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Global lifetime estimates of expected and preventable gastric cancers across 185 countries

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Chronic infection with *Helicobacter pylori* is a modifiable cause of gastric cancer. To assist policymakers in advocating for and planning prevention strategies, we projected the future burden of gastric cancer, including that attributable to *H. pylori*, among a cohort of young people born in 2008–2017. Expected gastric cancer cases, in the absence of intervention, were quantified in 185 countries by combining national age-specific incidence rates from GLOBOCAN 2022 and cohort-specific mortality rates from the United Nations' demographic projections. Globally, 15.6 million (95% uncertainty interval 14.0–17.3 million) lifetime gastric cancer cases are expected within these birth cohorts, 76% of which are attributable to *H. pylori*. Two-thirds of cases will be concentrated in Asia, followed by the Americas and Africa. Whereas 58% of cases are expected in traditionally high-incidence areas for gastric cancer, 42% of cases are expected to occur in lower-incidence areas owing to demographic changes, particularly in sub-Saharan Africa, where the future burden could be six times greater than estimated in 2022. A shift in focus toward the life course of today's young people and their prospects of developing gastric cancer, with or without effective interventions, underscores the need for greater investment in gastric cancer prevention, including the implementation of population-based *H. pylori* screen-and-treat strategies.

Although some higher-resource countries, notably in East Asia, have put in place organized early detection programs[1,2], gastric cancer remains the fifth most common cause of cancer death worldwide[3], and there is evidence that the disease will remain an important public health problem for the foreseeable future unless effective measures are implemented[4]. Long considered an 'unplanned triumph' of primary prevention[5], gastric cancer has been prone to underinvestment relative to other infection-related cancers, such as cervical or liver cancer[3,6,7]. Of note, gastric cancer incidence rates at younger ages (<50 years) are increasing in both low- and high-incidence populations[8–11], which may, in turn, result in a deceleration or reversal of the long-term declines in incidence rates. Further, the numbers of gastric cancer cases and deaths are projected to increase in the next decades through population aging and growth irrespective of overall trends[4].

Most gastric cancers, especially noncardia gastric cancer (NCGC), are caused by chronic infection with *Helicobacter pylori*[12,13] and can be prevented by treatment of the infection with a combination of antibiotics and proton pump inhibitors. A systematic review of the available randomized controlled trials and observational studies showed that studies of different designs consistently found that

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Table 1 | Estimates of gastric cancer incidence in individuals born between 2008 and 2017

Category	Number of people at risk	Expected gastric cancer cases in the absence of changes in the current control measures		Gastric cancer cases attributable to *H. pylori* infection		PAF	NCGC-to-CGC ratio
		n	%	*n*	%		
Continent							
Africa	361,976,899	1,734,090	11.09%	1,398,975	11.79%	80.67%	8.8
Americas	150,177,542	1,971,916	12.61%	1,525,317	12.86%	77.35%	5.3
Asia	747,283,175	10,620,801	67.92%	7,988,392	67.35%	75.21%	5.6
Europe	81,167,377	1,242,968	7.95%	904,805	7.63%	72.79%	4.6
Oceania	6,764,264	67,832	0.43%	43,794	0.37%	64.56%	2.3
Total	1,347,369,256	15,637,607	100.00%	11,861,283	100.00%	75.85%	5.4
Subregion							
Northern Africa	55,254,703	330,136	2.11%	259,254	2.19%	78.53%	7.9
Sub-Saharan Africa	306,722,196	1,403,954	8.98%	1,139,720	9.61%	81.18%	9.2
Latin America and the Caribbean	104,241,729	1,644,937	10.52%	1,329,804	11.21%	80.84%	9.6
Northern America	45,935,814	326,979	2.09%	195,513	1.65%	59.79%	2.1
Central Asia	15,435,999	304,933	1.95%	222,324	1.87%	72.91%	4.7
Eastern Asia	197,204,416	5,871,080	37.54%	4,516,617	38.08%	76.93%	5.9
Southeastern Asia	112,402,947	847,885	5.42%	676,930	5.71%	79.84%	8.4
Southern Asia	365,763,486	2,936,142	18.78%	2,093,237	17.65%	71.29%	4.2
Western Asia	56,476,328	660,760	4.23%	479,285	4.04%	72.54%	4.3
Eastern Europe	33,776,332	690,744	4.42%	526,802	4.44%	76.27%	6.3
Northern Europe	12,733,793	111,672	0.71%	70,688	0.60%	63.30%	2.6
Southern Europe	14,219,900	220,923	1.41%	169,918	1.43%	76.91%	6.6
Western Europe	20,437,352	219,629	1.40%	137,397	1.16%	62.56%	2.5
Australia and New Zealand	3,888,378	41,173	0.26%	24,464	0.21%	59.42%	2.0
Melanesia	2,745,204	24,651	0.16%	17,716	0.15%	71.87%	3.9
Micronesia	30,879	377	0.00%	297	0.00%	78.81%	7.0
Polynesia	99,804	1,631	0.01%	1,316	0.01%	80.70%	8.2
HDI							
Low	320,264,636	1,548,170	9.90%	1,241,606	10.47%	80.20%	8.4
Medium	406,547,794	3,079,506	19.69%	2,314,135	19.51%	75.15%	5.2
High	426,409,118	7,865,664	50.30%	5,958,303	50.23%	75.75%	5.0
Very high	194,147,709	3,144,267	20.11%	2,347,239	19.79%	74.65%	6.0
Age-standardized incidence rate category							
0 to 5	778,178,444	4,054,870	25.93%	3,022,097	25.48%	74.53%	4.0
>5 to 10	234,435,904	2,583,276	16.52%	1,998,555	16.85%	77.37%	6.0
>10	334,724,030	8,999,083	57.55%	6,840,333	57.67%	76.01%	5.8

