Original Article

# Interaction of smoking and spicy habits modifies the risk of erectile dysfunction

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**Background:** Having a spicy diet and smoking habit may be important factors causing erectile dysfunction (ED). The aim of this study is to investigate the impact of spicy diet and smoking habits on the risk of ED in men, with a focus on the interaction between these lifestyle factors.

**Methods:** Our investigation was conducted as a retrospective analysis spanning from June 2017 to June 2023. Participants underwent interviews utilizing the Structured Interview on Erectile Dysfunction (SIEDY) to evaluate the degree of pathological factors. The International Index of Erectile Function-5 (IIEF-5) was employed as a metric for assessing ED. Additionally, the subjects were comprehensively questioned about their smoking history and dietary preferences, which included an inquiry into how often they consumed spicy meals.

**Results:** Our research involved 373 participants, with 67.6% being individuals with ED. Among the participants, 50.7% were non-smokers and 49.3% were smokers, totaling 188 and 185, respectively. There was no significant difference in the spicy food frequency consumption among smokers with ED. However, non-smokers who consumed spicy food more frequently experienced more severe ED (P=0.02). ED patients showed significant differences in body mass index (BMI), blood glucose and testosterone, which were linked to vascular damage (P=0.03, P=0.02, P=0.04, respectively). Additionally, non-smokers who consumed more spicy food had higher scores on the SIEDY 2 scale, indicating marital factors (P=0.004). In non-smoking participant, a high spicy ratio indicated an even higher risk of ED [odds ratio 2.58, 95% confidence interval: 1.27–5.26; P=0.008], while there was no significant impact on ED in smoking participants (data not shown).

**Conclusions:** This retrospective study suggests that a considerable consumption of spicy foods is independently correlated with an elevated risk of ED, particularly among non-smoking men.

**Keywords:** Erectile dysfunction (ED); spicy diet; smoking habit; Structured Interview on Erectile Dysfunction (SIEDY)

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## Introduction

Erectile dysfunction (ED), also known as impotence, denotes a condition wherein individuals experience a recurrent inability to attain or maintain a penile erection that is sufficiently rigid for the completion of vaginal penetration and sexual intercourse (1). The guidelines indicate that smoking is a significant risk factor for ED (2). The etiology of ED in smokers is multifaceted and not entirely elucidated. However, it is hypothesized that the detrimental effects of cigarette smoke on hormonal balance, particularly alterations in estrogen levels, combined with dyslipidemia, endothelial dysfunction, and prothrombotic tendencies, may collectively exacerbate the risk and severity of ED (3). Smoking is associated with reduced bioavailability of nitric oxide (NO) and increased production of reactive oxygen species (ROS), which can also lead to the occurrence of ED (4). Also, other risk factors that are known to cluster with smoking, such as poor dietary habits and lack of physical activity, may significantly increase the risk of ED of smokers. In addition, it's not just traditional cigarettes; studies have shown that e-cigarettes are also closely associated with the occurrence of ED (5).

To prevent or treat ED, individuals can adopt to better lifestyles such as avoiding a sedentary lifestyle, quitting smoking, losing weight, adjusting dietary habits (including meal size and timing), and avoiding certain foods. Many studies have demonstrated a similar pathogenesis for ED and cardiovascular disease (CVD), involving endothelial dysfunction and atherosclerosis (6). Research indicates that a diet with the right amount of spice can provide protection against CVD (7). However, in the province of Hunan, China, people often consume excessive amounts of spicy food. Therefore, comprehending the impact of an excessive intake of spicy food on ED is crucial, particularly in terms of the potential link between a spicy diet and smoking.

The objective of the present study was to examine the relationship between the extent of ED and the frequency of spicy food consumption, while considering the impact of smoking, which is a known risk factor for ED. In order to examined this association, our study conducted an analysis with subjects of Chinese men attending an andrology outpatient clinic. To analyze each patient's diet habits (Including frequency of vegetables, pork, beef and mutton, fruits, freshwater fish, seafood, betel nut, spicy food, sweet food, snacks and take-out food), ED degree, work pressure, psychological symptoms and other related indicators, we utilized a combination of various questionnaires. We present this article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-24-26/rc).

### Highlight box

**Key findings**

- Non-smokers who consumed spicy food more frequently experienced more severe erectile dysfunction (ED).
- Eating spicy food more than 3 times a week was linked to a higher risk of ED in non-smokers.
- A high spicy food intake frequency was associated with psychological factor and lower testosterone levels in non-smokers.

**What is known and what is new?**

- Smoking is a significant risk factor for ED.
- ED shares pathophysiological links with cardiovascular disease (CVD).
- Spicy food consumption has been associated with CVD in some studies.
- The study suggests that frequent spicy food consumption may independently increase the risk of ED, especially among non-smokers.
- The inverse relationship between spicy food consumption and testosterone levels was identified in non-smokers.
- The study found that higher spicy food frequency was associated with more severe ED in non-smokers which may be related to psychological factors.

**What is the implication, and what should change now?**

- This study indicates the association between spicy diet and ED, particularly among non-smoking men. Hence, dietary habits for non-smoking men with ED may need to be adjusted to consider the impact of spicy food intake.

## Methods

The research including a cohort of 674 individuals who came to andrology clinics of Xiangya Hospital from June 2017 to June 2023. ED patients had been suffering from ED for a minimum of 6 months. The healthy control group participants include males with other sexual dysfunctions without ED, or those who came for a physical examination. After eliminating participants who unwilling to participate in the study (n=62), did not finish the questionnaire (n=213) or had a mental illness (n=26), we included 373 patients in our study. The study flowchart is shown in *Figure 1*. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Xiangya Hospital (No. 2019-S252) and informed consent was taken from all the participants.

