Original Article

Prevalence of chronic atrophic gastritis worldwide from 2010 to 2020: an updated systematic review and meta-analysis

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Background: Gastric cancer ranks 4th in cancer incidence and ranks 2nd in leading to cancer-related deaths worldwide. The present study aimed to provide an updated overview of the prevalence of chronic atrophic gastritis (CAG), one of the precancerous lesions of gastric cancer, in the recent 10 years and its association with *Helicobacter pylori* (HP) infection.

Methods: A meta-analysis of follow-up studies worldwide in the recent 10 years was performed by systematically searching in Web of Science, PubMed, Cochrane, and Embase.

Results: A total of 14 studies were finally enrolled in the present meta-analysis. The pooled results showed that the prevalence of CAG was about 25% in the study population, and the risk of CAG was about 2.4-fold higher in HP-positive patients than in those who were HP negative. Subgroup analyses showed that both the prevalence of CAG and the risk of CAG in HP-positive patients were higher when infection was diagnosed by histology than by serology.

Conclusions: The worldwide prevalence of CAG is still high, and HP infection remains an important risk factor for CAG. Future studies of large-scale are still in urgent need to further control the prevalence of CAG, so as to reduce the burden of gastric cancer.

Keywords: Chronic atrophic gastritis (CAG); prevalence; meta-analysis

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Introduction

Gastric cancer ranks 4th in cancer incidence and ranks 2nd in leading to cancer-related deaths worldwide (1). The public health burden of gastric cancer is still very high even though its incidence has declined in recent years (2).

Chronic atrophic gastritis (CAG) is one of a series of precancerous lesions that occurs in the gastric mucosa before the appearance of the intestinal subtype of gastric cancer. In general, the process is from non-atrophic gastritis to CAG, then to intestinal metaplasia, dysplasia and finally to adenocarcinoma (3). To understand the occurrence of this cancer and to determine the risk factors for its incidence, it is important to study the precursor lesions and the risk factors related to their incidence.

Helicobacter pylori (HP) infection is such a risk factor that was shown to be strongly associated with the incidence of CAG in a previous meta-analysis (4). Marques-Silva *et al.* also performed a meta-analysis regarding the prevalence of CAG, however, that analysis only included studies published before March, 2013 (5). Now eight years has passed, and we believed that an updated meta-analysis with more recent relevant studies included will provide more accurate data on the incidence of CAG. Therefore, we performed the

present analysis of follow-up studies to further prove the causal role of HP infection in the development of CAG. The present meta-analysis aimed to provide an updated overview of the prevalence of CAG in the recent 10 years and its association with HP infection. We present the following article in accordance with the PRISMA reporting checklist (available at https://apm.amegroups.com/article/view/10.21037/apm-21-1464/rc). This study has been registered in PROSPERO, and the registration number is "CRD42021250872".

Methods

Search strategy

This study followed the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) (6). A systemic search was performed in Web of Science, PubMed, Cochrane, and Embase for articles from 2010 to 2020. No language restrictions were set, and the search strategy was as follows: ((prevalence) or (rate)) and ((chronic atrophic gastritis) or (atrophic chronic gastritis)) and ((endoscopy) or (biopsy) or (histology) or (serology)).

Selection criteria

Inclusion criteria were articles addressing atrophic gastritis conditions, published in indexed journals from January 1, 2010 to December 1, 2020, including cross-sectional or retrospective articles. Reasons for exclusion included opinion articles or case reports, studies of experimental design, participants selected according to their previous conditions, and studies not reporting the relevant data clearly.

Data collection

Two authors independently collected the data from the enrolled studies using a data collection sheet. Information collected included first author, year of publication, diagnostic methods of CAG, demographic characteristics of the study population (country, population type, sample size, age, sex ratios of study participants). Data on the status of HP was also collected if the relevant data were reported. Discrepancies were resolved by a third reviewer.

Statistical analysis

A meta-analysis of the prevalence of CAG and the correlation between HP infection and the prevalence of CAG was performed using a random effects model. For the latter analysis, the relative efficacy was measured using risk ratios (RRs) with their corresponding 95% confidence intervals (CIs). The heterogeneity between studies was evaluated using a Q test, in which I^2<50% and P>0.05 indicated no significant heterogeneity (7,8). The robustness of the results was tested using sensitivity analysis by omitting studies sequentially. Also, we performed subgroup analyses to address the diagnostic methods of CAG and population type. STATA (version 15.0, STATA MP) was used to perform all analyses.