PAF, population attributable fraction.

H. pylori treatment prevents gastric cancer in *H. pylori*-positive individuals[14]. The working group convened by the International Agency for Research on Cancer/World Health Organization (IARC/WHO) in 2013 recommended that countries explore the possibility of introducing population-based *H. pylori* screen-and-treat programs based on the local disease burden, competing health priorities and cost-effectiveness analyses[15]. Nevertheless, there have been few attempts to implement such programs at the population level even in high-risk areas, although several European countries have recently initiated pilot studies as part of Europe's Beating Cancer Plan[16]. While a vaccine against *H. pylori* would be a powerful tool for gastric cancer prevention and would serve to overcome concerns surrounding antibiotic treatment, there appears little momentum at present to advance its development[17].

To assist policymakers and local stakeholders in advocating for and implementing prevention strategies, this study first quantifies the future burden of gastric cancer among individuals born between 2008 and 2017, assuming no changes in the current control measures for gastric cancer. We then estimate the number of cancers attributable to *H. pylori* infection as potentially preventable cancers within the same birth cohorts, taking into account the gastric cancer subsite. We present the results for the global population and for 185 countries by world region and Human Development Index (HDI).

Results

Expected gastric cancer cases by region, HDI and incidence

Assuming no change in future incidence rates, we would expect a lifetime estimate of 15.6 million new gastric cancer cases (95% uncertainty

