuming < 3 cups and ≥ 3 cups of black tea per day, respectively (P for trend: < 0.01). A linear association between concentration of black tea and depressive symptoms was also confirmed in our study.

Limitations: Cross-sectional data could not make a causation conclusion, and the observed association in our study could not be ascribed to any specific component in tea.

Conclusions: Our results indicated that higher black tea consumption was associated with a lower prevalence of depressive symptoms in the elderly.

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1. Introduction

Depression is a major mental illness in elders that is associated with significant prevalence and mortality (Smith, 2014). Based on estimation, depressive disorders affect more than 350 million people of all ages in the world (World Health Organization, 2012), and will be ranked third among disorders contributing to the global burden of disease by 2030 (Mathers and Loncar, 2006). Approximately 1 million people committing suicide are caused by depression each year, and this number is increasing worldwide (Ng et al., 2007).

Accumulating evidence showed that dietary changes may favor the improvement or worsening of depression (Manosso et al.,

2013). Tea is the most consumed beverage in the world after water, drunk in Asia for more than 4000 years (Gardner et al., 2007). The limitless benefits of tea have been evidenced by a great quantity of studies in the last few decades (Hayat et al., 2015). Animal and *in vivo* studies have identified that tea and its components have several possible antidepressant effects, including lowering the stress response (Kimura et al., 2007), ameliorating the overproduction of proinflammatory cytokines and mediators (Hsu et al., 2007), decrease in oxidative stress (Crespy and Williamson, 2004), modulation the hypothalamic–pituitary–adrenal axis (Zhu et al., 2012), etcetera. Nonetheless, controversy still exists in human studies.

Epidemiological data on the association between tea consumption and depressive symptoms are limited and inconsistent. The majority of studies supported that tea consumption was associated with a decreased risk of depressive symptoms (Dong et al., 2015; Grosso et al., 2016). On the contrary, some others observed no association (Ruusunen et al., 2010; Tsai et al., 2012).

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Moreover, the effect of different types of tea consumed on depressive symptoms needs to be further explored (Dong et al., 2015), considering that different types of tea may contain different kinds and quantity of bioactive ingredients. In addition, to our knowledge, there is a vacancy in literature on the association between tea concentration and depressive symptoms.

Thus in this study, we utilized the baseline data from a large population-based cohort study to explore the association of tea consumption (including the type and concentration of tea especially) with depressive symptoms among the elderly in eastern China.

2. Methods

2.1. Data source

The baseline data is from Zhejiang Major Public Health Surveillance Program, a community based cohort study focusing on aging and health among elderly in Zhejiang province, China. It was conducted by Zhejiang Provincial Center for Disease Control and Prevention, and the baseline survey was finished in 2014. Seven counties were randomly selected from a total of 90 counties in Zhejiang province. One town in each county and several communities in each town were then randomly selected. Permanent residents aged ≥ 60 years old in these selected communities were expected to be included in the study. At least 1500 elderly people who met the inclusion criteria in each county were invited for participation.

A face to face interview based on a self-designed questionnaire was performed by trained research assistants for each participant. Their information of demographic characteristics, family status, reproductive history, medical disease, behavioral risk factors, diet habits, injury, depressive symptoms, self-care ability and cognitive function was collected. Data were primarily checked by staff at Zhejiang Provincial Center for Disease Control and Prevention. Missing data and logical errors were fed back to the initial interviewer who would try to complete the dataset by reinvestigating the participants. After excluding those who refused to participate, 9411 (89.6%, totally 10,500 were invited primarily) valid questionnaires were obtained finally. In our analysis, observations with incomplete information on depressive symptoms and tea consumption were excluded.

The protocol was approved by the Ethics Committee of Zhejiang Provincial Center for Disease Control and Prevention, and written consents or finger prints were obtained from all participants prior to the research.