Results

Baseline characteristics

The final number of studies enrolled in this meta-analysis was 14. *Figure 1* shows the detailed selection process (9-22), and the baseline characteristics of the studies are summarized in *Table 1*. The studies were conducted in 11 countries including China, Italy, Canada, Columbia and so on, and were distributed in Asia, Europe, and North and South America. Sample sizes ranged from 93 to 5,284, and the age of the participants ranged from 1 to 83 years, with the proportion of female ranging from 37.7% to 70.4%. A total of 10 studies used histological methods to diagnose CAG, and the remaining 4 used serological methods.

Prevalence of CAG

As shown in *Figure 2*, the pooled results of all 14 studies indicated that the prevalence of CAG worldwide was 25% (95% CI: 18–32%). However, a significant heterogeneity was observed in this analysis, as I^2=99.5% and P<0.001. No significant change in the results was found when sensitivity analyses were performed by omitting each study sequentially. The results of subgroup analysis by population type are shown in Figure S1. We found that the prevalence of CAG was 16% (95% CI: 10–22%) in the general population and 35% (95% CI: 21–48%) in the selected population. We also found that the prevalence of CAG was generally higher when diagnosed by histology [32% (95% CI: 20–43%)] than by serology [10% (95% CI: 6–13%)], as shown in Figure S2. The heterogeneity was still significant in these subgroup analyses.

Association between HP and the prevalence of CAG

As shown in *Figure 3*, HP infection was associated with a

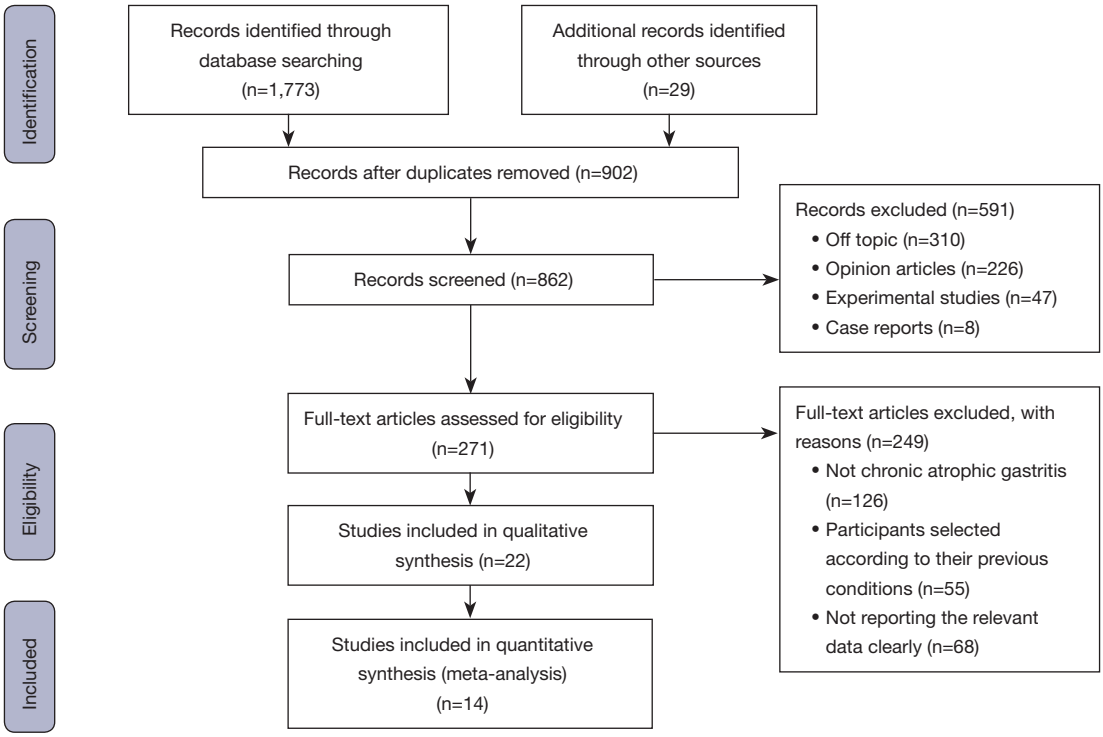

Figure 1 Flowchart for the selection of studies to be included in the meta-analysis.