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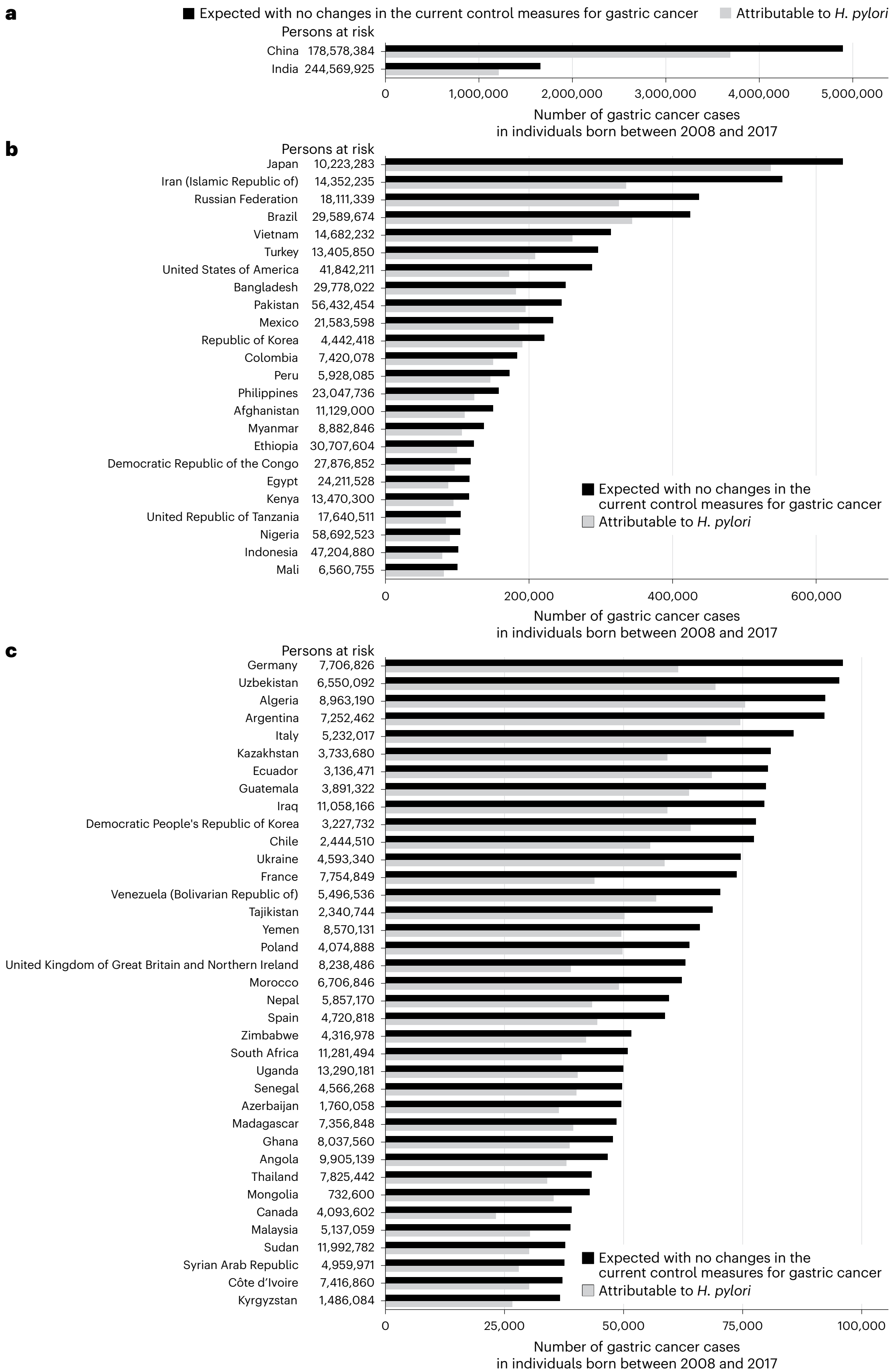

Fig. 1 | Country-specific estimates of gastric cancer cases. Expected numbers of country-specific gastric cancer cases in individuals born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer and the cases attributable to *H. pylori* infection. **a**–**c**, Countries are grouped according to their contribution to the overall gastric cancer burden, with countries sorted according to the expected number of gastric cancer cases and subsequently grouped into the following five categories: >1,000,000 (group A; **a**), 100,000–1,000,000 (group B; **b**) and 35,000–100,000 (group C; **c**). Countries from groups D and E are included in Extended Data Fig. 1, with the corresponding number of gastric cancer cases provided in Extended Data Table 3.

