

# *A Meta-Analysis of the Prevalence of Peptic Ulcer in Chinese Adults*

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**Abstract:** Peptic ulcer is a common digestive system disease, with a high incidence and easy recurrence, complications, and even life-threatening, has a serious impact on the physical and mental health of patients, and the current prevalence of peptic ulcer in Chinese adults is different, has not been paid attention to by clinical doctors. **Objective** To systematically evaluate the prevalence of peptic ulcer in Chinese adults in order to increase clinical attention. **Methods** The computer searched Chinese databases (CNKI, VIP, WanFang Data, CBM) and foreign language databases (PubMed, Web of Science, EMBASE, The Cochrane Library,) for cross-sectional studies of CHINESE adult PU until January 2022. The included literature was evaluated for quality and data extraction, and statistically analyzed using Stata 15.0 software. **Results** A total of 8 studies, including 29573 participants, were included. Meta-analysis shows that the overall prevalence of peptic ulcer in Chinese adults is 9% [95% CI (6%-11%)]. Subgroup analysis showed that the prevalence of gastric ulcers was 10.0% (95% CI (7%, 13.0%)) in men and 5% (95% CI (3%, 6%)) in women by sex; the prevalence of gastric ulcers was 8.0% (95% CI (2%, 18.0%)) in terms of location, 13% (95% CI (8%, 19%)), and in terms of regional distribution, the prevalence of southern ulcers was 9.0% (95% CI (5.0%, 12.0%)), northern region prevalence 9.0% [95% CI (2.0%, 17.0%)]; In terms of age distribution, the prevalence of age  $\geq 61$  years, 51-60 years, 41-50 years, 31-40 years, and  $\leq 30$  years was 4.0% [95% CI (0%, 7.0%)], 9.0% [95% CI (0%, 19.0%)], 8.0% [95% CI (1.0%, 15.0%)] and 7.0% [95% CI (2.0%, 13.0%)] and 25.0% [95% CI (16.0%, 34.0%)] In terms of occupational types, the prevalence of soldiers, students, workers, and peasants was 1.0% [95% CI (1.0%, 2.0%)], 29.0% [95% CI (24.0%, 33.0%)], 18.0% [95% CI (7.0%, 28.0%)] and 4.0% [95% CI (1.0%, 7.0%)], respectively; in terms of survey time, the prevalence rate before 2000 was 15.0% [95% CI (4.0%, 26.0%)] , prevalence after 2000 was 5.0% [95% CI (3.0%, 7.0%)]; **Conclusion** The prevalence of PU in adults in China is high, and there are differences in the prevalence of different genders, occupations and regions. Although there is a gradual downward trend, it is easy to recur and has many complications, so it is still necessary to be vigilant.

## 1. Introduction

Peptic ulcer (PU) refers to inflammation and necrosis lesions of the gastrointestinal mucosa

caused by various pathogenesis, mainly the stomach and duodenum <sup>[1]</sup>, which is a common digestive system disease. The main clinical manifestations of the disease are abdominal pain, bloating, nausea, belching, acid reflux, etc., of which abdominal pain is the main symptom, and the pain site is mainly the epigastric region, and the pain is chronic, cyclical, rhythmic <sup>[2]</sup> attacks. The incidence of PU is high, with epidemiological studies showing that about 10 to 12 percent of people develop peptic ulcers throughout their lives, with a prevalence of about 16 percent in men and 4 percent in women <sup>[3]</sup>. The disease often recurs and has many complications, such as ulcer bleeding, perforation, pyloric obstruction, etc. <sup>[4]</sup>, which are even life-threatening and have a huge impact on the physical and mental health of patients. At present, the prevalence of peptic ulcer in Chinese adults is mixed, with survey studies showing 13.83% in Beijing <sup>[5]</sup>, Tianjin 17.03% <sup>[6]</sup>, Guangzhou 19.72% <sup>[7]</sup>, Shiyan in Hubei 14.29% <sup>[8]</sup>, and Kunming 10.43% <sup>[9]</sup>. Therefore, epidemiological research on the overall PU prevalence of adults in China has not yet formed a unified consensus, so it is difficult to get full attention from clinical doctors and patients. On this basis, this study collected cross-sectional studies of pu prevalence among adults in China, and analyzed them for different subgroups in order to accurately understand the PU prevalence of adults in China and help to better prevent and treat them.