significant higher risk of CAG, with an RR of 2.40 (95% CI: 2.16–2.67). A significant heterogeneity was also observed as I^2=96.0% and P<0.001. Similarly, there was no significant change in the results when performing sensitivity analyses by omitting each study sequentially. The results of subgroup analysis by population type are shown in Figure S3; the RR of 2.56 (95% CI: 2.16–3.03) in the general population was found to be similar to the RR of 2.28 (95% CI: 2.00–2.60) in the selected population. As shown in Figure S4, subgroup analysis by diagnostic methods showed that RR of 2.78 (95% CI: 2.49–3.12) was higher when diagnosed by histology. However, only one study used serology to diagnose CAG, so this subgroup analysis was not available. The heterogeneity remained significant when performing these analyses.

Discussion

The present study is the most recent meta-analysis of the related topic. It aimed to provide the updated prevalence of CAG and explore changes over the past 10 years, in order to provide some guidance for future clinical decision making. In total, 14 studies with data on the prevalence of CAG were identified, among which the prevalence rates ranged from 6% to 66%. Our pooled results showed that 25% of people worldwide may have CAG, which is lower than previously reported in a meta-analysis published in 2014 (5). Most of the literature enrolled in that meta-analysis was from 1990 to 2010, and the lower prevalence observed in our results might reflect improvements in people's lifestyles and more efforts being made on the screening and treatment of precancerous gastric diseases.

It has been reported that HP infection is strongly associated with the occurrence of CAG (4). The increase in the prevalence of CAG in HP-positive patients was expected and was confirmed by our study. The prevalence of CAG was found to be 2.4-fold higher in HP-positive patients compared with those who were HP negative. This ratio was similar to the result from the previous meta-analysis described above (5), but s lower than reported in another meta-analysis published in 2010 (23). Most of the studies enrolled in the 2010 meta-analysis were published in the 1990s. One potential explanation for the decreased risk of CAG over time in HP-positive patients might be the development of tolerance to the virulence of HP.

Another important finding of our study was that both the population type and the diagnostic method used could affect

Table 1 Baseline characteristics of enrolled studies

Study	Country	Sample size	Population type	Age (years), median [range]	Women, n (%)	Determination of CAG	HP+		HP–	
							CAG	Non-CAG	CAG	Non-CAG
Emura *et al.* 2010	Columbia	650	General	NR [49–70]	390 (60.0)	Histology	NR	NR	NR	NR
Cam *et al.* 2014	Turkey	750	General	10.1 [1–18]	362 (48.3)	Histology	24	366	1	359
Song *et al.* 2015	Sweden	5,284	General	NR [35–64]	2,420 (45.8)	Serology	NR	NR	NR	NR
Roman *et al.* 2016	Russia	918	General	51.8 [26–83]	646 (70.4)	Serology	NR	NR	NR	NR
Bas *et al.* 2020	Turkey	2,214	General	NR [18–69]	929 (42.0)	Histology	493	924	84	713
Fagan-Garcia *et al.* 2019	Canada	308	General	NR [0–96]	171 (55.5)	Histology	96	128	0	84
Muhsen *et al.* 2019	Israel	1,644	General	NR [25–78]	774 (47.1)	Serology	75	1,144	50	375
Kikuchi *et al.* 2011	Japan	300	Selected	NR [22–87]	113 (37.7)	Histology	NR	NR	NR	NR
Eshmuratov *et al.* 2010	Korea	1,330	Selected	NR	551 (41.4)	Histology	679	428	81	142
Lombardo *et al.* 2010	Italy	1,387	Selected	40 [18–80]	704 (50.8)	Serology	NR	NR	NR	NR
Rugge *et al.* 2010	Italy	93	Selected	55 [22–73]	45 (48.4)	Histology	NR	NR	NR	NR
Alina *et al.* 2011	Israel	1,651	Selected	NR	834 (50.5)	Histology	234	506	60	851
Liu *et al.* 2010	China	1,179	Selected	52.5 [35–85]	621 (52.7)	Histology	NR	NR	NR	NR
Haziri *et al.* 2010	Kosova	802	Selected	NR	369 (46.0)	Histology	93	386	48	275

CAG, chronic atrophic gastritis; HP, *Helicobacter pylori*; NR, not reported.

the prevalence of CAG. People with upper gastrointestinal symptoms were naturally more likely to have CAG than those without symptoms, which is also why the prevalence of CAG in our study was higher in the selected population than in the general population. Both the prevalence of CAG and the risk of CAG in HP-positive patients were found to be higher when diagnosed by histology than by serology, and one possible reason for this might be the low sensitivity of serology to diagnose CAG.

