Chapter 3.3.

Gastric cancer prevention research in the USA

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Summary

- In the USA, the burden of gastric cancer is low, but there are well-documented racial/ethnic and socioeconomic disparities, particularly in mortality.
- The epidemiological pattern of gastric cancer in the USA is evolving, with increasing incidence in young people, particularly in women.
- The USA has not implemented any gastric cancer prevention programmes targeting identifiable high-risk populations. However, upcoming management recommendations by professional medical societies may help to guide future research efforts and public health policies.
- The intramural programme of the United States National Cancer Institute has a research portfolio on gastric cancer that informs biological concepts, clinical practice, and public health policy.

3.3.1 Introduction

In the USA, the estimated number of new cases of gastric cancer in 2024 was about 27 000, and the overall 5-year relative survival for the period 2014–2020 was 36.4% [1]. These poor outcomes reflect the generally late stage of diagnosis of this preventable and curable cancer type. The lack of preventive strategies in the USA represents a major health-care disparity, because gastric cancer disproportionately occurs in minoritized communities and immigrant groups in the USA, such as Asian Americans, Hispanic Americans, Black Americans, and American Indian and Alaska Native people.

The epidemiological pattern of gastric cancer in the USA is evolving. According to data from the United States National Cancer Institute (NCI) Surveillance,

Epidemiology, and End Results (SEER) Program and the North American Association of Central Cancer Registries, the incidence of non-cardia gastric cancer is increasing in young non-Hispanic White people and Hispanic people, particularly in women [2, 3]. Consistent with these observations, gastric cancer mortality increased slightly or was stable in individuals younger than 50 years in Hispanic Americans and people from some Latin American countries [4]. The age-adjusted rates of total new gastric cancers in the USA in 2017–2021 showed a statistically significant increase, with an overall average annual percentage change of 1.98% (95% confidence interval [CI], 0.46–2.78%). The sex-specific average annual percentage change was 3.27% (95% CI, 2.26–4.00%) for women and 0.74% (95% CI, −0.65% to 1.74%) for men [5]. These findings demonstrate the importance of gastric cancer for public health in the USA.

3.3.2 Prevalence of *H. pylori* infection

The overall prevalence of *H. pylori* infection in the USA is estimated to be about 30–40% [6]. However, there are subpopulations in the USA that have higher rates of *H. pylori* infection. Some examples are given here.

- In a nested case–control study in Alaska Native people, 92% of the patients with gastric cancer and 82% of the control group were seropositive for *H. pylori* infection. A higher percentage of cases (95%) and controls (93%) were seropositive for CagA [7].
- Tribal members from the Navajo Nation have higher rates of *H. pylori* infection and gastric cancer. In a cross-sectional study, 57% of participants tested positive for *H. pylori*, and 79% of those who tested positive were positive for the *cagA* gene [8].
- A study evaluating the seroprevalence of *H. pylori* in the Hispanic community in the USA demonstrated an overall seropositivity rate of 57%, with substantially higher seropositivity rates in individuals who were not born in the USA and in those living in lower socioeconomic conditions [9].
- In a retrospective study of United States veterans with *H. pylori* testing data from 1999–2018, non-Hispanic Black people had an *H. pylori* positivity rate of 40%,

compared with 20% for non-Hispanic White people [10]. *H. pylori* infection was diagnosed in 26% of all individuals tested.

- A recent scoping review that combined data from 41 publications found that data on population-based *H. pylori* seroprevalence are lacking in the USA [11]. The *H. pylori* seroprevalence rates were highest in American Indian and Alaska Native people, followed by the Hispanic and non-Hispanic groups. The seroprevalence rates were lowest in the non-Hispanic White and Asian and Pacific Islander groups. Differences in age and birth cohort patterns emerged among racial/ethnic groups [11].

3.3.3 Gastric cancer prevention research

Attempts to increase the awareness of gastric cancer and to address both primary and secondary prevention have been made by local grass-roots initiatives, mainly in Alaska and in states with large immigrant populations, such as California, Florida, New Jersey, and New York.