## 2. Information and Methods

### 2.1. Literature search strategy

The system searches Chinese databases (CNKI, VIP, WanFang Data, CBM) and foreign language databases (PubMed, Web of Science, EMBASE, The Cochrane Library), and the search time limit is until January 2022. At the same time, the citations included in the literature are searched to ensure the comprehensiveness of the literature. Chinese search terms include: peptic ulcer, ulcer disease, gastric ulcer, duodenal ulcer, prevalence, incidence, epidemiology, etc. English search terms include: Epidemiology, prevalence, China, Chinese, Peptic Ulcer, pep\* AND ulcer, stomach AND ulcer\*, duoden\* AND ulcer\*, gastr\* AND ulcer\*. Taking PubMed as an example, the specific search strategy is shown in Table 1.

Table 1: PubMed retrieval policy

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|                                |
|--------------------------------|
| #1 China [Mesh]                |
| #2. China OR Chinese           |
| #3. #1 OR #2                   |
| #4. Peptic Ulcer [Mesh]        |
| #5. ( pep* AND ulcer*)         |
| #6 (stomach AND ulcer*)        |
| #7(duoden* AND ulcer*)         |
| #8 (gastr* AND ulcer*)         |
| #9 #4 OR #5 OR #6 OR #7 OR #8  |
| #10 Epidemiology [Mesh]        |
| #11 prevalence OR Epidemiology |
| #12 #10 OR #11                 |
| #13 #3 AND #9 AND #12          |

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### 2.2. Inclusion and Exclusion Criteria

Inclusion criteria: (1) cross-sectional studies; (2) Chinese adults  $\geq 18$  years of age; (3) The

outcome measure was pu prevalence.

Exclusion criteria: (1) abnormal or incomplete data; (2) Literature that does not clearly report diagnostic criteria or basis; (3) Case reports, reviews, etc.; (4) Inpatient or outpatient patients.

### 2.3. Literature screening and data extraction

After the necessary training, 2 researchers obtained the literature according to the above literature retrieval method and then independently screened it. Preliminary removal of irrelevant literature by reading the title and abstract; Then, the preliminary screening literature is read in full, and the literature is screened according to the criteria for ranking, and if there is a dispute, the third person participates in the discussion and finally reaches a consensus. The name of the first author, the year of publication, the time of investigation, the respondent, the area of investigation, the sex, age, diagnostic criteria, sample size, number of PU cases and prevalence of the literature were extracted and screened.

### 2.4. Risk assessment of bias in the included studies

The included literature was quality evaluated using the AHRQ<sup>[10,11]</sup> quality evaluation criteria by two investigators and cross-checked the results.

### 2.5. Statistical methods

The data were meta-analyzed using Stata 15.0 software to calculate PU prevalence and 95% confidence interval (CI). Use I<sup>2</sup> and Q tests to assess heterogeneity on the included data; If the P>0.1 and the I<sup>2</sup><50%, indicating no obvious heterogeneity, the meta-analysis was performed using a fixed-effect model. Instead, a random effects model is used. Subgroup analysis was performed according to different characteristics. Publication bias was assessed using Begg's test, with a statistically significant difference of P<0.05.