2.2. Assessment of depressive symptoms

Depressive symptoms was evaluated using the Patient Health Questionnaire-9 scale (PHQ-9) (Kroenke et al., 2001), 9-question version of the Primary Care Evaluation of Mental Disorders measured by self-reporting. Total score for the nine items ranges from 0 to 27, with greater values indicating increased severity. Scores of 5, 10, 15, and 20 represented cutpoints for mild, moderate, moderately severe and severe depressive symptoms, respectively. The PHQ-9 has been validated with acceptable psychometric properties for screening of depression in Chinese population (S. Chen et al., 2010). In our study, a cut-off score of five or more was used to define depressive symptoms.

2.3. Tea consumption

Data on tea consumption was collected in the diet habits section within the questionnaire: frequency of tea consumption (the

number of days when drinking tea weekly, days/week), daily volume of tea consumption in the days when drinking tea (cups/day, a cup was defined as 250 ml), preferred type of tea (green tea, black tea, oolong tea, pu'er tea, scented tea and fruit tea) and preferred concentration of tea (light, moderate and heavy).

The volume of tea consumption (cups/day) was calculated from frequency of tea consumption and daily volume of tea consumption in the days when drinking tea. It was divided into three categories: none, < 3 cups/day and ≥ 3 cups/day. Due to the small sample sizes of people who drank oolong tea, pu'er tea, scented tea and fruit tea, they were classified as "other types of tea" group.

2.4. Other variables

Based on findings reported in the literature, variables described below were considered as potential confounders and were included in our analysis: age (years, continuous variable), gender ("man" and "women"), race ("Han ethnicity" and "minority"), education level ("lower than primary", "primary", "junior middle", "senior middle" and "college and above"), marital status ("single", "married" and "divorced/widowed"), living status ("alone" and "not alone"), income (thousand yuan, continuous variable), vegetables intake (" < 3 " and " ≥ 3 " times/week), fruits intake (" < 3 " and " ≥ 3 " times/week), red meat intake (" < 3 " and " ≥ 3 " times/week), fish intake (" < 3 " and " ≥ 3 " times/week), eggs intake (" < 3 " and " ≥ 3 " times/week), smoking ("never", "past" and "current"), alcohol drinking ("never", "past" and "current"), physical activity ("yes" and "no"), hypertension ("presence" and "absence"), diabetes ("presence" and "absence"), coronary heart disease ("presence" and "absence"), Activities of Daily Living Scale scores (continuous variable) and Mini-Mental State Examination scores (continuous variable). Detailed information on some of these variables were described as follows.

(1) Physical activity was assessed on the basis of the response (yes or no) to a single question about doing exercise regularly. (2) Medical disease section of the questionnaire contained the items on the presence or absence of 16 common diseases, which should be formally diagnosed. Hypertension, diabetes and coronary heart disease (CHD) were considered in this study. (3) The frequency of certain food intake during the past year was also collected in the diet habits section of questionnaire, including vegetables, fruits, red meat, fish and eggs. It was divided into two categories: < 3 and ≥ 3 times/week. (4) The self-care ability was evaluated by the Activities of Daily Living Scale (ADL) in the Chinese National Basic Public Health Service Specification. It consists of self-feeding, bathing, dressing, toilet hygiene and functional mobility, with the total score of 37. (5) Cognitive function was assessed with the Mini-Mental State Examination (MMSE) (Tombaugh and McIntyre, 1992), which was administered by specially trained research assistants. Considering the long pre-dementia stage of late life neurocognitive disorders, MMSE scores was controlled as a continuous variable to rule out the influence by impaired cognitive functioning (Feng et al., 2016).

2.5. Statistical analysis

Descriptive statistics were applied to illustrate the general characteristics of included participants. The associations between general characteristics and depressive symptoms were examined by *t*-test, Chi-square test or Kruskal-Wallis test as appropriate to variables. The general characteristics which were associated with depressive symptoms were considered as potential confounders. Crude odds ratios (ORs), 95% confidence intervals (CIs) and corresponding *P* values of depressive symptoms associated with tea consumption were calculated by binary logistic regression in model 1. Adjustment for age and gender was performed in model

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