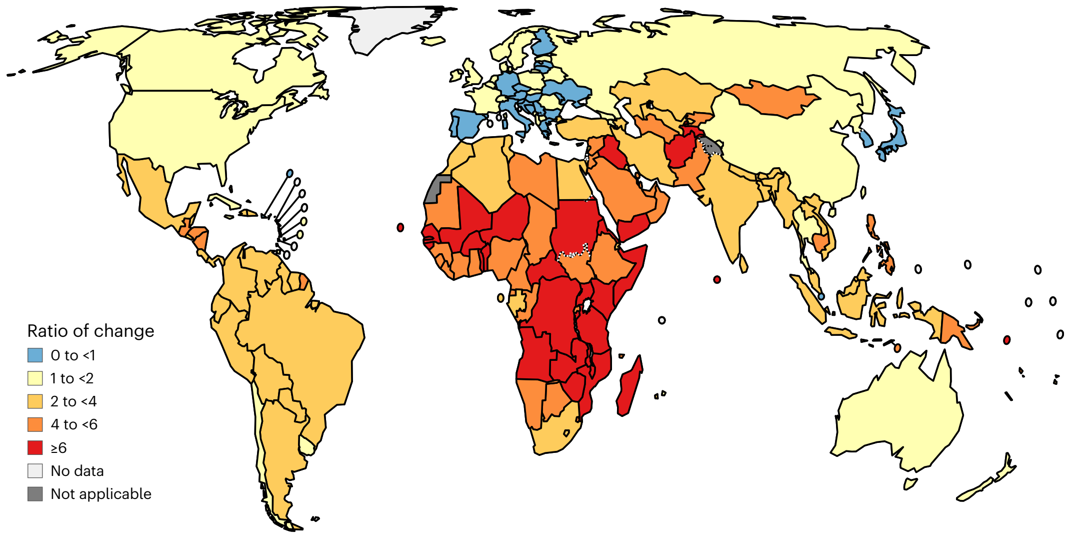

Fig. 2 | Ratio of the future-to-current number of gastric cancer cases. Ratio of the average number of expected lifetime gastric cancer cases in an average single birth cohort across birth cohorts born between 2008 and 2017 versus the total number of cases estimated cross-sectionally in 2022 (indicated here as the ratio of change). The designations used and the presentation of the material in this article do not imply the expression of any opinion whatsoever on the part of WHO and the IARC about the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

interval (UI) 14.0–17.3 million) among all men and women born between 2008 and 2017 globally (Table 1). The Asian continent is the major contributor to the expected burden, with more than 10.6 million cases (95% UI 9.8–11.4 million; 68% of all cases), followed by the Americas (2.0 million (95% UI 1.8–2.1 million); 13%), Africa (1.7 million (95% UI 1.3–2.4 million); 11%), Europe (1.2 million (95% UI 1.1–1.3 million); 8%) and Oceania (0.07 million (95% UI 0.05–0.20 million); 0.4%) (Table 1). Among the expected gastric cancer cases, approximately 76% are attributable to *H. pylori* infection globally, with 8.0 million gastric cancer cases in Asia attributable to the bacteria (accounting for 67% of the global burden of gastric cancer cases attributable to *H. pylori*), followed by 1.5 million (13%) and 1.4 million (12%) cases in the Americas and Africa, respectively.

Examining the burden by world subregion, we estimated that 5.9 million (95% UI 5.6–6.1 million) gastric cancer cases in eastern Asia and 2.9 million (95% UI 2.6–3.2 million) cases in southern Asia are expected to occur. These numbers are followed by 1.6 million (95% UI 1.5–1.8 million) in Latin America and the Caribbean and 1.4 million (95% UI 1.0–2.1 million) expected cases in sub-Saharan Africa (Table 1). More than 70% of the estimated burden of gastric cancer is concentrated in countries with very high (3.1 million, 95% UI 2.9–3.3 million) or high (7.9 million, 95% UI 7.3–8.3 million) HDI (Table 1). Although more than half of all gastric cancer cases are expected to occur in areas where the age-standardized incidence rates of the disease are greater than 10 in 100,000, a further 42% of cases are expected in areas where the rates are lower than this threshold (Table 1). The stratified analyses by sex and world region are shown in Extended Data Tables 1 and 2. The expected number of gastric cancer cases attributable to *H. pylori* infection is higher in women (16%) than in men (9%) in Africa, whereas the opposite is true for Asia (71% in men versus 61% in women).