## 3. Result

### 3.1. Literature screening process and results

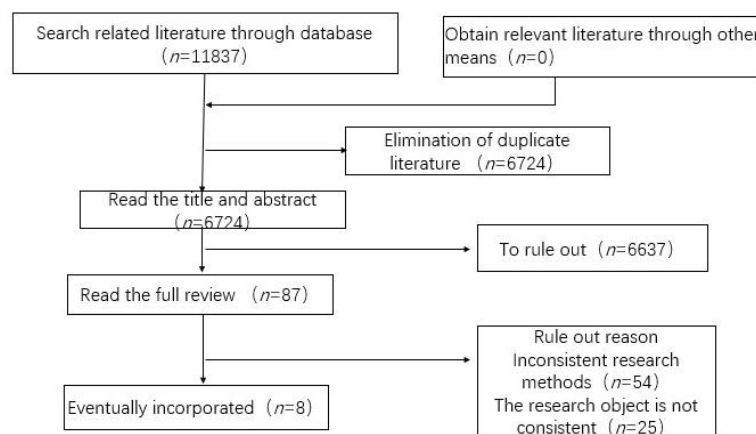


Figure 1: Literature search map

A total of 11837 studies were obtained in the initial examination, and 8 studies were finally included after layer by layer screening<sup>[12-19]</sup> The literature screening process and results are shown

in Figure 1.

### 3.2. The basic information and risk of bias of the included literature were evaluated

The basic information of the literature is shown in Table 2. The risk of bias is assessed in Table 3.

Table 2: Basic characteristics of the included literature

| Author       | Published year | Sample size | Survey area | Survey time    | age   | Diagnostic criteria                          |
|--------------|----------------|-------------|-------------|----------------|-------|--|
| Dongli Li    | 2013           | 7500        | northern    | -              | ≤50   | Gastroscope                                  |
| Mei Zhang    | 1998           | 3440        | Beijing     | 1993.7-10      | ≥60   | Gastrosocopy or X-ray examination            |
| Xiaodan Li   | 1998           | 409         | Shanghai    | 1989.12-1997.4 | ≥18   | Gastroscope                                  |
| ShiYing Cao  | 1994           | 685         | Shanghai    | -              | ≥18   | Gastrointestinal barium meal or Gastrosocopy |
| Xudong Zhang | 2005           | 8188        | Sichuan     | 2003.8-11      | ≥30   | Gastroscope                                  |
| Bingyi Zhang | 2008           | 2580        | Gansu       | 2006-2007      | ≥20   | Gastroscope                                  |
| Ronghai Liu  | 2001           | 611         | Yancheng    | 2000.7         | 20-80 | Barium x-ray meal or Bastrosocopy            |
| Wen Wang     | 2006           | 6160        | south       | -              | 17-36 | -  |

Note - Indicates that there is no relevant content

Table 3: Assessment of risk of bias in the included literature

| Author       | 1   | 2   | 3   | 4   | 5  | 6   | 7  | 8   | 9  | 10  | 11 | Total |
|--------------|-----|-----|-----|-----|----|-----|----|-----|----|-----|----|-------|
| Dongli Li    | yes | yes | yes | yes | no | yes | no | yes | no | yes | no | 7     |
| Mei Zhang    | yes | yes | yes | yes | no | yes | no | yes | no | no  | no | 6     |
| Xiaodan Li   | yes | yes | yes | yes | no | no  | no | yes | no | no  | no | 4     |
| ShiYing Cao  | yes | yes | no  | yes | no | yes | no | yes | no | no  | no | 5     |
| Xudong Zhang | yes | yes | yes | yes | no | yes | no | yes | no | no  | no | 6     |
| Bingyi Zhang | yes | yes | yes | yes | no | yes | no | no  | no | yes | no | 6     |
| Ronghai Liu  | yes | yes | yes | yes | no | yes | no | yes | no | no  | no | 6     |
| Wen Wang     | yes | yes | no  | yes | no | no  | no | yes | no | no  | no | 4     |

Note: AHRQ= Institute for Health Care Quality and Research, USA; 1. Is the source of data clear? 2 Are the inclusion and exclusion criteria for exposed and non-exposed groups listed or reference to previous publications? 3 Is a time period for identifying patients given? 4. If the subjects are not from the population, are the subjects continuously observed? 5. Do the subjective factors of the evaluators cover up other aspects of the research objects? 6 describes any evaluation performed to ensure quality (e.g. testing/retesting of primary outcome measures); 7 whether the reason for excluding any of the patients from the analysis was explained; (8) whether it describes measures to evaluate and/or control confounding factors; 9 is whether it provides an explanation of how missing data were handled in the analysis; 10 whether the patient response rate and the completeness of data collection were summarized; 11 is whether the percentage of patients with incomplete data identified as expected or the follow-up results, if any, were provided.