Gastric cancer symposium in Anchorage, Alaska

In July 2019, a multiagency work group hosted a symposium in Anchorage, Alaska, that brought together internationally recognized experts and local leaders to evaluate issues related to gastric cancer in the Alaska Native population [12]. The goal of this symposium was to identify strategies to combat gastric cancer in the Alaska Native population that are scientifically sound, logistically realistic, and culturally acceptable. Key discussions included implementing clinical and community education, targeted screening and surveillance within clinical practice, and basic science and epidemiological investigations. The members of the scientific panel discussed the high prevalence of *H. pylori* infection in the Alaska Native population and the need for *H. pylori* treatment for people with a high-risk gastric pathology or a family history of gastric cancer. The members of the community panel discussed the risk factors for gastric cancer and noted the high prevalence in the Alaska Native population of known risk factors, such as *H. pylori* infection, smoking, and consumption of salted and smoked foods. The community panel thought that more information was needed about the risks associated with the lack of running water in homes, exposure to ground contaminants, and the use of iq'mik, which is a homemade chew that is

commonly used in some regions of Alaska and that mixes tobacco with fungus ash. They also thought that additional education for communities was needed to increase the understanding of gastric cancer, its risk factors, and the benefits of screening [12].

2020 Gastric Cancer Summit at Stanford University

In March 2020, a summit was convened at Stanford University, in California, to bring together various groups from across the country to propose a framework for gastric cancer prevention that would be applicable to the USA, which has a population composed of diverse racial/ethnic groups with differing risks of gastric cancer [13]. The result of this summit was a white paper, which provided expert consensus statements that evolved from this summit [14]. The recommendations were as follows.

- Testing for *H. pylori* should be performed in the following individuals, irrespective of the presence of symptoms:
    - individuals with a family history of gastric cancer in a first-degree relative;
    - first-generation immigrants from regions with high prevalence of *H. pylori* infection; and
    - individuals belonging to racial/ethnic groups at increased risk of gastric cancer (Black Americans, Alaskan Natives, American Indians, Asian Americans, and Hispanic Americans).
- All individuals with a positive test result of active infection with *H. pylori* should be offered treatment.
- Testing to confirm eradication should be performed after treatment.
- Endoscopic screening with biopsies should be offered beginning at age 50 years to the following individuals:
    - individuals with a family history of gastric cancer in a first-degree relative;
    - first-generation immigrants from regions with high gastric cancer incidence; and

- individuals belonging to racial/ethnic groups at increased risk of gastric cancer (Black Americans, Alaskan Natives, American Indians, Asian Americans, and Hispanic Americans).

- If gastric intestinal metaplasia or more severe pathology is identified, endoscopic surveillance should be offered.

Additional Gastric Cancer Summits at Stanford University were held in November 2022 and November 2024 to continue the work of the initial summit. The progress that had been made in health policy and research was presented. Substantial progress has been reported, including additional societal guidelines addressing the primary and secondary prevention of gastric cancer in the USA. A conference summary of the November 2024 summit is currently being prepared for publication.

3.3.4 Existing guidelines from academic societies

Currently, there are no clear guidelines for gastric cancer prevention from any of the gastroenterology or cancer societies in the USA.

Recommendations

In the USA, most first-line treatments for *H. pylori* are clarithromycin-based triple therapy, with eradication rates of < 90% [15]. The low eradication rates are because clarithromycin resistance rates are > 30% [16]. In 2024, the American College of Gastroenterology updated its recommendations for *H. pylori* screening and treatment specifically for the primary and secondary prevention of gastric cancer [17]. The indications for an *H. pylori* screen-and-treat approach are as follows:

- current or history of gastric premalignant conditions;
- current or history of early gastric cancer resection;
- current or prior history of gastric adenocarcinoma;
- patients with gastric adenomas or hyperplastic polyps;
- individuals with a first-degree relative with gastric cancer;
- individuals at increased risk of gastric cancer, including certain non-White racial/ethnic groups, immigrants from regions or countries with high gastric

cancer incidence, hereditary cancer syndromes associated with an increased risk of gastric cancer;

- patients with autoimmune gastritis.

The American Society for Gastrointestinal Endoscopy recommendations [18], published in 2015, suggest:

- screening and treating for *H. pylori* in racial and/or ethnic groups at high risk of gastric cancer; and
- a screening oesophago-gastro-duodenoscopy (OGD) for gastric cancer to be considered in new immigrants to the USA from regions or countries with a high risk of gastric cancer, including South America, China, Japan, the Republic of Korea, and the Russian Federation, especially if there is a family history of gastric cancer in a first-degree relative [18].