Expected gastric cancer cases and the cases attributable to *H. pylori* infection

About two-fifths (42%) or 6.5 million (95% UI 6.1–6.9 million) new cases among these cohorts will occur in China and India alone (Fig. 1a and Extended Data Table 3). A further 5.6 million (95% UI 4.8–6.5 million, 36%) cases will occur among cohorts born in 25 countries where the expected burden is between 100,000 and 1 million cases (Japan, Iran, Russia, Brazil, Vietnam, Turkey, the USA, Pakistan, Bangladesh, Mexico, South Korea, Colombia, Peru, Philippines, Afghanistan, Myanmar, Democratic Republic of the Congo, Ethiopia, Kenya, Egypt, Nigeria, Tanzania, Mali, Indonesia and Uzbekistan; Fig. 1b and Extended Data Table 3). An additional 2.3 million (95% UI 1.8–3.2 million, 15%) cases are expected in countries where the expected burden is between 35,000 and 100,000 cases (Fig. 1c), with the remaining 8% (1.2 million (95% UI 0.9–1.9 million) cases) occurring in the remaining 158 countries (Extended Data Fig. 1 and Extended Data Table 3).

Ratio of change

The effect of future demographic changes on the national and regional gastric cancer burden is illustrated in Figs. 2 and 3 by comparing the average number of expected gastric cancer cases across a lifetime in an average single birth cohort relative to the national GLOBOCAN estimates for the year 2022. Demographic changes are expected to markedly increase the gastric cancer burden. In most of sub-Saharan Africa, where the current burden is low, the future burden in an average single birth cohort could be six times higher than at present (Figs. 2 and 3), with the burden in Asia and Latin America expected to be two to six times higher. Conversely, fewer gastric cancer cases relative to the 2022 GLOBOCAN estimates are expected in cohorts from the South Korea, Japan and some European countries with high or very high HDI (Fig. 2).

The correlation between the ratio of the future-to-current number of gastric cancer cases (ratio of change) and country-specific HDI was −0.71 (95% confidence interval −0.78, −0.64; Fig. 4). Twenty-three of forty-eight sub-Saharan African countries and territories with low or middle HDI are expected to have a future burden that is more than six times higher than estimated in 2022. By contrast, some East Asian countries with very high HDI and the highest incidence rates worldwide at present, such as the South Korea and Japan, are expected to have a decreased future burden, with a ratio of change of <1.

Effect of various assumptions on the expected number of gastric cancer cases

In sensitivity analyses, we assessed the impact of various scenarios on the expected number of gastric cancer cases (Fig. 5 and Extended Data Table 4). Under the scenarios of year-on-year decreases or increases of −3% or 3% in the NCGC incidence rates over 20 years, a 38.2% decrease or 66.5% increase in the expected cases is estimated. This contrasts with the more modest impact of the same range of trends in cardia gastric cancer (CGC) rates of only a 12% change in the estimates.