 

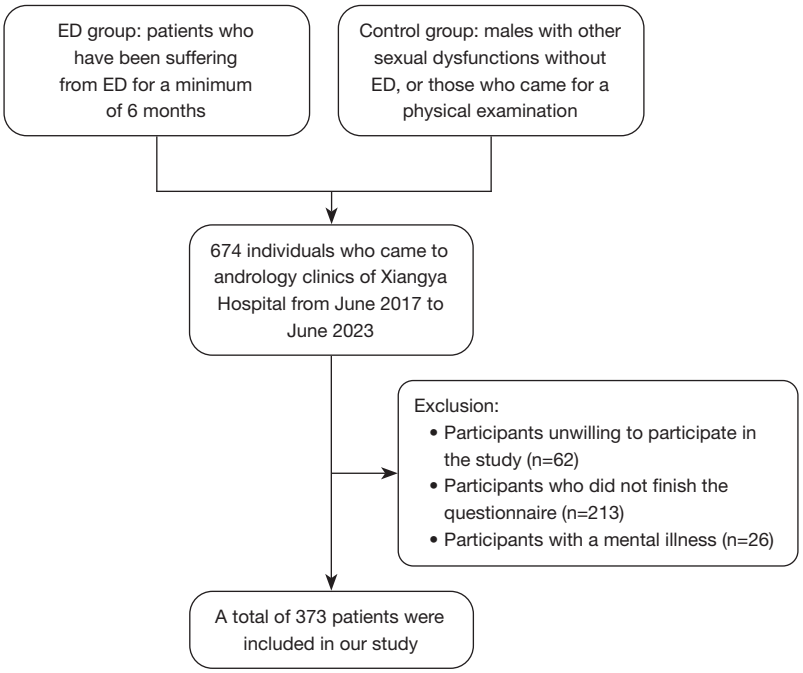


**Figure 1** Study flowchart for enrollment of patients. ED, erectile dysfunction.

Participants in the study were asked to complete detailed questionnaires before receiving any diagnosis or treatment. The questionnaires incorporated questions pertaining to demographic data, dietary habits, and the Structured Interview on Erectile Dysfunction (SIEDY) (8). The SIEDY questionnaire was employed to assess the influence of organic, relational, and psychopathological factors on ED. Comprising 13 items across three scales, the SIEDY is designed to pinpoint and quantify elements associated with ED. Scale 1, which spans scores from 0 to 12, centers on organic aspects, with scores of 4 or above signaling the existence of organic issues. Scale 2, also ranging from 0 to 12, targets marital factors, with scores of 2 or more indicating relationship difficulties. Scale 3 is dedicated to psychopathological elements.

Study participants completed the International Index of Erectile Function-5 (IIEF-5), a validated tool for assessing the degree of ED (9). The IIEF-5 scores were stratified to classify the severity of ED as follows: a score of 22–25 indicating no ED, 16–21 indicating mild ED, 12–15 indicating mild-to-moderate ED, and 5–11 indicating moderate-to-severe ED. All participants also completed questionnaires about their dietary and lifestyle habits. We asked participants about their usual eating habits in detail, including consumption of vegetables, pork, beef and mutton, fruits, freshwater fish, seafood, betel nut, spicy food, sweet food, snacks and take-out food, which provided a comprehensive understanding of their dietary conditions. For common food items including pork, beef and mutton, vegetables and take-out food, there were five options: consume in every meal; consume twice a day, consume once a day, consume 3–5 times a week and do not consume at all, respectively. For the other diets, there were also five options: eat every day, eat often, eat occasionally, eat rarely and do not eat at all. Concurrently, participants were requested to fill out the Generalized Anxiety Disorder-7 (GAD-7) questionnaire to evaluate the presence and severity of anxiety symptoms, as well as the Patient Health Questionnaire-9 (PHQ-9) to ascertain the presence and extent of depressive symptoms (10,11). The PHQ-9 questionnaire is used to screen for depression. It contains 9 questions, each rated on a 4-point scale from 0 to 3, with a total score ranging from 0 to 27. Higher scores indicate more severe depressive symptoms. The GAD-7 questionnaire is designed to screen for anxiety disorders in medical settings. It contains 7 questions, each rated on a 4-point scale from 0 to 3, with a total score ranging from 0 to 21. Higher scores indicate greater anxiety symptoms.

All participants underwent comprehensive physical assessments, which comprised of the measurement of body weight, stature, blood pressure, pulse rate, respiratory rate, and daily sedentary behavior. Additionally, body

 