### 3.3. Results of Meta-analysis

3.3.1 The results of heterogeneity test showed that there was heterogeneity in the included 8 articles ( $I^2=99.3\%$ ,  $P < 0.01$ ), and random effect model was used. Meta-analysis showed that the prevalence of PU in Chinese adults was 9% [95%CI (6%-11%)]. See Figure 2 for details.

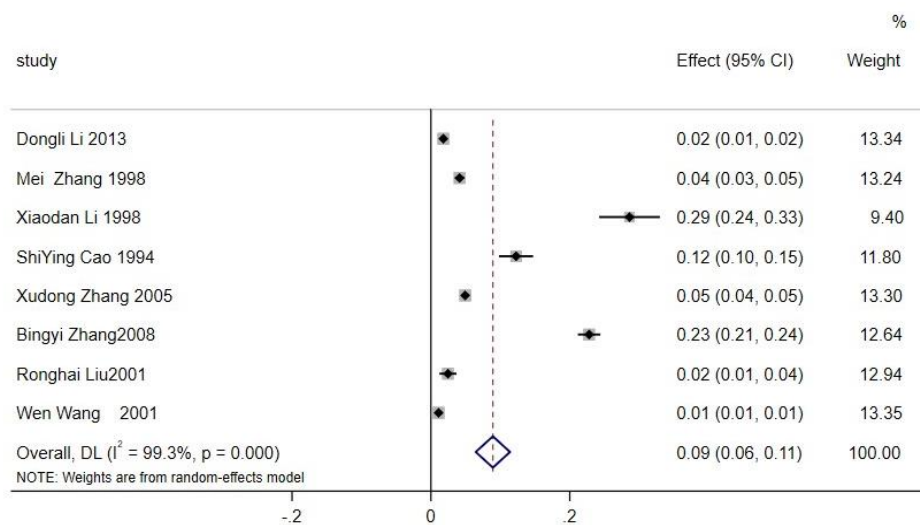


Figure 2: Forest map of PU prevalence among Chinese adults

3.3.2 Subgroup analysis. Subgroup analysis was conducted according to different factors, and the results showed that gender: male prevalence was 10%, female prevalence was 5%; The prevalence of gastric ulcer was 8%, and that of duodenal ulcer was 13%. Regional distribution: the prevalence was 9% in the north and 9% in the south. Age distribution: the prevalence of  $\geq 61$  years old was 4%, 51-60 years old was 9%, 41-50 years old was 8%, 31-40 years old was 3%,  $\leq 30$  years old was 25%. Occupation: The prevalence rate was 1% for soldiers, 29% for students, 18% for workers and 4% for farmers. Survey time: The prevalence was 15% before 2000 and 5% after 2000. See Table 4 for details.