However, there are some limitations of this analysis that should be kept in mind. First, there was a huge heterogeneity in the existing literature. For example, the diagnostic criteria of CAG varied among different studies, and different methods were used in different studies to assess HP infection. Second, the number of studies that reported the status of HP infection and the corresponding sample sizes were small, which might affect the statistical results. Third, because only one author collected the data, mistakes are more likely. Finally, because of a lack of data, we failed to analyze the many potential risk factors for CAG other than HP infection.

Generally speaking, the worldwide prevalence of CAG is still high, and HP infection remains an important risk factor for CAG Future studies of large-scale are still in urgent need to further control the prevalence of CAG, so as to reduce the burden of gastric cancer. We believe that eradication of HP infection will effectively reduce the incidence rate of CAG. Other measures to prevent CAG include improving eating habits and enhancing physical exercise.

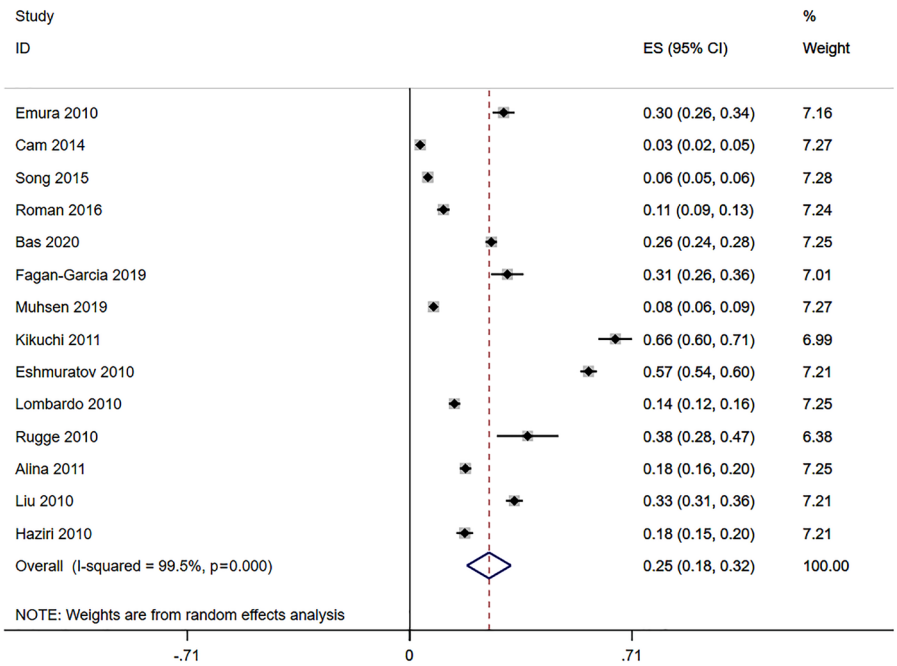

Figure 2 Forest plot for the prevalence of chronic atrophic gastritis worldwide from 2010 to 2020. CI, confidence interval; ES, effect size.