However, these suggestions are not considered to be evidenced-based guidelines, are not well publicized, and do not contain critical guidance on what constitutes a screening OGD, which should include biopsies according to the Sydney protocol. New guidelines and clinical recommendations for gastric cancer screening are in preparation by the American Gastroenterological Association; however, they are currently under review and have not been published.

Clinical studies

A 2024 study evaluated community-based testing for *H. pylori* infection in a large immigrant, underserved (i.e. with limited access to services) population in South Florida [19]. Although this was a relatively small study, it demonstrates the feasibility of performing larger prospective studies evaluating the effectiveness of both primary and secondary prevention strategies that are needed for the United States Preventive Services Task Force and the gastroenterology societies to develop stronger guidelines for gastric cancer prevention in the USA.

The Gastric Precancerous Conditions Study (GAPS; ClinicalTrials.gov ID, NCT04191551), which is being performed at Stanford University, is a prospective observational study with two overarching objectives: (i) to improve the non-invasive identification of patients with gastric intestinal metaplasia, and (ii) to develop

biological markers to predict the subset of intestinal metaplasia that will progress to gastric cancer. Additional small pilot and feasibility studies for both primary and secondary prevention strategies are currently being planned at various centres throughout the USA, such as the City of Hope (Los Angeles, California), the University of Southern California, and Kaiser Permanente (California). The City of Hope has recently started a prospective pilot study called the Our Stomach Health Project. This is a prospective study to evaluate the feasibility of a cancer screening programme to assess the risk of gastric cancer in Asian Americans, Hispanic Americans, and Black Americans. Eventually, prospective, large, multicentre, federally funded studies will be needed to provide the level of evidence required to make substantial recommendations to implement in guidelines for gastric cancer prevention in the USA.

3.3.5 Current and planned research projects for gastric cancer prevention: the NCI perspective

The Division of Cancer Epidemiology and Genetics (DCEG) at the NCI is part of the intramural programme of the United States National Institutes of Health (NIH) and is a global research leader in cancer epidemiology. The DCEG's research portfolio informs biological concepts, clinical practice, and public health policy. DCEG investigators conduct transdisciplinary research that focuses mainly on risk factors for cancer and involves extensive collaborations within the NCI, within the NIH, and with national and international institutions. (This section does not include any research projects funded by the extramural programme of the NCI and other NIH centres; information on those projects can be found at https://reporter.nih.gov/.)

Given that a substantial proportion of gastric cancer cases and deaths can be avoided, DCEG investigators and other experts have proposed a strategic framework to achieve effective prevention and control of gastric cancer in the Americas [20]. This strategic framework can be used as a resource for making decisions on public policy and developing funding priorities.

For the fiscal year 2022, the NCI's financial commitment to gastric cancer research, for both the intramural and extramural programmes, was US$ 16 million [21]. However, the NCI is committed to advancing this research agenda and has taken some actions to guide it. In December 2021, the NCI convened the Clinical

Trials and Translational Research Advisory Committee (CTAC) ad hoc Gastric and Esophageal Cancers Working Group to advise on translational research strategies to most effectively advance this field. The working group report highlighted the importance of developing precision approaches for the prevention, screening, detection, surveillance, and treatment of gastric and oesophageal cancers [22]. In May 2024, the NCI hosted the first Think Tank on Advancing Gastric Cancer Prevention, a forum to enable a multidisciplinary group of gastric cancer experts to review the state of the science and to collaboratively identify the critical gaps in knowledge. This international meeting was organized to provide specific clinical and translational prevention strategies that will be practicable for use in the high-risk populations in the USA and in other countries with a low or moderate risk of gastric cancer.

In addition to the descriptive work on trends in gastric cancer incidence and mortality, the DCEG portfolio for gastric cancer research is wide-ranging. The Nutrition Intervention Trial in Linxian, China, showed that nutritional interventions can be effective in reducing gastric cancer mortality [23, 24], as did an independent cancer incidence trial in Shandong Province, China [25].

