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ORIGINAL RESEARCH

Association of eating rate and post-dinner snacking with depressive symptoms in Chinese adult men

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Abstract

Eating behaviors are associated with mental health. However, although most studies have assessed specific eating behaviors, none have evaluated the association of eating rates and post-dinner snacking with depressive symptoms. This study investigated this relationship in adult Chinese men. A total of 1552 participants aged 25–68 years were included in this study. Logistic regression analysis was conducted to examine the relationship between eating behaviors and depressive symptoms, and the corresponding odds ratios and 95% confidence intervals (CIs) were calculated. Self-administered questionnaires were used to evaluate eating rates and post-dinner snacking, and the Self-Rating Depression Scale was used to assess depressive symptoms. In the unadjusted model, the odds ratios and 95% CIs for depressive symptoms associated with normal and fast eating compared with slow eating were 1.47 (1.15, 1.89) and 1.60 (1.14, 2.23), respectively (*p* for trend = 0.002). This significant positive association remained unchanged in the final adjusted model (*p* for trend = 0.006). No significant relationship was found between post-dinner snacking and depressive symptoms. These findings showed that eating fast was linked to a higher risk of depressive symptoms and suggested that speed of eating may influence the mental health of adult men.

Keywords

Eating rates; Post-dinner snacking; Depressive symptoms; Chinese men; Cross-sectional study

1. Introduction

Depression is a noncommunicable disease and a cause of concern in developing and developed countries because of its high morbidity and heavy burden [1, 2], accounting for 12.7% of all-cause mortality worldwide [3]. In addition, depression can lead to other health problems including type 2 diabetes [4], cardiovascular disease [5], and suicide [6]. These comorbidities confirm the significant burden of depression. Recent years have seen rapid economic development and significant changes in all aspects of Chinese society, including population urbanization and increased education rates. However, despite these improvements, the prevalence of depression in China has continued to increase. Research has demonstrated that up to 30% of Chinese adults aged 16–60 years old suffer from depression [7], which underscores the significant burden of depression in China. Therefore, the prevention and management of depression are crucial.

Eating behaviors are critical for human health and is related to various health outcomes. Eating rate and post-dinner snacking are two prominent eating behaviors that have been extensively studied. A fast eating rate has been related to an increased prevalence of obesity, weight gain [8], and an increased risk of type 2 diabetes [9]. Similarly, post-dinner

snacking has been positively linked to hypertension [10] and cardiovascular events [11]. In contrast, several studies have explored the relationship between various eating behaviors and mental health, including breakfast consumption [12], binge eating [13], late-night eating [14], and snacking [15]. Hence, it is plausible to hypothesize that eating rate and post-dinner snacking may also be associated with depressive symptoms. For instance, Colles *et al.* [16] observed a positive correlation between depressive symptoms and nocturnal snacking in Australian adults, while Huang *et al.* [17] shown that snacking after dinner was related with depressive symptoms in Japanese adults. However, Luyao *et al.* [18] conducted a study with Chinese adults that showed no notable relationship between depressive symptoms and snacking after dinner. Furthermore, the relationship between eating rate and depression was investigated. Although these studies focused on adult populations, their results were inconsistent, and evidence regarding the relationship between eating rate and depression remains limited. Furthermore, the analysis did not consider sex differences in eating behaviors and depressive states. Several studies have demonstrated that eating behaviors and depressive states differ between men and women [19–21], highlighting the importance of separating sexes in research on eating behaviors and depression. Nevertheless, there is a limited understanding

of how eating behaviors are linked to depressive symptoms in men. Therefore, this study aimed to investigate the relationship between eating behaviors and depressive symptoms in a sample of adult Chinese men.

2. Materials and methods

2.1 Study participants

This cross-sectional study was based on data from two health examinations of adult employees in Pingfang District, Harbin, China, in 2017. During the health examinations, all personnel were invited to participate in our study. We distributed questionnaires to those who agreed to participate, and participation was voluntary. The inclusion criteria were males employed, willingness to participate in the study, and no history of mental illness or physical disability. A total of 2101 adult men underwent health examinations and agreed to participate in the study. Informed consent was obtained from 1821 men for the analysis of their data in this study. The study protocol received approval from the Human Research Ethics Committee at our Institute. After applying the exclusion criteria, including individuals taking antidepressants, receiving psychological therapy, having a physical disability, being hospitalized, or not completing the questionnaire, the final study population comprised 1552 men.