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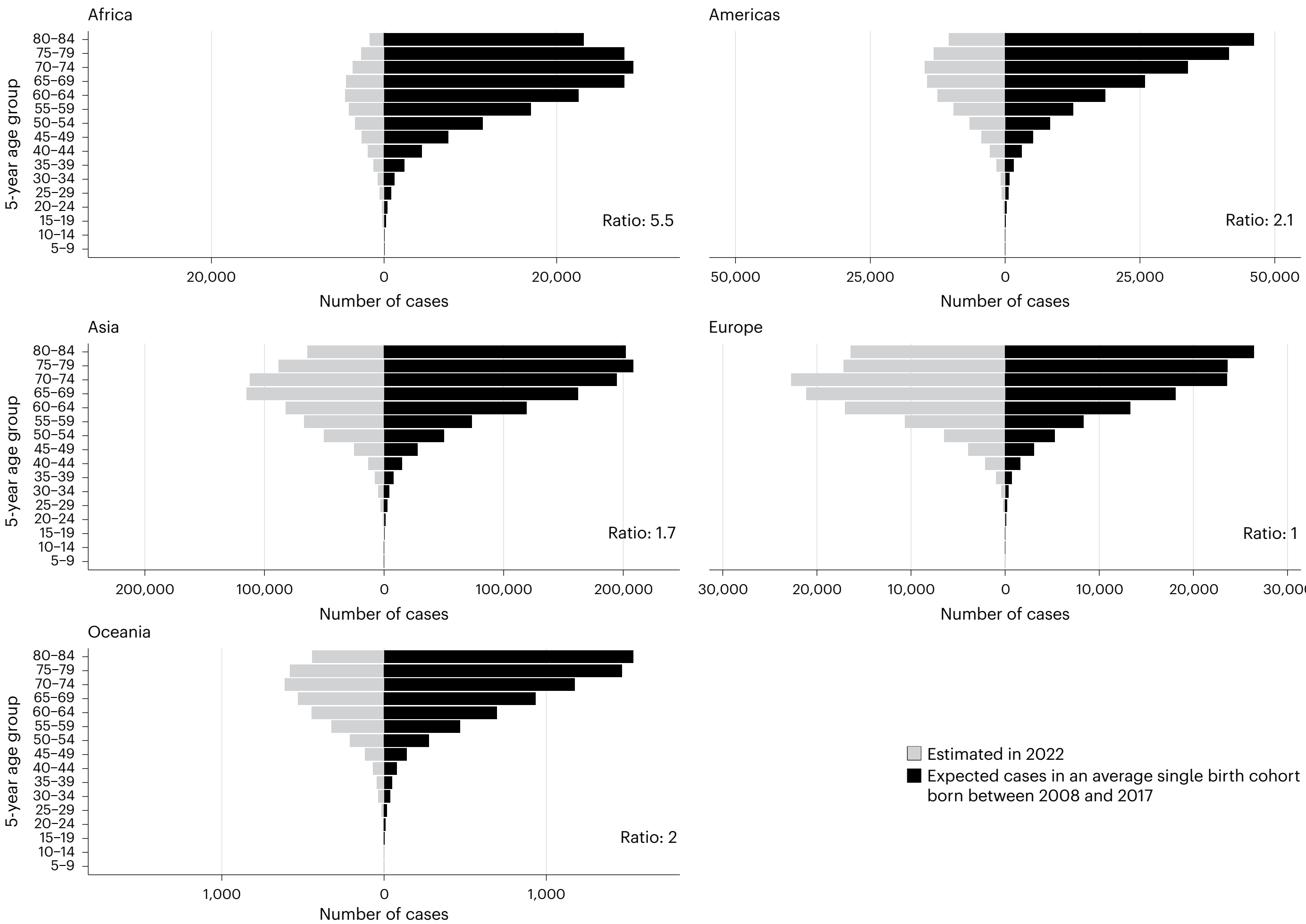

Fig. 3 | Age-specific number of expected gastric cancer cases. Age-specific distribution of the average number of expected gastric cancer cases in an average single birth cohort across birth cohorts of individuals born between 2008 and 2017 in the absence of changes in the current control measures, compared with those estimated cross-sectionally in 2022. 'Ratio' indicates the ratio of change.

Still, under this assumption of −3% year-on-year decreases in the NCGC incidence rates over 20 years, the estimated number of gastric cancer cases in our cohort will be higher than the cross-sectional estimates from GLOBOCAN 2022 (ratio of change = 1.1).

When we assessed the population-level impact of *H. pylori* screen-and-treat strategies, the expected number of gastric cancer cases would be reduced by up to 75% with 100% effectiveness of the intervention, compared with 67.5% and 60% when 90% and 80% of impact were assumed, respectively (Fig. 5). These analyses are also presented by sex and region (Extended Data Fig. 2). While little differences were observed between men and women in terms of the expected number of gastric cancer cases under these scenarios, the impact of using the lower or higher 95% projections of the United Nations (UN) death rates was relatively larger in Africa and Oceania compared to other regions, indicating that life expectancy in these regions has a larger effect on the estimated number of gastric cancer cases.

Discussion

In the absence of changes in the current practices of gastric cancer prevention, we expect that 15.6 million gastric cancer cases worldwide will occur among individuals born between 2008 and 2017, with around three-quarters of these preventable if *H. pylori* infection is eradicated. Our results highlight Asia as the main contributor to the estimated burden of gastric cancer (10.6 million cases), followed by the Americas (2.0 million cases) and Africa (1.7 million cases). The impact of demographic changes will be striking in these latter continents, with the lifetime gastric cancer burden among these birth cohorts in Africa, for example, estimated to be nearly six times greater than the currently estimated burden in 2022.