Table 4: Subgroup analysis of PU in Chinese adults

| group          | Number of literature         | Prevalence (%) | 95% CI      | I <sup>2</sup> (%) | P-value |
|----------------|------------------------------|----------------|-------------|--------------------|---------|
| gender         |                              |                |             |                    |         |
| man            | 8 <sup>[12-19]</sup>         | 10             | (0.07,0.13) | 99.3%              | <0.01   |
| woman          | 5 <sup>[13-18]</sup>         | 5              | (0.03,0.06) | 85.7%              | <0.01   |
| type           |                              |                |             |                    |         |
| gastric ulcer  | 3 <sup>[14, 16-17]</sup>     | 8              | (0.02,0.08) | 99.4%              | <0.01   |
| duodenal ulcer | 3 <sup>[14, 16-17]</sup>     | 13             | (0.08,0.19) | 98.9%              | <0.01   |
| region         |                              |                |             |                    |         |
| northern       | 3 <sup>[12-13, 17]</sup>     | 9              | (0.02,0.17) | 99.7%              | <0.01   |
| south          | 5 <sup>[14-16, 18-19]</sup>  | 9              | (0.05,0.12) | 99.0%              | <0.01   |
| age            |                              |                |             |                    |         |
| $\geq 61$      | 4 <sup>[13-14, 16, 18]</sup> | 4              | (0.00,0.07) | 98%                | <0.01   |
| 51-60          | 3 <sup>[14, 16, 18]</sup>    | 9              | (0.00,0.19) | 94.5%              | <0.01   |
| 41-50          | 3 <sup>[14, 16, 18]</sup>    | 8              | (0.01,0.15) | 95.2%              | <0.01   |
| 31-40          | 3 <sup>[14, 16, 18]</sup>    | 7              | (0.02,0.13) | 96.3%              | <0.01   |
| $\leq 30$      | 2 <sup>[14, 18]</sup>        | 25             | (0.16,0.34) | 0                  | <0.01   |
| Occupation     |                              |                |             |                    |         |
| Soldier        | 2 <sup>[12, 19]</sup>        | 1              | (0.01,0.02) | 91.2%              | 0.001   |
| Student        | 1 <sup>[14]</sup>            | 29             | (0.24,0.33) | 0                  | -       |
| Worker         | 2 <sup>[15, 17]</sup>        | 18             | (0.07,0.28) | 98%                | <0.01   |
| Farmer         | 2 <sup>[16, 18]</sup>        | 4              | (0.01,0.07) | 95.2%              | <0.01   |
| Survey time    |                              |                |             |                    |         |
| Before 2000    | 3 <sup>[13-15]</sup>         | 15             | (0.04,0.26) | 98.7%              | <0.01   |
| After 2000     | 5 <sup>[12, 16-19]</sup>     | 5              | (0.03,0.07) | 99.6%              | <0.01   |

### 3.4. Publication bias

Begg's funnel plot was drawn for a total of 8 literatures,  $P=0.063$ , without significant publication bias. See Figure 3 and Table 5 for details.

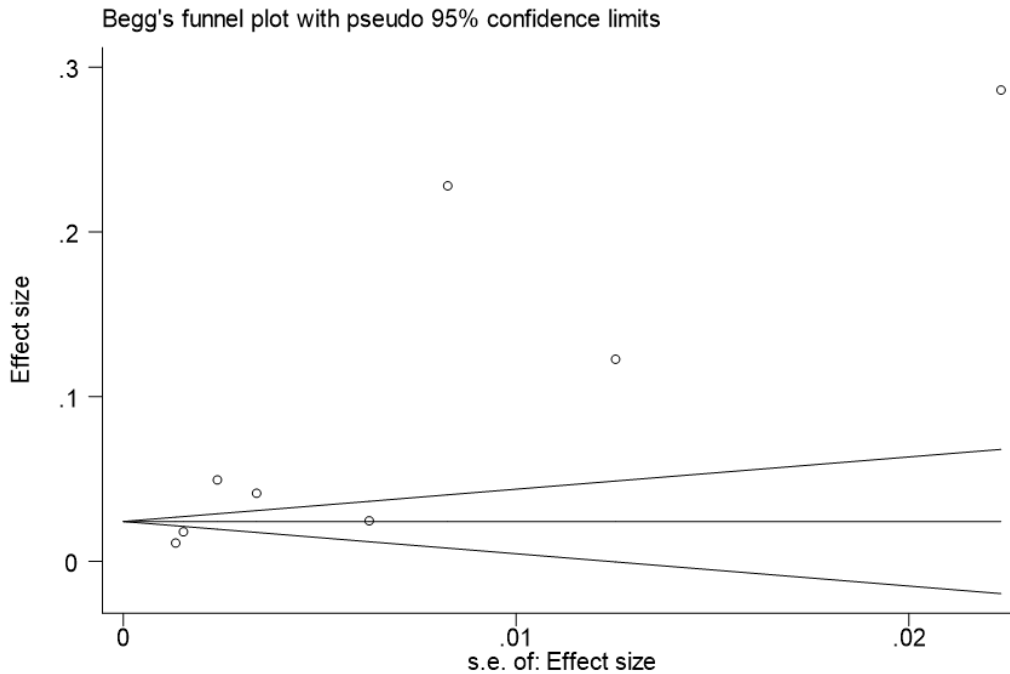


Figure 3: Begg's funnel plot of literature on prevalence of PU in Chinese adults

Table 5: Begg's test

|  |
|--|
| adj. Kendall's Score (P-Q) = 16                  |
| Std. Dev. of Score = 8.08                        |
| Number of Studies = 8                            |
| $z = 1.98$                                       |
| $\text{Pr} >  z  = 0.048$                        |
| $z = 1.86$ (continuity corrected)                |
| $\text{Pr} >  z  = 0.063$ (continuity corrected) |