2.2 Assessment of eating behaviors

The assessment of eating behaviors was conducted through a self-administered questionnaire that comprised inquiries about the rate of eating and after-dinner snacking habits. The frequency of snacking after dinner was assessed using the following question: "How many days per week did you snack after dinner in the past 30 days?" and Participants were asked to choose their frequency of post-dinner snacking from "never", "one day per week" to "7 days per week". Based on their responses, the participants were categorized as "seldom" (less than twice/week), "sometimes" (2–5 times/week), and "always" (6–7 times/week). Eating rates were assessed by asking: "Compared with other people, how fast do you eat?" and were classified into the following categories: "very slowly", "relatively slowly", "medium", "relatively fast" and "very fast". As the number of participants in both the "very slowly" and "very quickly" categories was small, we merged the "very slow" and "relatively slow" categories into a single "slow" category, and the "relatively quickly" and "very quickly" categories into a single "fast" category.

2.3 Assessment of depressive symptoms

The assessment of depressive symptoms was conducted using the Chinese version of the Self-Rating Depression Scale (SDS). The SDS is widely used to measure depression severity and is reliable in the Chinese adult population. The SDS contains 20 self-reported questions with good internal consistency and validity and adopts most of the Diagnostic and Statistical Manual IV criteria for major depression [22, 23]. The SDS generates scores ranging from 20 to 80, with a cut-off score of 45 indicating the presence of depressive symptoms [12, 24].

Cronbach's alpha coefficient for the test score reliability of the SDS was 0.77. Moreover, The SDS has been validated for use in Chinese populations, establishing its reliability and validity [25].

2.4 Covariates

Two measurements of blood pressure were taken using an automatic device (KENTAROU HBP-9021; OMRON Co., Ltd., Tokyo, Japan) on the upper left arm after 5 min of rest in a seated position. The mean blood pressure (BP) was used for the analysis. Hypertension was defined as meeting any of the following criteria: systolic blood pressure of 140 mmHg or higher, diastolic BP of 90 mmHg or higher, or use of antihypertensive medications [26]. Diabetes was defined as a fasting blood glucose concentration of ≥ 126 mg/dL or the use of antidiabetic medications. Weight and height were measured and body mass index (BMI) was calculated as weight/height^2 (kg/m^2). Educational level was classified into two categories: lower than college level or equivalent to or higher than college level. Two categories were used to classify occupation: deskwork or others. Information on age, smoking status, drinking status, occupation, and living status was obtained using a questionnaire survey. Physical activity was assessed using the International Physical Activity Questionnaire. Total physical activity was calculated as follows: METs × hours/week [27]. Physical activity frequency was classified into three categories: low, intermediate, and high.

2.5 Statistical analyses

Statistical analyses were performed using SPSS version 24.0 for Windows (IBM Inc., New York, NY, USA), with a significance level (α) set at $p < 0.05$. The independent and dependent variables included eating behaviors and depressive symptoms, respectively. The differences between the eating behavior categories were examined using logistic regression analysis. In order to establish the relationship between eating behaviors and depressive symptoms, multivariate logistic regression analysis was performed on both unadjusted and adjusted models. Model 1 was subjected to adjustment for age and BMI, whereas model 2 underwent further adjustments for physical activity, living status, smoking and drinking status, educational level, occupation, hypertension, and diabetes mellitus to evaluate their impact on the association between eating behaviors and depressive symptoms.

3. Results

Data were obtained from 1552 participants, of whom 460 (29.6%) had depressive symptoms. The characteristics of participants according to eating behavior categories are presented in Table 1. The proportion of participants with a high BMI (≥ 28 kg/m^2) significantly increased with eating rate categories (p for trend = 0.007). In contrast, the proportions of young participants (aged <40 years) and those with a high BMI increased across the post-dinner snacking categories (p for trend <0.001 for both). The proportion of participants aged 40–49 years with normal body weight (19–24 kg/m^2) was significantly decreased across the post-dinner snacking

TABLE 1. The characteristics of the participants based on eating behaviors.