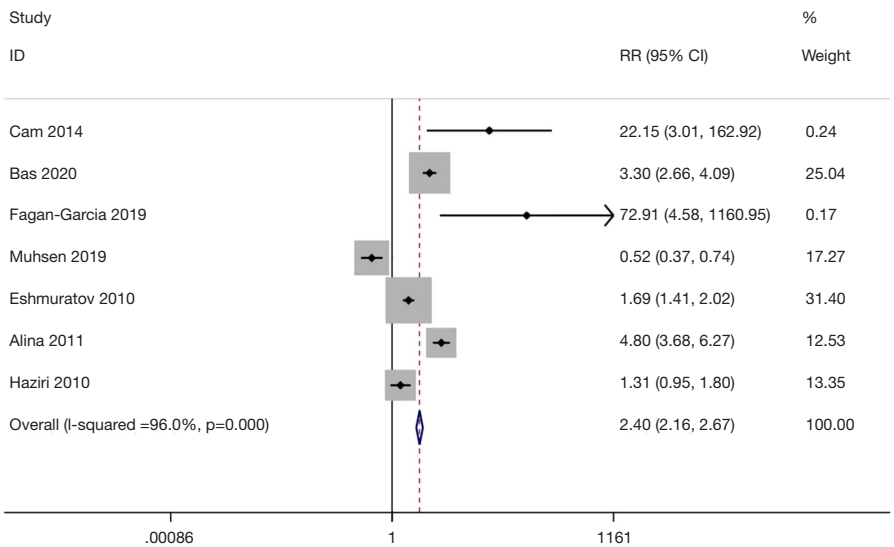

Figure 3 Forest plot for the association between *Helicobacter pylori* infection and the incidence of chronic atrophic gastritis. CI, confidence interval; RR, risk ratio.

Conclusions

This is the most recent meta-analysis to investigate the prevalence of CAG, which was found to be ~25% in the general population, and the risk of CAG was ~2.4-fold higher in HP-positive patients than in those who were HP negative. Further analyses involving more studies with more participants are still needed to investigate the future prevalence of CAG and its risk factors.

Acknowledgments

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Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at https://apm.amegroups.com/article/view/10.21037/apm-21-1464/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://apm.amegroups.com/article/view/10.21037/apm-21-1464/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.

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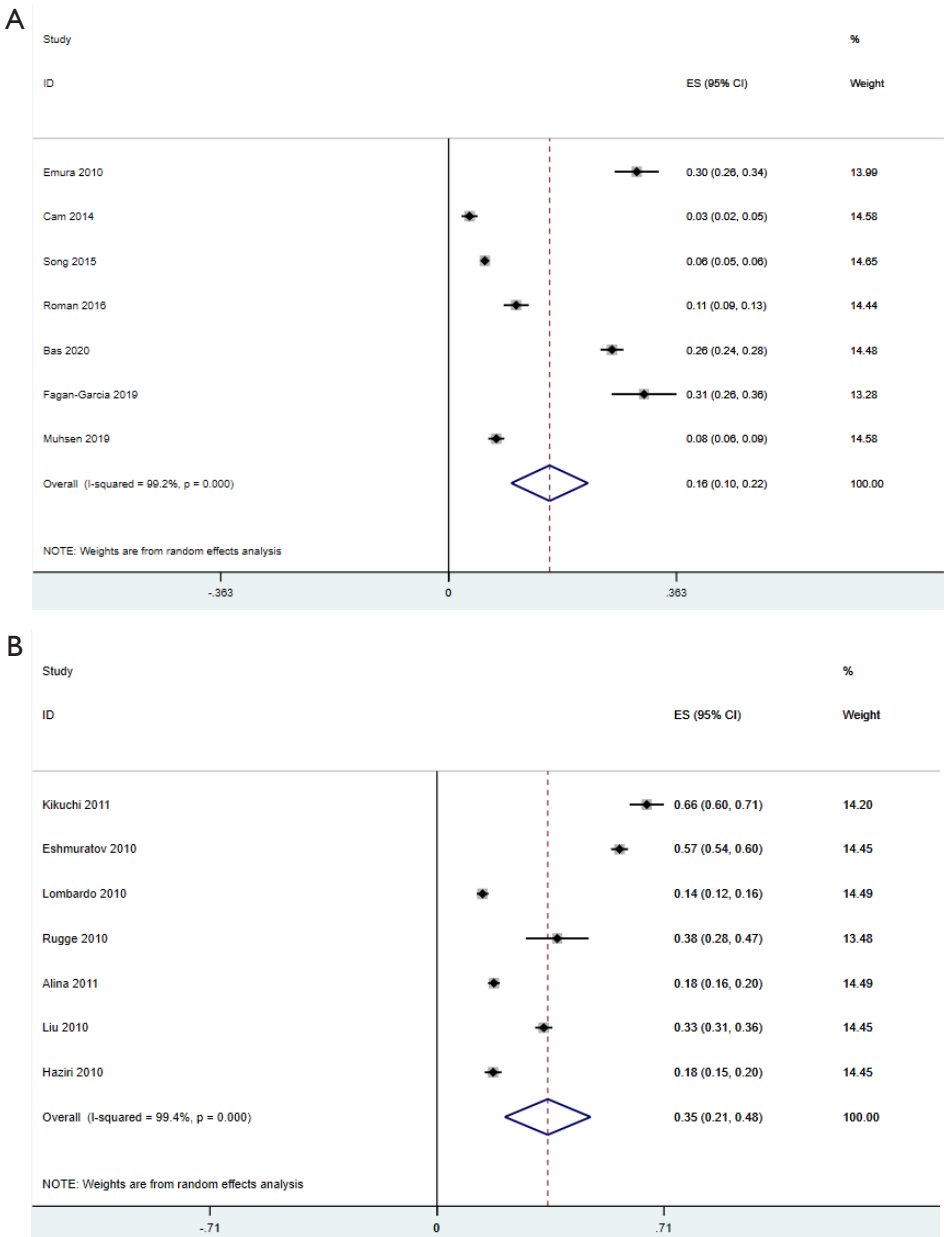