**Table 1** Association between the basic data and ED

| Characteristics | Without ED (n=121) | With ED (n=252) | P |
|---|---|---|---|
| Age (years) | 31.54±8.05 | 33.80±7.44 | 0.008* |
| BMI (kg/m$^2$) | 22.90±3.66 | 23.78±3.64 | 0.03* |
| Height (cm) | 172.15±10.61 | 170.62±8.07 | 0.13 |
| Weight (kg) | 67.43±10.12 | 69.15±11.29 | 0.16 |
| Systolic pressure (90–139 mmHg) | 122.60±10.23 | 122.68±12.22 | 0.96 |
| Blood sugar (3.9–6.1 mmol/L) | 5.20±0.59 | 5.59±1.70 | 0.02* |
| Cholesterol (2.8–5.17 mmol/L) | 4.78±0.94 | 4.99±1.31 | 0.13 |
| Triglyceride (0.56–1.7 mmol/L) | 1.96±2.00 | 1.75±1.04 | 0.20 |
| HDL (1.08–1.91 mmol/L) | 1.20±0.36 | 1.17±1.28 | 0.39 |
| LDL (2.07–3.37 mmol/L) | 2.98±0.67 | 3.15±0.81 | 0.07 |
| FSH (0.95–11.95 U/L) | 4.46±2.47 | 4.38±2.32 | 0.77 |
| LH (1.2–7.8 U/L) | 5.16±1.87 | 5.00±2.10 | 0.50 |
| PRL (1.61–18.77 ng/mL) | 13.53±7.60 | 12.33±7.73 | 0.18 |
| Testosterone (9.45–37.45 nmol/L) | 19.85±6.17 | 13.82±6.83 | 0.04* |
| PHQ-9 | 5.68±4.53 | 7.14±5.00 | 0.007* |
| GAD-7 | 5.15±4.26 | 5.84±4.63 | 0.17 |
| SIEDY-1 | 2.11±1.77 | 3.59±2.12 | <0.001** |
| SIEDY-2 | 3.98±2.36 | 4.26±2.32 | 0.30 |
| SIEDY-3 | 6.94±1.79 | 7.07±1.74 | 0.51 |

Data are expressed as the mean ± SD. *, P<0.05; **, P<0.001. ED, erectile dysfunction; SD, standard deviation; BMI, body mass index; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FSH, follicle-stimulating hormone; LH, lutropin; PRL, prolactin; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7; SIEDY, Structured Interview on Erectile Dysfunction.

mass index (BMI) was calculated, and the prevalence of diabetes mellitus, hypertension, and hyperlipidemia was documented. Additionally, liver function, vitamin D, sex hormone binding protein (SHBG), and other laboratory tests were conducted. The laboratory testing was done without knowledge of the participants' situation.

### *Statistical analysis*

The data were presented as the mean ± standard deviation for normally distributed variables and as medians (quartiles) for variables with a non-normal distribution. Differences in normally distributed variables were analyzed using Student's *t*-test, while non-normally distributed variables were compared using the Wilcoxon rank-sum (Mann-Whitney *U*) test. The chi-squared test was used to compare differences in categorical variables between participant groups. Spearman's or Pearson's method was used for linear analysis. All statistical analyses were performed using SPSS 22.0 for Windows. A P value less than 0.05 was considered statistically significant. We used G-power software to calculate the sample size we needed. Our parameters were: tail: two, effect size: 0.5, α err prob: 0.05, power: 0.95. The final calculation results showed that at least 42 samples were needed per group.

## Results

### *Comparison of the characteristics of patients with ED*

*Table 1* displays the connections between the primary sociodemographic, clinical, and biochemical characteristics and ED. Out of the total of 373 patients, 67.6% reported experiencing ED. In the analysis, it was found that ED

 

**Table 2** Association between the basic data and smoke

| Characteristics | No smoking (n=188) | Smoking (n=185) | P |
|---|---|---|---|
| Age (years) | 33.30±8.25 | 32.79±7.14 | 0.53 |
| BMI (kg/m$^2$) | 23.05±3.42 | 23.97±3.88 | 0.02* |
| IIEF-5 | 16.81±5.66 | 16.30±5.82 | 0.39 |
| Hemoglobin (g/L) | 154.96±10.18 | 160.34±10.36 | <0.001** |
| Systolic pressure (mmHg) | 123.37±11.71 | 121.66±11.36 | 0.30 |
| Blood sugar (3.9–6.1 mmol/L) | 5.34±0.81 | 5.50±1.61 | 0.27 |
| Cholesterol (2.8–5.17 mmol/L) | 4.96±1.36 | 4.86±1.01 | 0.49 |
| Triglyceride (0.56–1.7 mmol/L) | 1.65±1.52 | 1.99±1.32 | 0.03* |
| HDL (1.08–1.91 mmol/L) | 1.27±0.37 | 1.19±0.20 | <0.001** |
| LDL (2.07–3.37 mmol/L) | 3.07±0.77 | 3.11±0.76 | 0.66 |
| FSH (0.95–11.95 U/L) | 4.65±2.62 | 4.07±1.90 | 0.02* |
| LH (1.2–7.8 U/L) | 5.14±2.13 | 4.93±1.93 | 0.35 |
| PRL (1.61–18.77 ng/mL) | 13.91±8.76 | 11.54±8.27 | 0.004* |
| Vitamin D (26–65 ng/mL) | 27.75±8.88 | 26.67±8.80 | 0.29 |

Data are expressed as the mean ± SD. *, P<0.05; **, P<0.001. SD, standard deviation; BMI, body mass index; IIEF, International Index of Erectile Function; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FSH, follicle-stimulating hormone; LH, lutropin; PRL, prolactin.

patients were notably older (P=0.008). Additionally, there were significant increases in BMI and blood glucose, which are associated with vascular damage, among ED patients (P=0.03, P=0.02 respectively). The PHQ-9 score, indicating depressive symptoms, also showed a significant increase (P=0.007). On the other hand, the testosterone level in ED patients decreased significantly. In our study, only the SIEDY-1 score exhibited a significant difference (P<0.001).