This section summarizes the recent activities of DCEG investigators in gastric cancer, with a particular focus on *H. pylori* and studies that have potential translational applications, including the creation of new resources.

Helicobacter pylori *Genome Project*

DCEG investigators, in collaboration with an international, multidisciplinary team, created an international biobank of clinically annotated genetic and epigenetic variations of *H. pylori*. The *Helicobacter pylori* Genome Project Research Network has quantified, with great resolution, the different inferred ancestral sources of *H. pylori* subpopulations and the recent and ongoing admixture among subpopulations [26]. Analyses currently under way are comparing strains from patients with different types of gastric disease to identify genetic and epigenetic bacterial features that determine human pathogenicity. Other studies are addressing antibiotic resistance, among other topics. This publicly available worldwide collection of complete genomes and epigenomes with high-quality metadata will become a major asset for *H. pylori* genomics and gastric cancer research.

Golestan Cohort Study

In 2004, researchers at the Digestive Disease Research Institute and Tehran University of Medical Sciences, IARC, and the NCI launched the Golestan Cohort Study. This 50 000-person prospective cohort study recruited a large fraction of the eligible population in Golestan Province in the Islamic Republic of Iran. Historically, the people of this region had high rates of oesophageal squamous cell carcinoma (OSCC). The population in this region has several distinctive lifestyle features, including a substantial fraction of the elderly population using opium, frequent consumption of very hot tea, and limited diversity in the diet. The study was designed principally to examine the etiology of OSCC, but Golestan Province also has high rates of gastric adenocarcinoma. Although rates of OSCC are decreasing in the population, gastric cancer remains a substantial public health problem and rates have been stable over the past two decades [27]. As in the populations with a high incidence of OSCC in central China, the population in Golestan Province has a high fraction of cardia gastric cancer, with a ratio of 1:1 with non-cardia gastric cancer. Cardia gastric cancer is often incorrectly thought of as a disease that occurs most frequently in White men in high-income, industrialized countries, but in fact most cardia gastric cancers occur in rural populations in Asia [28]. Previous *H. pylori* studies in north-eastern Islamic Republic of Iran have shown that infection with *H. pylori* is nearly universal in the population aged > 40 years and that most people have CagA-positive strains [29]. This study confirmed the direct association between *H. pylori* infection and the risk of both gastric cardia and non-cardia adenocarcinoma. Recently, the NCI, along with external collaborators, measured *H. pylori* antibodies, serum pepsinogens, and trefoil factor 3 concentrations in a large nested case–control study of gastric cancer in this cohort, to facilitate studies of other etiological and protective exposures. In addition to *H. pylori*, studies in this cohort have examined the relationship between gastric cancer risk and oral health [30], opium use [31], indoor air pollution [32], water source [33], diet [34, 35], and blood group [36].

Genetic susceptibility to gastric carcinogenesis

Genome-wide association studies of gastric cancer in populations with East Asian [37, 38] and European [39] ancestry, led by DCEG investigators and others, have

identified susceptibility variants for gastric carcinogenesis. However, studies in Hispanic and Latino people have been quite limited. DCEG investigators are leading a genome-wide association study in Hispanic and Latino people, with about 3500 cases and about 4500 controls from North, Central, and South America. In collaboration with intramural and extramural experts, a multi-ancestry analysis (i.e. meta-analysis and polygenic risk score) is planned, to better define the underlying architecture of genetic susceptibility to gastric cancer and to generate a more useful polygenic risk score for screening.

Gastric Cancer Precursor Lesions study

Studies of premalignant lesions may provide insights into cancer etiology and inform risk stratification. In 2017, investigators at the DCEG and the Pontificia Universidad Católica de Chile launched the Gastric Cancer Precursor Lesions (GCPL) study. This is a multidisciplinary project, based in Chile, to evaluate risk factors for intestinal metaplasia, a precancerous change of the mucosa of the stomach with intestinal epithelium that confers an increased risk of gastric cancer. Patients with intestinal metaplasia may benefit from endoscopic surveillance to enable diagnosis of cancer at an earlier stage. Therefore, potential non-invasive markers of intestinal metaplasia are being evaluated. A better understanding of the etiology of premalignant lesions may inform future efforts for gastric cancer prevention and control in the USA and globally. The GCPL study is evaluating risk factors that have been insufficiently studied, such as *H. pylori* genomics and non-*H. pylori* gastric microbiota and parasitic infections. The study is also evaluating potential non-invasive screening markers, including pepsinogens and polygenic risk scores.