Figure S1 (A) Subgroup meta-analysis for the prevalence of chronic atrophic gastritis in the general population; (B) subgroup meta-analysis for the prevalence of chronic atrophic gastritis in the selected population.

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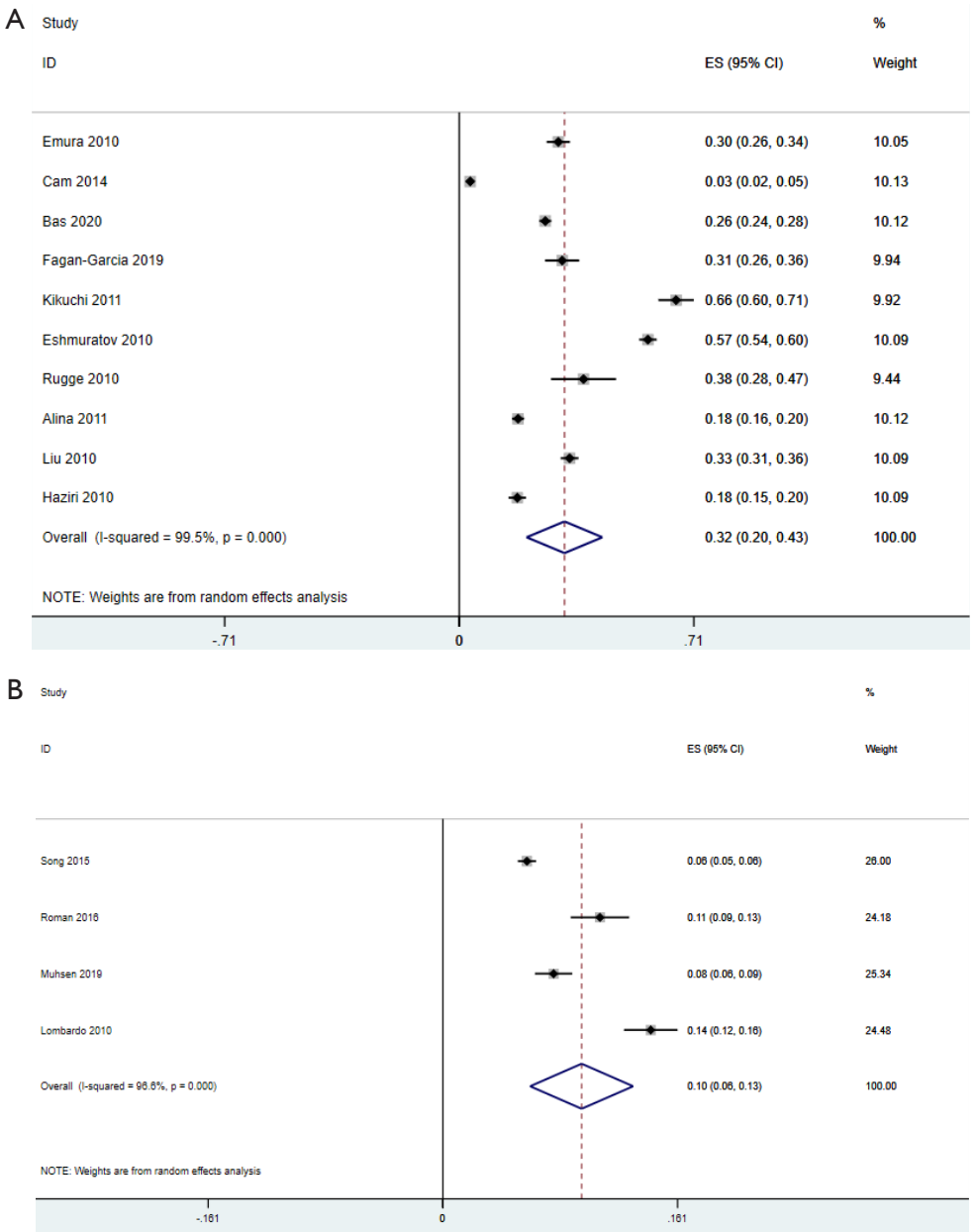