### 3.5. Sensitivity analysis

There was a high degree of heterogeneity in the 8 included literatures. Sensitivity analysis using Metainf showed that most of the studies deviated from the estimated value to a small extent, among which the study of Li Xiaodan<sup>[14]</sup> et al., with a sample size of 409, was the study with the smallest sample size among the included literatures. The research of Zhang Bingyi et al.<sup>[17]</sup> also deviated. The survey samples were underground workers in mines, all male, belonging to a special population, and it was speculated that it might be related to them. Therefore, sample size and occupation may be the source of heterogeneity. See Figure 4 for details.

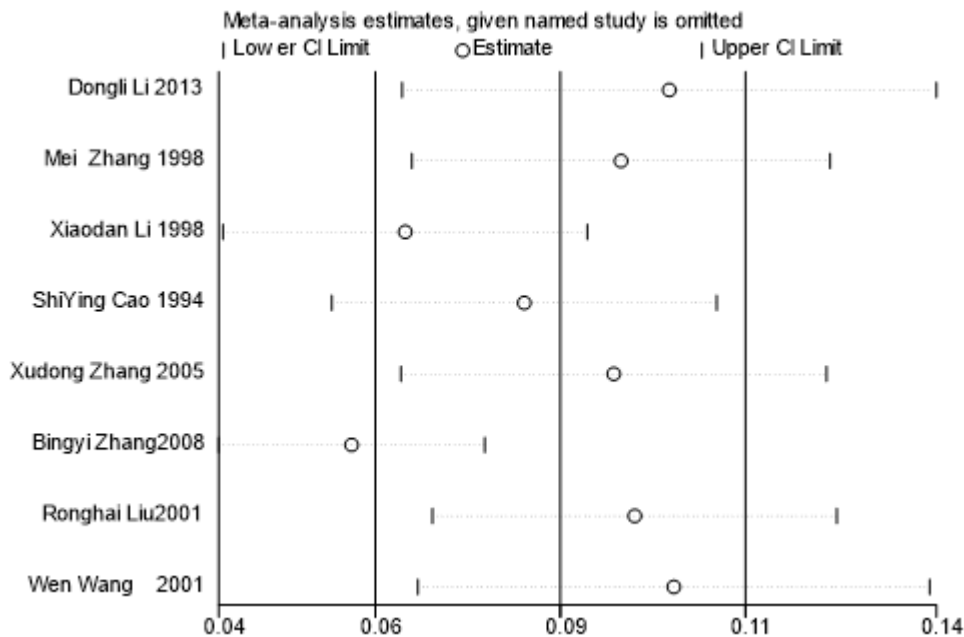


Figure 4: Sensitivity analysis

#### 4. Discuss

A total of 8 cross-sectional studies including 29573 subjects were included in this study. Meta-analysis showed that the prevalence of PU in Chinese adults was 9% [95%CI (6%,11%)], which was consistent with previous findings [20]. It can be found that the prevalence of PU in China is higher than the global average. According to the survey, in 2019, the global prevalence of PU was about 8.09% [95%CI 6.79,9.58] [21]. Compared with foreign countries, the prevalence of PU in China was in the middle, and the prevalence rates in India and the United States were 4.72% [22] and 13.8% [23], respectively. This may be closely related to geographical location, diet, environment, culture, etc.