### *Comparison of the characteristics of patients with and without smoking*

The association between participants' characteristics and smoking is shown in *Table 2*. The BMI of non-smoking participants and smoking participants were 23.05 and 23.97 kg/m$^2$, and the high-density lipoprotein (HDL) levels were 1.27 and 1.19 mmol/L, respectively. These two indicators of vascular injury showed a significant difference between smoking and non-smoking participants (P=0.02, P<0.001). In addition, the follicle-stimulating hormone (FSH) and prolactin (PRL) levels of smoking participants were significantly lower than those of non-smoking participants (P=0.02, P=0.004). Interestingly, in our study, although IIEF-5 of smoking participants decreased compared with non-smoking participants, there was no significant difference (P=0.39). However, ED was found to be serious with the increase of smoking after grouping according to the number of cigarettes per day (data not shown). GAD-7 and PHQ-9 scores representing anxiety and depression were also not associated with smoking (data not shown).

### *Differences in dietary sequencing between ED and control groups*

The eating habits of ED patients and control patients are shown in *Figures 2,3*. The frequency of eating fruit in the ED group was significantly lower than that in the normal population (P=0.048). Although no significant difference was found between the ED group and the control group, the ED group had a more frequent tendency to eat pork and spicy food than the control group (P=0.10, P=0.06). In addition to fruits, pork and spicy food habits, no significant difference was found in the other dietary indicators between the two groups of participants in our study.

 

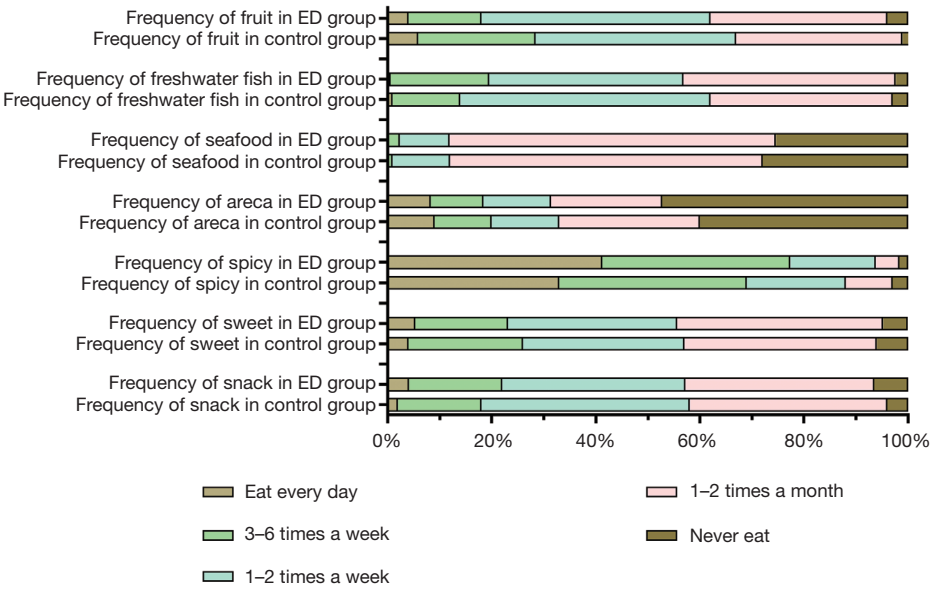


**Figure 2** Comparison of diet of patients with ED and negative control group. ED, erectile dysfunction.

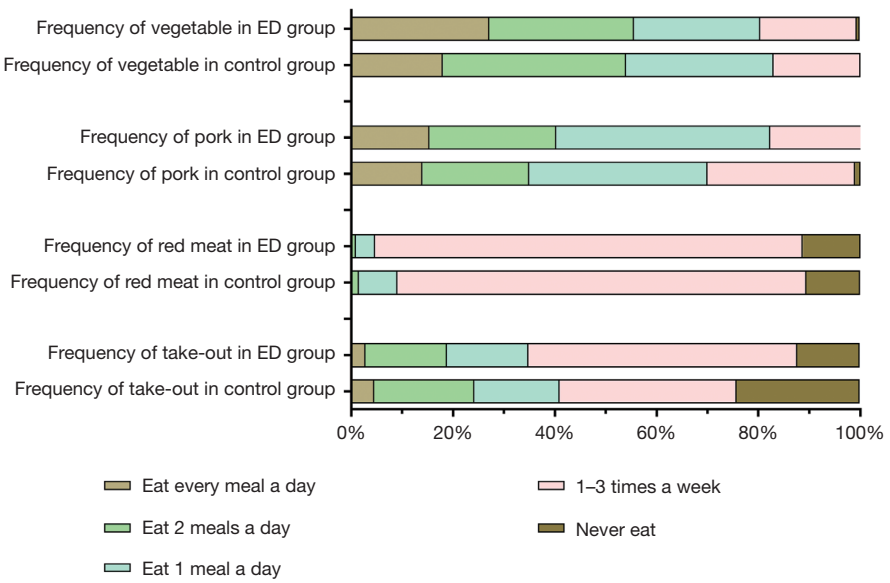


**Figure 3** Comparison of routine diet between ED patients and negative control group. ED, erectile dysfunction.

### *Comparison of spicy food consumption and endocrine parameters in smokers and non-smokers*

Next, we conducted a comparison between smokers and non-smokers to examine the connection between spicy food consumption and endocrine parameters. The findings are presented in *Tables 3*,*4*. Among participants who had never smoked or had quit smoking for over a year, an increase in spicy food consumption frequency was linked to a significant increase in BMI, indicating a potential association between spicy food consumption and organic diseases (P=0.053). Additionally, testosterone levels, which serve as indicators of endocrine factors, decreased significantly with an increase in spicy food consumption frequency (P=0.045). In smoking patients, there was no relationship observed between BMI, testosterone levels and spicy food frequency (P=0.65, P=0.58).