Figure S2 (A) Subgroup meta-analysis for the prevalence of chronic atrophic gastritis diagnosed by histology; (B) subgroup meta-analysis for the prevalence of chronic atrophic gastritis diagnosed by serology.

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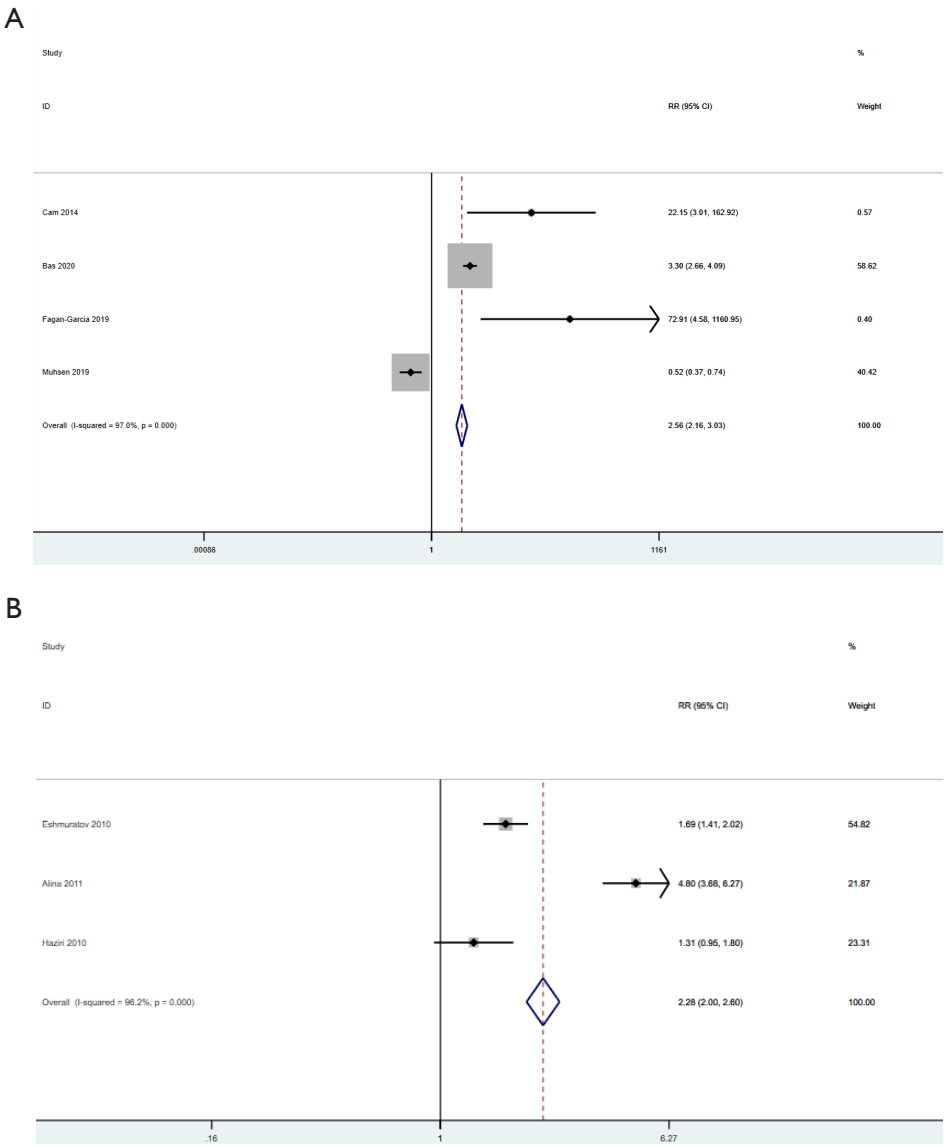

Figure S3 (A) Subgroup meta-analysis for the association between *H. pylori* infection and the incidence of chronic atrophic gastritis in the general population; (B) subgroup meta-analysis for the association between *H. pylori* infection and the incidence of chronic atrophic gastritis in the selected population.