Upper Gastrointestinal Cancer Studies in Shanxi Province, China

The Upper Gastrointestinal Cancer Studies in Shanxi Province, China, were started in 1985 to look for major susceptibility genes for upper gastrointestinal cancers and to identify the genetic changes associated with their development [40]. These studies have provided most of the biological materials and data for the DCEG's genome-wide association studies of OSCC and cardia and non-cardia gastric cancer in Asian people. Evaluation of somatic and germline molecular markers (including assessment of gene–environment interactions) in malignant and premalignant tissues is in progress.

3.3.6 Addressing gaps in health policy

The lack of national screening guidelines prompted participants of the 2020 Gastric Cancer Summit at Stanford University to write a white paper with recommendations for the primary and secondary prevention of gastric cancer in the USA [14] (see Section 3.3.3). In April 2022, these recommendations were submitted to the United States Preventive Services Task Force, which is responsible for producing all the national screening guidelines that health insurance companies are required to fully cover in health insurance policies for people living in the USA. In 2022, the recommendation for primary prevention by testing for *H. pylori* infection did not move into the final research plan stage and evidence review.

An additional important pathway to changing health policy and practice in the USA is to establish guidelines through the national medical societies, such as the American Gastroenterological Association, the American College of Gastroenterology, and the American Society for Gastrointestinal Endoscopy. These three societies are all actively considering updating guidelines for both primary and secondary prevention of gastric cancer as a result of recent national efforts, such as the Gastric Cancer Summit at Stanford University, the NCI's Think Tank on Advancing Gastric Cancer Prevention, and other gastric cancer-specific forums. The lack of evidence for prevention strategies in the USA is the primary reason that the country does not have meaningful guidelines for gastric cancer prevention.

Several non-profit organizations in the USA are dedicated to educating and influencing policy-makers at the federal, state, and local government levels about gastric cancer. These organizations include No Stomach for Cancer [41], the Gastric Cancer Foundation [42], and the Debbie's Dream Foundation [43]. These organizations focus on raising awareness of gastric cancer, lobbying government policy-makers to increase funding for gastric cancer research, and supporting patients and families affected by gastric cancer.

3.3.7 Conclusions and future directions

Gastric cancer remains a leading cause of mortality among certain racial, ethnic, and immigrant groups in the USA, but there are no structured national strategies for its prevention. In the USA, gastric cancer is slowly gaining attention as a preventable

disease, and the clinical societies are actively updating prevention guidelines. Community education would be an effective and feasible public health strategy to enhance knowledge and awareness of this lethal disease. Demonstrative studies on implementation of primary and secondary prevention strategies for gastric cancer in various high-risk populations are needed to inform public health policy and health-care delivery.