 

**Table 3** The association of characteristics between the spicy diet and ED in non-smoking group

| Characteristics | Eat spicy food everyday (n=75) | Eat spicy food 3–6 days a week (n=47) | Eat spicy food less than 3 days a week (n=66) | P |
|---|---|---|---|---|
| Age (years) | 34.51±7.21 | 31.70±7.46 | 32.45±8.94 | 0.12 |
| BMI (kg/m$^2$) | 23.51±3.11 | 22.78±2.87 | 21.61±4.03 | 0.053 |
| Hemoglobin (120–160 g/L) | 154.58±7.81 | 156.33±9.53 | 154.27±12.84 | 0.58 |
| LDL (2.07–3.37 mmol/L) | 3.12±0.76 | 3.07±0.95 | 3.01±0.63 | 0.74 |
| Vitamin D (26–65 ng/mL) | 27.24±9.75 | 28.54±8.30 | 27.66±8.46 | 0.77 |
| Cholesterol (2.8–5.17 mmol/L) | 4.99±1.01 | 4.92±1.32 | 4.97±1.72 | 0.97 |
| Triglyceride (0.56–1.7 mmol/L) | 1.72±1.46 | 1.68±1.94 | 1.57±1.22 | 0.87 |
| Testosterone (9.45–37.45 nmol/L) | 17.12±6.97 | 19.01±6.05 | 19.72±6.05 | 0.045* |

Data are expressed as the mean ± SD. *, P<0.05. ED, erectile dysfunction; SD, standard deviation; BMI, body mass index; LDL, low-density lipoprotein.

**Table 4** The association of characteristics between the spicy diet and ED in smoking group

| Characteristics | Eat spicy food everyday (n=72) | Eat spicy food 3–6 days a week (n=74) | Eat spicy food less than 3 days a week (n=39) | P |
|---|---|---|---|---|
| Age (years) | 33.00±8.38 | 33.19±7.68 | 33.70±6.74 | 0.94 |
| BMI (kg/m$^2$) | 24.29±3.14 | 23.69±5.18 | 24.48±3.57 | 0.65 |
| Hemoglobin (120–160 g/L) | 161.93±7.89 | 158.61±10.65 | 165.92±13.76 | 0.02* |
| LDL (2.07–3.37 mmol/L) | 3.02±0.73 | 3.17±0.82 | 3.30±0.61 | 0.32 |
| Vitamin D (26–65 ng/mL) | 27.01±9.16 | 25.67±8.52 | 28.66±10.11 | 0.41 |
| Cholesterol (2.8–5.17 mmol/L) | 4.82±1.04 | 4.89±1.06 | 5.13±0.81 | 0.52 |
| Triglyceride (0.56–1.7 mmol/L) | 1.79±1.60 | 1.70±2.03 | 1.55±1.31 | 0.44 |
| Testosterone (9.45–37.45 nmol/L) | 18.98±7.13 | 19.26±6.54 | 17.50±5.66 | 0.58 |

Data are expressed as the mean ± SD. *, P<0.05. ED, erectile dysfunction; SD, standard deviation; BMI, body mass index; LDL, low-density lipoprotein.

### *Comparison of questionnaire results and spicy food intake frequency in smokers and non-smokers*

*Figures 4*,*5* shows the relationship between spicy eating frequency and several questionnaire results among non-smokers and smokers respectively. Our study revealed that there was no significant difference in the relationship between ED and spicy food consumption frequency among smokers (P=0.55). However, among non-smokers, a higher spicy food frequency consumption was associated with a more severe degree of ED (P=0.02). Interestingly, participants in non-smokers who consumed more spicy food had significantly higher scores on the SIEDY-2 scale, suggesting a significant correlation between spicy food consumption and damage to the husband-wife relationship (P=0.004). In addition, SIEDY-1, which indicates organic damage, SIEDY-3, which indicates psychological factors, and anxiety scores were not found to be significantly associated with the spicy food frequency consumption.

### *Risk of spicy consumption in non-smoking participant*

We revealed the association of eating spicy food for more than 3 times per week with an increased risk of ED and related psychological disorders in non-smokers. In patients with non-smoking, there was a significant positive correlation with spicy frequency and the severity of ED, SIEDY-2 scores, and GAD-7 score (P=0.02, P=0.03, P=0.045 respectively) (showed in *Figure 6*). *Figure* 7 shows risk of spicy consumption in non-smoking participants. In non-smoking group, more than 3 times a week the spicy

 