	Eating rates			
	Slow	Medium	Fast	*p* for trend
N	521	791	240	
Age (years)				
<40	32.2	25.2	44.6	0.043
40–49	27.6	27.2	27.9	0.991
≥50	40.1	47.7	27.5	0.058
BMI (kg/m^2)				
<19	3.8	3.0	1.7	0.113
19–24	48.0	57.8	46.7	0.440
24–28	38.8	30.7	34.2	0.051
≥28	9.4	8.5	17.5	0.007
PA (%)				
Low	30.7	31.5	32.5	0.618
Middle	34.9	31.2	37.1	0.950
High	34.4	37.3	30.4	0.585
Education level ≥12years (%)	35.1	27.2	31.7	0.085
Occupation (desk work; %)	41.8	42.1	47.1	0.248
Living along (%)	16.3	15.7	24.2	0.034
Smoking status (%)				
Smoker	35.7	32.4	32.5	0.271
Drinking status (%)				
Drinking everyday	31.1	34.5	32.5	0.479
Drink occasionally	54.5	48.5	46.3	0.016
No drinking	14.4	17.0	21.2	0.020
Hypertension (%)	34.4	34.4	27.5	0.123
Diabetes (%)	8.6	8.3	5.8	0.249
	Post-dinner snacking			
	Seldom	Sometimes	Always	
N	802	550	200	
Age (years)				
<40	31.2	20.2	56.5	<0.001
40–49	32.9	21.6	21.5	<0.001
≥50	35.9	58.2	22.0	0.515
Body mass index (kg/m^2)				
<19	2.7	4.0	2.0	0.897
19–24	52.9	58.0	38.0	0.029
24–28	35.2	30.9	37.5	0.844
≥28	9.2	7.1	22.5	<0.001
Physical activity (%)				
Low	31.8	30.7	31.5	0.810
Middle	33.7	30.5	40.0	0.403
High	34.5	38.7	28.5	0.555
Education level ≥12years (%)	34.5	24.4	31.5	0.018
Occupation (desk work; %)	41.4	43.3	47.0	0.154
Living along (%)	17.5	14.0	25.0	0.195

TABLE 1. Continued.

| | Post-dinner snacking | | | |
	Seldom	Sometimes	Always	
Smoking status (%)				
Smoker	33.0	33.5	35.5	0.556
Drinking status (%)				
Drinking everyday	32.7	36.2	26.0	0.398
Drink occasionally	50.7	48.4	53.0	0.933
No drinking	16.6	15.5	21.0	0.342
Hypertension (%)	31.5	36.7	31.0	0.466
Diabetes (%)	9.2	8.2	3.0	0.010

Results were obtained using Chi square test for categorical variables. Values represent percentage.

categories (p for trend <0.001 and $= 0.029$, respectively).

The relationship between eating rate and depressive symptoms is shown in Table 2. In the unadjusted model, the odds ratios (ORs) and 95% confidence intervals (95% CIs) for depressive symptoms associated with slow, medium, and fast eating rates were 1.00 (reference), 1.47 (1.15, 1.89), and 1.60 (1.14, 2.23), respectively (p for trend $= 0.002$). This significant positive association remained unchanged even after adjusting for demographic variables in Model 1 (p for trend $= 0.002$) and for lifestyle and health status in Model 2 (p for trend $= 0.006$).

The relationship between post-dinner snacking and depressive symptoms is showed in Table 3. There was no significant association observed between post-dinner snacking and depressive symptoms in either the unadjusted or the adjusted models.

4. Discussion

This study examined the relationships between eating rates, post-dinner snacking, and depressive symptoms among adult Chinese men. The findings revealed a positive relationship between fast eating and a higher incidence of depressive symptoms in the 25–68-year-old age group. This significant association remained unchanged after controlling for potential confounding variables including age, BMI, lifestyle, and health status. These results are consistent with prior research and suggest that eating rates may influence men's mental health.

Of the total participants, 29.6% experienced depressive symptoms, which is consistent with the findings of previous studies in which the prevalence of depressive symptoms in Chinese adults aged 18–93 years was 26.3% [28, 29]. However, the prevalence of depression found in our study differed from that observed in Korean (5.7%) [30] and Chinese adults aged 22–77 years (63.2%) [31]. This discrepancy between studies may be due to differences in participants, sample sizes, or depression assessments.

Previous epidemiological researches have revealed a relationship between depression and various eating behaviors including breakfast consumption, emotional eating, and food addiction [32–34]. Binge eating is also associated with depressive symptoms [35, 36]. Although the eating behaviors evaluated in the previous studies were different from those evaluated in our study, our findings showed that problematic eating behaviors are related with a high risk of depressive symptoms. In contrast, as previously mentioned, Australian and Japanese studies indicated that snacking after dinner is associated to the prevalence of depressive symptoms [16, 17], An inconclusive result was reported in a study of Chinese adults [18], which showed that no significant association exists between snacking after dinner and depressive symptoms; however, it reported that eating fast was associated with a higher prevalence of depressive symptoms which is in line with our study. These findings suggest that the association between depressive symptoms and eating behaviors may vary by country. In addition, none of the previous studies performed sex-stratified analyses. Various biological processes are hypothesized to be involved in the heightened susceptibility of women to depression, which diverge from those in men. These processes comprise fluctuations in hormones, genetically determined predisposition, and excessive reactivity to hormones in the brain's systems that regulate depressive states [21]. Therefore, it is important to analyze men and women separately. This study is the first to evaluate the association between eating rates, post-dinner snacking, and depressive symptoms in Chinese men.