References

1. NCI (2024). Cancer stat facts: stomach cancer. Bethesda (MD), USA: National Cancer Institute. Available from: https://seer.cancer.gov/statfacts/html/stomach.html.
2. Anderson WF, Camargo MC, Fraumeni JF Jr, Correa P, Rosenberg PS, Rabkin CS (2010). Age-specific trends in incidence of noncardia gastric cancer in US adults. JAMA. 303(17):1723–8. https://doi.org/10.1001/jama.2010.496 PMID:20442388
3. Anderson WF, Rabkin CS, Turner N, Fraumeni JF Jr, Rosenberg PS, Camargo MC (2018). The changing face of noncardia gastric cancer incidence among US non-Hispanic whites. J Natl Cancer Inst. 110(6):608–15. https://doi.org/10.1093/jnci/djx262 PMID:29361173
4. Torres-Roman JS, Alvarez CS, Guerra-Canchari P, Valcarcel B, Martinez-Herrera JF, Dávila-Hernández CA, et al. (2022). Sex and age differences in mortality trends of gastric cancer among Hispanic/Latino populations in the United States, Latin America, and the Caribbean. Lancet Reg Health Am. 16:100376. https://doi.org/10.1016/j.lana.2022.100376 PMID:36777153
5. NCI (2024). SEER*Explorer: an interactive website for SEER cancer statistics. Bethesda (MD), USA: Surveillance Research Program, National Cancer Institute. Available from: https://seer.cancer.gov/statistics-network/explorer/application.html.
6. Hooi JKY, Lai WY, Ng WK, Suen MMY, Underwood FE, Tanyingoh D, et al. (2017). Global prevalence of *Helicobacter pylori* infection: systematic review and meta-analysis. Gastroenterology. 153(2):420–9. https://doi.org/10.1053/j.gastro.2017.04.022 PMID:28456631
7. Keck JW, Miernyk KM, Bulkow LR, Kelly JJ, McMahon BJ, Sacco F, et al. (2014). *Helicobacter pylori* infection and markers of gastric cancer risk in Alaska Native persons: a retrospective case-control study. Can J Gastroenterol Hepatol. 28(6):305–10. https://doi.org/10.1155/2014/892084 PMID:24945184
8. Pete D, Salama NR, Lampe JW, Wu MC, Phipps AI (2024). The prevalence and risk factors of *Helicobacter pylori* infection and *cagA* virulence gene carriage in adults in the Navajo Nation. Microbiota Health Dis. 6:e1007. https://doi.org/10.26355/mhd_20247_1007 PMID:39071941
9. Tsang SH, Avilés-Santa ML, Abnet CC, Brito MO, Daviglus ML, Wassertheil-Smoller S, et al. (2022). Seroprevalence and determinants of *Helicobacter pylori* infection in the Hispanic Community Health Study/Study of Latinos. Clin Gastroenterol Hepatol. 20(3):e438–51. https://doi.org/10.1016/j.cgh.2021.02.042 PMID:33667677
10. Shah SC, Halvorson AE, Lee D, Bustamante R, McBay B, Gupta R, et al. (2024). *Helicobacter pylori* burden in the United States according to individual demographics and geography: a nationwide analysis of the veterans healthcare system. Clin Gastroenterol Hepatol. 22(1):42–50.e26. https://doi.org/10.1016/j.cgh.2023.05.016 PMID:37245717
11. McMahon MV, Taylor CS, Ward ZJ, Alarid-Escudero F, Camargo MC, Laszkowska M, et al. (2025). *Helicobacter pylori* infection in the United States beyond NHANES: a scoping review of seroprevalence estimates by racial and ethnic groups. Lancet Reg Health Am. 41:100890. https://doi.org/10.1016/j.lana.2024.100890
12. Nolen LD, Vindigni SM, Parsonnet J, Bruce MG, Martinson HA, Thomas TK, et al.; Symposium leaders (2020). Combating gastric cancer in Alaska Native people: an expert and community symposium. Gastroenterology. 158(5):1197–201. https://doi.org/10.1053/j.gastro.2019.11.299 PMID:31836529
13. Huang RJ, Koh H, Hwang JH, Abnet CC, Alarid-Escudero F, Amieva MR, et al.; Summit Leaders (2020). A summary of the 2020 Gastric Cancer Summit at Stanford University. Gastroenterology. 159(4):1221–6. https://doi.org/10.1053/j.gastro.2020.05.100 PMID:32707045
14. Huang RJ, Epplein M, Hamashima C, Choi IJ, Lee E, Deapen D, et al. (2022). An approach to the primary and secondary prevention of gastric cancer in the United States. Clin Gastroenterol Hepatol. 20(10):2218–2228.e2. https://doi.org/10.1016/j.cgh.2021.09.039 PMID:34624563
15. Shah S, Cappell K, Sedgley R, Pelletier C, Jacob R, Bonafede M, et al. (2023). Diagnosis and treatment patterns among patients with newly diagnosed *Helicobacter pylori* infection in the United States 2016–2019. Sci Rep. 13(1):1375. https://doi.org/10.1038/s41598-023-28200-3 PMID:36697470
16. Ho JJC, Navarro M, Sawyer K, Elfanagely Y, Moss SF (2022). *Helicobacter pylori* antibiotic resistance in the United States between 2011 and 2021: a systematic review and meta-analysis. Am J Gastroenterol. 117(8):1221–30. https://doi.org/10.14309/ajg.0000000000001828 PMID:35509128
17. Chey WD, Howden CW, Moss SF, Morgan DR, Greer KB, Grover S, et al. (2024). ACG clinical guideline: treatment of *Helicobacter pylori* infection. Am J Gastroenterol. 119(9):1730–53. https://doi.org/10.14309/ajg.0000000000002968 PMID:39626064