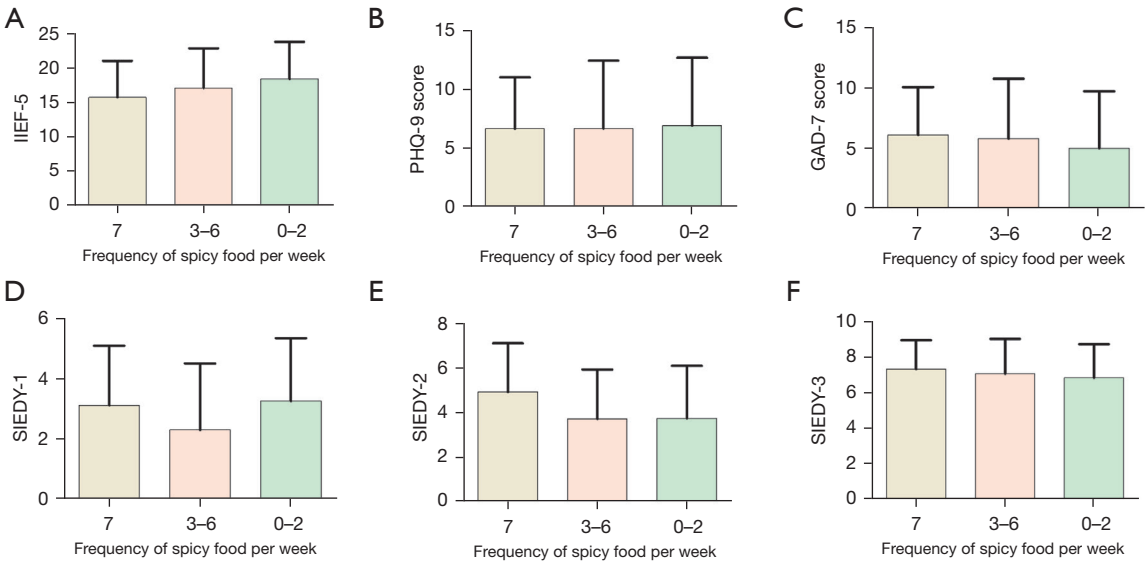


**Figure 4** The levels of (A) IIEF-5, (B) PHQ-9, (C) GAD-7, (D) SIEDY-1, (E) SIEDY-2, and (F) SIEDY-3 in different spicy eating frequency among non-smokers. IIEF, International Index of Erectile Function; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7; SIEDY, Structured Interview on Erectile Dysfunction.

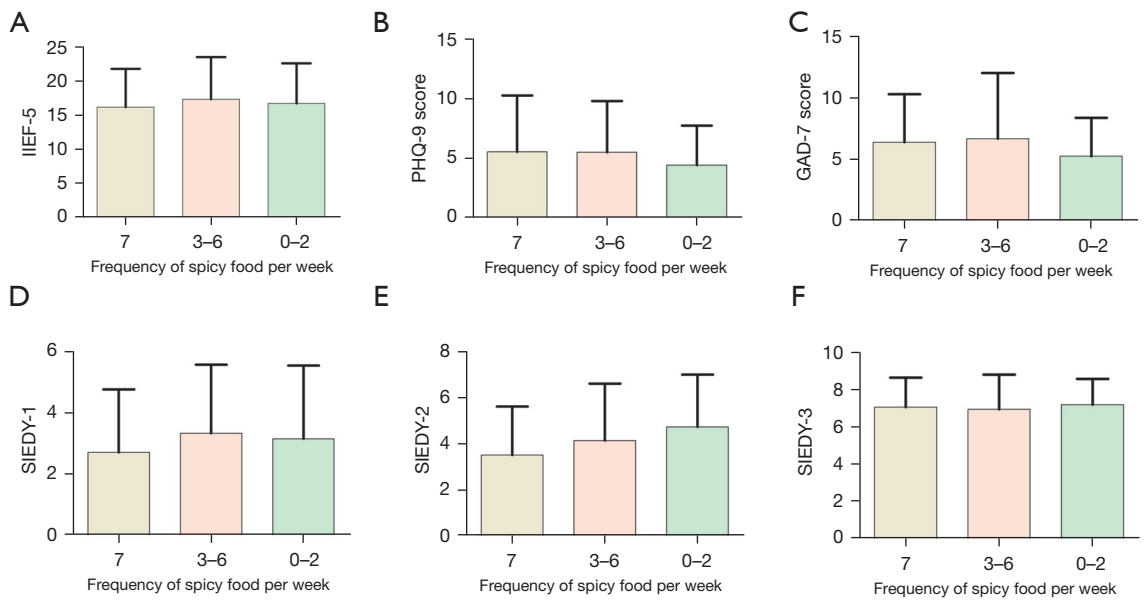


**Figure 5** The levels of questionnaire score in different spicy eating frequency among smokers. (A) The levels of IIEF-5 in different spicy eating frequency among smokers; (B) the levels of PHQ-9 in different spicy eating frequency among smokers; (C) the levels of GAD-7 in different spicy eating frequency among smokers; (D) the levels of SIEDY-1 in different spicy eating frequency among smokers; (E) the levels of SIEDY-2 in different spicy eating frequency among smokers; (F) the levels of SIEDY-3 in different spicy eating frequency among smokers. IIEF, International Index of Erectile Function; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7; SIEDY, Structured Interview on Erectile Dysfunction.