In this study, the prevalence of PU was significantly different among patients in different subgroups. Previous studies have shown that the infection rate of helicobacter pylori in men is higher than that in women [24-25]. At the same time, men smoke and drink more than women, and helicobacter pylori, smoking and drinking are closely related to the incidence of peptic ulcer [26]. Female estrogen may also have a protective effect on PU [27]. In terms of age, the prevalence of PU is higher in the elderly, especially over 50 years old, which may be related to elderly patients with chronic diseases such as hypertension and diabetes, poor physical function, and more drugs with direct damage to gastric mucosa, such as NSAIDs [28]. In terms of regional distribution, this study found that there was no significant difference in the prevalence between the south and the north, but it was confirmed by literature [29] that the prevalence of peptic ulcer in the south was higher than that in the north. However, no clear study has yet explained the reason for the high prevalence of peptic ulcer in the south, which may be closely related to dietary habits and geographical environment. By comparing the prevalence rate of PU in different survey periods, it can be found that the prevalence rate of peptic ulcer in China has decreased significantly since 2000, which may be closely related to the improvement of living standards, the improvement of environmental hygiene and the change of group eating style [30]. The decrease of HP infection rate will further reduce the incidence of peptic ulcer. Meta-analysis showed that the prevalence of duodenal ulcer was higher than that of gastric ulcer in China, and previous data showed that the ratio of duodenal



ulcer to gastric ulcer was 1.5-5.6:1<sup>[31]</sup>. The results of this study were consistent with literature reports. The reason why the prevalence of duodenal ulcer is higher than that of gastric ulcer has not been clearly reported, but some studies believe that it may be related to the aggressive factors such as excessive gastric acid secretion, pepsin, drugs, smoking, *Helicobacter pylori* and stress<sup>[26]</sup>. In terms of occupation, this study showed that students and workers have a higher incidence of PU, which may be closely related to academic burden, social pressure and mental factors<sup>[32]</sup>. At the same time, it may be related to not eating on time and preference for snacks<sup>[33]</sup>. Zhang Xiuqing<sup>[34]</sup> et al. also found that the prevalence of gastric and duodenal ulcers in underground coal mine workers was higher than that in surface workers, which was consistent with the results of this study. The reason may be closely related to occupational stress caused by excessive occupational tasks<sup>[35]</sup>. At the same time, it is related to bad environment<sup>[36]</sup>, depression, anxiety and other negative emotions<sup>[37]</sup>.

The results show that the prevalence of PU in Chinese adults is high, which brings great economic loss and burden to society, and has a great impact on patients' physical and mental health. Therefore, in the process of clinical treatment, it is recommended that clinical workers pay attention to patients' mental health while treating diseases, and make full use of the advantages of Chinese traditional medicine to give individualized treatment. PU, as a common disease of the digestive system, has many complications and is easy to relapse. People need to recognize the risk factors of the disease and reduce the incidence of the disease from the source. Publicity and health education in hospitals can help people have a deeper understanding of PU. Finally, play a preventive role by reducing or avoiding long-term exposure to risk factors, such as smoking and alcohol consumption, while preventing recurrence.

This study has the following limitations :(1) the heterogeneity of the included literatures is high, which may be related to the characteristics of single-group rate meta-analysis; (2) The sample size of the study was limited, and the number of participants was small, so there may be some bias in estimating the prevalence of PU in all Chinese adults. (3) The study found that peptic ulcer was related to season, with a high incidence in winter and spring and a low incidence in summer<sup>[38]</sup>. The literature included in this study did not involve the investigation of season, which failed to reflect the difference.

In conclusion, the prevalence of PU in Chinese adults is high. The study also found that the prevalence rate has been decreasing year by year since 2000. This may be related to the development of socioeconomic level, lifestyle change and eradication of *Helicobacter pylori*. However, it is worth noting that literatures<sup>[39-40]</sup> have reported that with the decrease of *helicobacter pylori* infection rate and the incidence of *helicobacter pylori* associated ulcers, the incidence of non-*helicobacter pylori* associated ulcers, such as nsaid-associated ulcers, will gradually increase. Therefore, both doctors and patients still need to be highly vigilant, and the publicity of PU can be strengthened, so that the general public can understand PU deeply, so as to prevent and effectively treat PU in advance.

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