The mechanisms underlying for the association between eating rates and depression are not yet fully understood. There are several explanations that may demonstrate why eating behaviors are associated with depressive symptoms. Eating slowly not only decreases hunger, increases satiety, and promotes fullness, but also to facilitates insulin secretion and suppresses glucagon [37, 38]. As a result, it can reduce the occurrence of diseases related to depressive symptoms such as diabetes, and avoid the physical discomfort caused by digestive problems due to fast eating. Alternatively, simply considering that people with good eating habits also have good lifestyle habits, which may be indirectly associated with mental health. In contrast, a previous study showed that eating fast was related to being overweight and obesity [39]. The risk of depression is known to be higher in obese individuals [40], and body weight could be a potential mediator of the relationship between eating habits and depression. In our study, eating fast and regular post-dinner snacking were correlated with a higher BMI (≥ 28 kg/m^2). BMI was included as a confounder in the data analysis. However, the results remained unchanged after adjusting for

T A B L E 2. Adjusted association between eating rates and depressive symptoms among men[a].

	Eating rate			p for trend[d]
	Slow	Medium	Fast	
N	521	791	240	
Depressive symptoms (n)	126	253	81	
Unadjusted model	1	1.47 (1.15, 1.89)[e]	1.60 (1.14, 2.23)[e]	0.002
Adjusted model 1[b]	1	1.45 (1.13, 1.87)[e]	1.61 (1.15, 2.26)[e]	0.002
Adjusted model 2[c]	1	1.39 (1.08, 1.80)[e]	1.53 (1.08, 2.16)[e]	0.006

[a] Variables are presented as estimated geometrics means (95% CI).
[b] Adjustment for body mass index, and age.
[c] Further adjustment for physical activity, living status, smoking and drinking habits, educational level, occupation, hypertension and diabetes.
[d] Derived from Multiple logistic regression analysis.
[e] Significantly different to the first category, $p < 0.05$.

T A B L E 3. Adjusted association between post-dinner snacking and depressive symptoms among men[a].

	Post-dinner snacking			p for trend[d]
	Seldom	Sometimes	Always	
N	802	550	200	
Depressive symptoms (n)	220	179	61	
Unadjusted model	1	1.28 (1.01, 1.62)	1.16 (0.83, 1.63)	0.125
Adjusted model 1[b]	1	1.27 (1.00, 1.62)	1.20 (0.84, 1.70)	0.095
Adjusted model 2[c]	1	1.24 (0.97, 1.59)	1.17 (0.82, 1.67)	0.153

[a] Variables are presented as estimated geometrics means (95% CI).
[b] Adjustment for body mass index, and age.
[c] Further adjustment for physical activity, living status, smoking and drinking habits, educational level, occupation, hypertension and diabetes.
[d] Derived from Multiple logistic regression analysis.

BMI, suggesting that BMI did not affect the association of eating behaviors with depressive symptoms in our study.

This study has several limitations. First, owing to its cross-sectional design, causal relationships between eating behaviors and depressive symptoms cannot be inferred. Therefore, prospective and interventional studies are needed to determine the causal relationships. Second, self-reporting can potentially lead to recall bias and misclassification of exposure and outcome. Third, although several confounding factors were adjusted, the potential mediating effects of other covariates could not be ruled out. Fourth, all participants were men from a single city in China; for this reason, our study may not accurately represent the general population. Finally, the physical activity data in our study were self-reported, which may have introduced bias and inaccuracies. Future studies should consider using objective measures of physical activity to improve the accuracy of data collection.

5. Conclusions

In conclusion, eating fast was related with a higher prevalence of depressive symptoms among adult Chinese men. This finding implies that speed of eating may be related with mental health among adult men and has important implications in the fields of health education and preventive medicine. Prospective and randomized studies are warranted to confirm these findings and clarify the causality. Moreover, the mechanisms underlying the link between eating behaviors and depressive symptoms are incompletely understood and require further investigation.

AUTHOR CONTRIBUTIONS

WXZ and WL—designed the research study. WL—performed the research. JJY and SLC—provided help and advice on the investigation. WXZ—analyzed the data, wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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