 

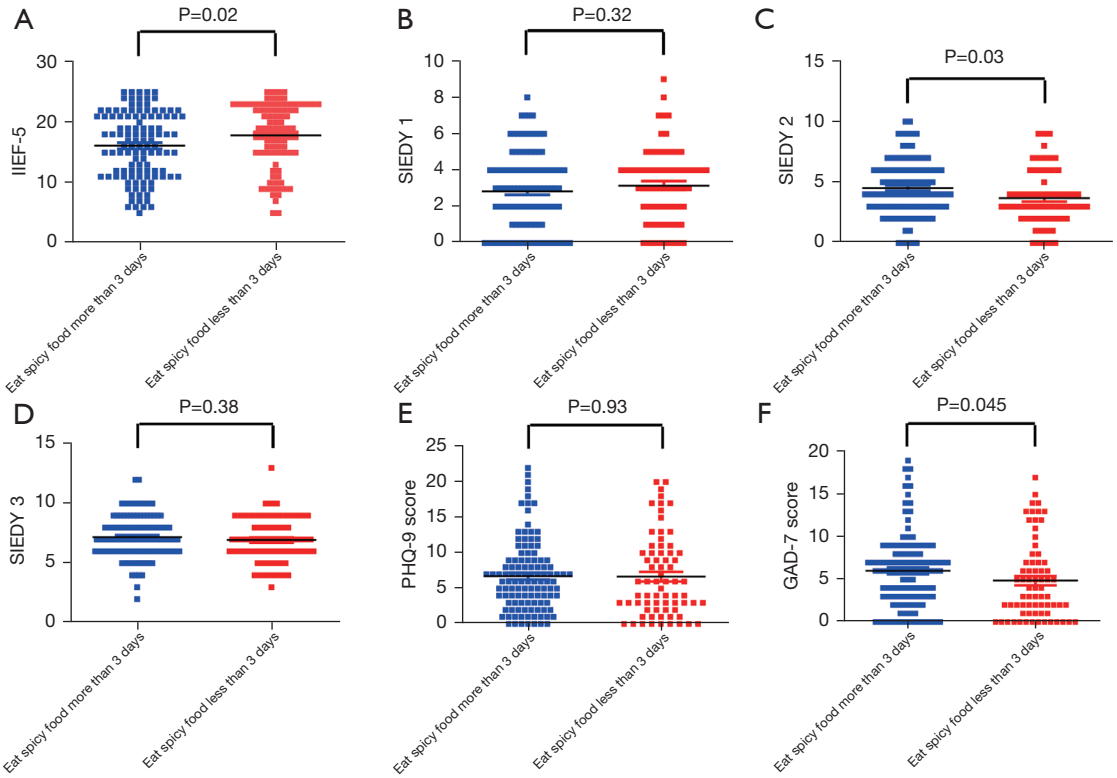


**Figure 6** Scale score of different spicy diet frequency. IIEF-5, SIEDY-1, SIEDY-2, SIEDY-3, PHQ-9 and GAD-7 score of different degree of erectile dysfunction. IIEF, International Index of Erectile Function; SIEDY, Structured Interview on Erectile Dysfunction; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7.

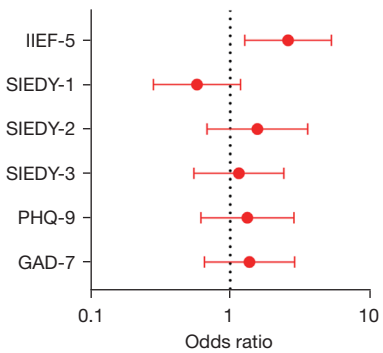


**Figure 7** OR and CI of the effect of spicy eating frequency on IIEF-5, SIEDY-1, SIEDY-2, SIEDY-3, PHQ-9 and GAD-7 score. IIEF, International Index of Erectile Function; SIEDY, Structured Interview on Erectile Dysfunction; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7; OR, odds ratio; CI, confidence interval.

intake was associated with a 158.6% higher ED risk [odds ratio (OR) 2.58, 95% confidence interval (CI): 1.27–5.26; P=0.008]. According to this model, the risk of relationship damage and the risk of anxiety and depression were 1.5 and 1.3 times or more in non-smoking participant consuming spicy food for 3 times or more per week, respectively (OR 1.56, 95% CI: 0.68–3.57, P=0.07; OR 1.33, 95% CI: 0.62–2.84, P=0.09; OR 1.37, 95% CI: 0.66–2.88, P=0.09).

## Discussion

To the best of our knowledge, this study represents the first exploratory analysis examining the interaction between the consumption of major spicy food groups and smoking habits in relation to the prevalence of ED. The findings indicate that spicy food consumption may have a significant impact

 

on the incidence of ED, especially among non-smoking males. In contrast, no significant correlation was found between spicy eating frequency and ED in smoking men. Evidence from observational studies suggests that there is a positive dose-response association between the quantity and duration of smoking and the risk of ED (3).

Certainly, this analysis does not facilitate the delineation of the precise dietary components within spicy foods that contribute to the adverse effects observed in male smokers. Chili pepper, as a flavor-enhancing spice, has been ubiquitously used in cuisines worldwide, and its products and bioactive ingredients are being extensively studied (12).

Since the initial proposal by the Princeton I conference in June 1999 that individuals with high-risk ED may be susceptible to cardiovascular complications, an abundance of research has emerged linking CVDs to the onset and progression of ED (13-15). Conditions such as diabetes mellitus, hypertension, hyperlipidemia, and smoking are well-recognized as pivotal risk factors for cardiovascular pathogenesis, and these factors have a direct and detrimental effect on vascular functionality (14). Moreover, numerous studies have substantiated that these same risk factors are indeed applicable to the development of ED, underscoring the interconnected pathophysiology of cardiovascular health and sexual dysfunction (16,17). Vascular damage caused by factors including diabetes and a high-fat diet are important factors in the progression of ED (18,19). However, it is established that capsaicin stimulates transient receptor potential (TRP) channels, thereby potentially initiating intracellular pathways that combat obesity by modulating mediators of lipolysis and thermogenesis (20). The attenuated risk of obesity may confer a decreased incidence of other cardiometabolic disorders (21). Furthermore, the antioxidative and anti-inflammatory attributes of capsaicin have been documented in various studies (22).