18. Wang A, Shaukat A, Acosta RD, Bruining DH, Chandrasekhara V, Chathadi KV, et al.; ASGE Standards of Practice Committee (2015). Race and ethnicity considerations in GI endoscopy. Gastrointest Endosc. 82(4):593–9. https://doi.org/10.1016/j.gie.2015.06.002 PMID:26260384
19. Kumar S, Araque M, Stark VS, Kleyman LS, Cohen DA, Goldberg DS (2024). Barriers to community-based eradication of *Helicobacter pylori* infection. Clin Gastroenterol Hepatol. 22(10):2140–2142.e1. https://doi.org/10.1016/j.cgh.2024.03.008 PMID:38580161
20. Riquelme A, Abnet CC, Goodman KJ, Piazuelo MB, Ruiz-Garcia E, de Assumpção PP, et al. (2023). Recommendations for gastric cancer prevention and control in the Americas. Lancet Reg Health Am. 27:100608. https://doi.org/10.1016/j.lana.2023.100608 PMID:37840576
21. NCI (2024). Funding for research areas. Bethesda (MD), USA: National Cancer Institute. Available from: https://www.cancer.gov/about-nci/budget/fact-book/data/research-funding.
22. National Cancer Institute Clinical Trials and Translational Research Advisory Committee (CTAC) Gastric and Esophageal Cancers Working Group (2022). Working group report. Bethesda (MD), USA: National Cancer Institute. Available from: https://deainfo.nci.nih.gov/advisory/ctac/1122/Goodman-Rustgi2.pdf.
23. Blot WJ, Li JY, Taylor PR, Guo W, Dawsey S, Wang G-Q, et al. (1993). Nutrition intervention trials in Linxian, China: supplementation with specific vitamin/mineral combinations, cancer incidence, and disease-specific mortality in the general population. J Natl Cancer Inst. 85(18):1483–92. https://doi.org/10.1093/jnci/85.18.1483 PMID:8360931
24. Qiao YL, Dawsey SM, Kamangar F, Fan J-H, Abnet CC, Sun X-D, et al. (2009). Total and cancer mortality after supplementation with vitamins and minerals: follow-up of the Linxian General Population Nutrition Intervention Trial. J Natl Cancer Inst. 101(7):507–18. https://doi.org/10.1093/jnci/djp037 PMID:19318634
25. Li WQ, Zhang JY, Ma JL, Li Z-X, Zhang L, Zhang Y, et al. (2019). Effects of *Helicobacter pylori* treatment and vitamin and garlic supplementation on gastric cancer incidence and mortality: follow-up of a randomized intervention trial. BMJ. 366:l5016. https://doi.org/10.1136/bmj.l5016 PMID:31511230
26. Thorell K, Muñoz-Ramírez ZY, Wang D, Sandoval-Motta S, Boscolo Agostini R, Ghirotto S, et al.; HpGP Research Network (2023). The *Helicobacter pylori* Genome Project: insights into *H. pylori* population structure from analysis of a worldwide collection of complete genomes. Nat Commun. 14(1):8184. https://doi.org/10.1038/s41467-023-43562-y PMID:38081806
27. Ghasemi-Kebria F, Semnani S, Fazel A, Etemadi A, Amiriani T, Naeimi-Tabiei M, et al. (2023). Esophageal and gastric cancer incidence trends in Golestan, Iran: an age-period-cohort analysis 2004 to 2018. Int J Cancer. 153(1):73–82. https://doi.org/10.1002/ijc.34518 PMID:36943026
28. Arnold M, Ferlay J, van Berge Henegouwen MI, Soerjomataram I (2020). Global burden of oesophageal and gastric cancer by histology and subsite in 2018. Gut. 69(9):1564–71. https://doi.org/10.1136/gutjnl-2020-321600 PMID:32606208
29. Shakeri R, Malekzadeh R, Nasrollahzadeh D, Pawlita M, Murphy G, Islami F, et al. (2015). Multiplex *H. pylori* serology and risk of gastric cardia and noncardia adenocarcinomas. Cancer Res. 75(22):4876–83. https://doi.org/10.1158/0008-5472.CAN-15-0556 PMID:26383162
30. Yano Y, Abnet CC, Poustchi H, Roshandel G, Pourshams A, Islami F, et al. (2021). Oral health and risk of upper gastrointestinal cancers in a large prospective study from a high-risk region: Golestan Cohort Study. Cancer Prev Res (Phila). 14(7):709–18. https://doi.org/10.1158/1940-6207.CAPR-20-0577 PMID:33731409
31. Sheikh M, Shakeri R, Poustchi H, Pourshams A, Etemadi A, Islami F, et al. (2020). Opium use and subsequent incidence of cancer: results from the Golestan Cohort Study. Lancet Glob Health. 8(5):e649–60. https://doi.org/10.1016/S2214-109X(20)30059-0 PMID:32353313
32. Sheikh M, Poustchi H, Pourshams A, Khoshnia M, Gharavi A, Zahedi M, et al. (2020). Household fuel use and the risk of gastrointestinal cancers: the Golestan Cohort Study. Environ Health Perspect. 128(6):67002. https://doi.org/10.1289/EHP5907 PMID:32609005
33. Eichelberger L, Murphy G, Etemadi A, Abnet CC, Islami F, Shakeri R, et al. (2015). Risk of gastric cancer by water source: evidence from the Golestan case-control study. PLoS One. 10(5):e0128491. https://doi.org/10.1371/journal.pone.0128491 PMID:26023788
34. Namaki M, Hashemian M, Arj A, Poustchi H, Roshandel G, Loghman AH, et al. (2023). Diet quality and subsequent incidence of upper gastrointestinal cancers: results from the Golestan Cohort Study. Arch Iran Med. 26(9):489–98. https://doi.org/10.34172/aim.2023.74 PMID:38310404
35. Collatuzzo G, Etemadi A, Sotoudeh M, Nikmanesh A, Poustchi H, Khoshnia M, et al. (2022). Meat consumption and risk of esophageal and gastric cancer in the Golestan Cohort Study, Iran. Int J Cancer. 151(7):1005–12. https://doi.org/10.1002/ijc.34056 PMID:35489023