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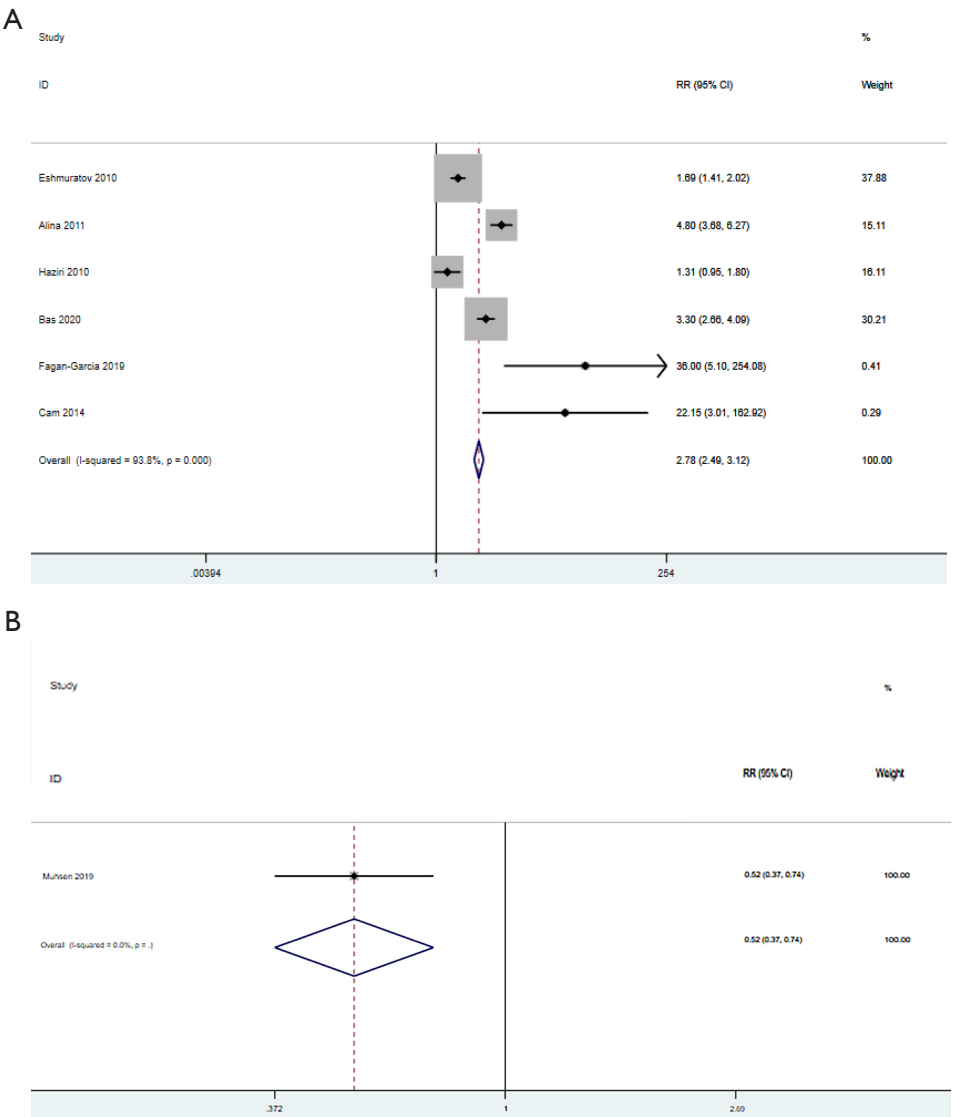

Figure S4 (A) Subgroup meta-analysis for the association between *H. pylori* infection and the incidence of chronic atrophic gastritis diagnosed by histology; (B) subgroup meta-analysis for the association between *H. pylori* infection and the incidence of chronic atrophic gastritis diagnosed by serology.

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