Contrary to the study of CVD, our results showed that the frequency of eating spicy food can promote the occurrence of ED in the Chinese population. First, the number of studies on the spicy consumption and CVD was small, which have not been studied in the Chinese Han population. The results may be different due to the ethnic differences between the Han population and the Western population. Secondly, it is recognized that the cardiovascular system is replete with sensory nerves that are sensitive to capsaicin, implying that capsaicin may play a role in modulating cardiovascular functions (23). However, this only plays a role in the cardiovascular system. Capsaicin may not play a key regulatory role in other blood vessels of the human body, including cerebral vessels and penile cavernous vessels, etc. Finally, considering the variability in dietary habits across the included countries, the definition of what is considered "spicy" may differ. People in Hunan eat spicy food to a great extent, and very spicy food may further promote the occurrence of ED.

The correlation between chronic prostatitis (CP) and ED may also be a factor that affects spicy eating habits and promotes the occurrence of ED. A large number of literatures have found the correlation between CP and ED. Consumption of spicy foods is acknowledged as a contributing factor to the susceptibility of chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS). Zhang *et al.* have established that physical/chemical occupational hazards and the gastrointestinal discomfort induced by the consumption of spicy foods, are strongly correlated with the incidence and progression of symptoms consistent with CP/CPPS (24). A subsequent analysis evaluated a total of 176 edible products and found spicy foods as the principal trigger for symptom exacerbation in patients with CP/CPPS (25). Capsaicin, the compound responsible for the pungency in hot peppers, has been observed to enhance rectal sensory perception in individuals with irritable bowel syndrome (IBS), a condition that is frequently comorbid with CP/CPPS and painful bladder syndrome/interstitial cystitis (PBS/IC), exhibiting prevalence rates of 22.4% and 40–52.6%, respectively (25). Eating spicy food may exacerbate ED by causing CP/CPPS, which also explains the increase in SIEDY 1 scores among people who eat spicy food.

Testosterone, a crucial male sex hormone, plays a vital role in sexual function and libido. It has been established that testosterone deficiency, known as hypogonadism, can lead to sexual dysfunction, including ED (26). In our study, we observed that the frequency of eating spicy food was inversely related to testosterone levels among non-smokers. The potential link between testosterone and spicy food consumption has been previously noted. Bègue *et al.* demonstrated that testosterone levels predicted spicy food preference in men, indicating a possible connection between testosterone and spicy food intake (27). This also explains that the intake of spicy foods can affect the occurrence of ED through testosterone.

Our results showed that among non-smoking men, the higher spicy frequency eating, the higher the severity of ED. However, no significant difference was found among male smokers. In our study, the frequency of eating spicy food may be related to psychological symptoms. People who eat spicy food more frequently have higher levels of

 

SIEDY-2, which indicates that the relationship between spouses is worse (28). This may be because the hot pepper in Hunan is very hot. Men in Hunan who eat hot pepper frequently tend to form an irritable character, which is prone to quarrels and disharmonious family relations. Research has already proven that there is a positive correlation between frequent consumption of spicy food and anxiety symptoms in adolescents (29). SIEDY-2 has been shown to be proportional to the severity of ED. One possible rationale for the observed correlation between a preference for spicy foods and general obesity is linked to culinary practices, such as the higher oil content commonly used in the preparation of chili sauces, and the use of chili oil as a seasoning in Chinese cooking. Additionally, the consumption of spicy dishes may be accompanied by a higher intake of carbohydrate-laden foods to mitigate the sensation of heat, potentially leading to greater weight gain over time. And other studies have demonstrated that the relationships are more pronounced in the absence of smoking and alcohol consumption, a conclusion that concurs with the findings of our current research.

Our previous research shows that young Chinese men are more likely to suffer from psychogenic mild ED, which may be related to conservative sex education in China (30). A study showed significantly higher IIEF-5 scores in patients with psychogenic ED versus organic ED, with most cases of mild ED being psychogenic (31). Most of our participants were under 40 years old. ED in these young men is more likely to be psychogenic than organic, which can explain why men who eat spicy food frequently is of more serious ED severeness in China.

Chili pepper is a widely consumed spice, particularly favored by Asian, including Chinese, populations. Hunan Province boasts the highest consumption of chili in China, with an impressive 99.7% of residents reporting weekly intake of spicy foods (32). Our study elucidates the mechanisms underlying the relationship between spicy food consumption and ED in Chinese populations, focusing on the aspects of energy balance, appetite regulation, and fat oxidation.

The advantage of our research lies in being the first Chinese study to investigate the association between spicy food consumption and ED in both smokers and non-smokers, and our results can be used as a guide for the dietary habits of patients with ED. The primary limitation of our research is that this cross-sectional design merely established an association between spicy food consumption and ED, without delineating a causal relationship. Subsequent investigations are necessary to corroborate this association.

## Conclusions

Our investigation revealed that among Chinese non-smoking male outpatients, those with more severe ED showed more spicy diet. For Chinese males, the non-smoking population may necessitate a higher threshold of spicy food intervention compared to smokers to enhance therapeutic efficacy.

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## Footnote

*Reporting Checklist:* The authors have completed the STROBE reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-24-26/rc

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*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-24-26/coif). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Xiangya Hospital (No. 2019-S252) and informed consent was taken from all the

 

participants.



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