36. Etemadi A, Kamangar F, Islami F, Poustchi H, Pourshams A, Brennan P, et al. (2015). Mortality and cancer in relation to ABO blood group phenotypes in the Golestan Cohort Study. BMC Med. 13(1):8. https://doi.org/10.1186/s12916-014-0237-8 PMID:25592833
37. Abnet CC, Freedman ND, Hu N, Wang Z, Yu K, Shu X-O, et al. (2010). A shared susceptibility locus in *PLCE1* at 10q23 for gastric adenocarcinoma and esophageal squamous cell carcinoma. Nat Genet. 42(9):764–7. https://doi.org/10.1038/ng.649 PMID:20729852
38. Hu N, Wang Z, Song X, Wei L, Kim BS, Freedman ND, et al. (2016). Genome-wide association study of gastric adenocarcinoma in Asia: a comparison of associations between cardia and non-cardia tumours. Gut. 65(10):1611–8. https://doi.org/10.1136/gutjnl-2015-309340 PMID:26129866
39. Hess T, Maj C, Gehlen J, Borisov O, Haas SL, Gockel I, et al. (2023). Dissecting the genetic heterogeneity of gastric cancer. EBioMedicine. 92:104616. https://doi.org/10.1016/j.ebiom.2023.104616 PMID:37209533
40. Gao Y, Hu N, Han XY, Ding T, Giffen C, Goldstein AM, et al. (2011). Risk factors for esophageal and gastric cancers in Shanxi Province, China: a case-control study. Cancer Epidemiol. 35(6):e91–9. https://doi.org/10.1016/j.canep.2011.06.006 PMID:21846596
41. No Stomach for Cancer (2024). Available from: https://nostomachforcancer.org/.
42. Gastric Cancer Foundation (2024). Available from: https://gastriccancer.org/.
43. Debbie's Dream Foundation (2024). Available from: https://debbiesdream.org/.