In Asia, the major contributor to the current gastric cancer burden worldwide, few countries have introduced gastric cancer prevention programs. While the South Korea[2], Japan[1] and China[18] continue focusing efforts on organized programs through national or regional endoscopic screening for gastric cancer, population-based *H. pylori* screen-and-treat programs are also being progressively implemented, for example, in the Matsu Islands[19], Japan (through national health insurance coverage of *H. pylori* treatment for patients with endoscopically confirmed gastritis)[20], and Bhutan[21]. In 2023, Bhutan completed time-bound national programs for gastric cancer prevention as part of the Health Flagship Project, a population-based *H. pylori* screen-and-treat program for persons aged 18–75 years, and population-based endoscopic screening for precancerous lesions for those aged 40–75 years[21].

The lack of public health action on gastric cancer prevention in the Americas has been highlighted[22]. This is despite the substantial *H. pylori*-attributable gastric cancer burden in the region and evidence from a long-term chemoprevention trial showing that *H. pylori* eradication had a long-term beneficial effect, including substantial reductions in histological progression in a high-risk Hispanic population[23]. In the USA, there are currently no national guidelines or formal

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recommendations for gastric cancer prevention, although gastric cancer disproportionately affects Asian Americans, Hispanic Americans, African Americans and American Indian–Alaska Native individuals[6], and an increasing trend in young individuals (age <50 years) has been observed between 2016 and 2022, most notably in women[24].

Similarly, in Africa, no known population-based gastric cancer prevention programs are available despite *H. pylori* infection being very common on the continent. Efforts are ongoing to improve data collection and formulate evidence-based and locally relevant practice guidelines on *H. pylori* management in Africa[25]. Our results endorse the importance of making changes to the current practice and urge regional health systems to be prepared to manage the growing burden of this largely preventable disease by planning pilot and feasibility projects, including *H. pylori* screen-and-treat programs.

The observation of the contrasting low risk of gastric cancer despite ubiquitous *H. pylori* infection, for example, in Africa[26], may in part reflect the lack of robust cancer registries to capture the actual number of cases, emphasizing the importance of establishing high-quality population-based registries. This may also partly be an effect of competing mortality from *H. pylori*-related gastrointestinal conditions[27]. Gastric cancer is already a common cancer in some western African countries, such as Senegal, Guinea and Mali. Given the anticipated increasing burden of gastric cancer shown here, local cancer control planning must be reconfigured to embrace prevention policies. More than one-quarter of the future global burden is expected to occur in countries that can be categorized as having very low incidence rates. These findings further highlight the fact that gastric cancer will remain a major public health problem globally over the next decades, with the substantial demographic-driven increase in burden in these traditionally low-risk areas compounding the continuing high burden in high-risk areas.

In our study, we observed that much of the global burden of gastric cancer continues to occur in very high- or high-HDI countries in East Asia, mostly in China, due to their large and aging populations. In these birth cohorts, we used the most recent attributable fraction estimates of *H. pylori* infection for CGC (62%) and NCGC (79%) in China as measured by a sensitive immunoblot assay[28,29]. The findings suggest that the beneficial effects of *H. pylori* treatment extend beyond NCGC in this high-burden setting, leading to larger estimates of impact than previously understood. A large-scale trial of community-based *H. pylori* eradication in China reported no severe intolerable adverse events while highlighting its potential as a public health policy for gastric cancer prevention[30].

Given that gastric cancer is largely preventable, more active intervention and control programs should be implemented in these high-resource East Asian countries. This can be done by prioritizing gastric cancer prevention and allocating resources to the primary prevention of the disease, considering the continued high *H. pylori*-attributable burden that is foreseen. Our finding of a negative correlation between the ratio of future-to-current number of gastric cancer cases and HDI suggests that prevention strategies need to be adapted to each country's resource level. Treatment of *H. pylori* at the population level is currently the best evidence-based and most affordable approach that could be adapted in low- to medium-HDI settings, along with early diagnosis focusing on detecting symptomatic patients as early as possible for better treatment and survival, compared to endoscopy-based screening programs or cancer treatment. The potential of the population-level impact of *H. pylori* screen-and-treat strategies in reducing the future number of gastric cancer cases is clearly shown in our results. Previous cost-effectiveness analyses consistently reported that *H. pylori* screen-and-treat strategies are a cost-effective intervention for gastric cancer prevention, even in low-risk settings[31].

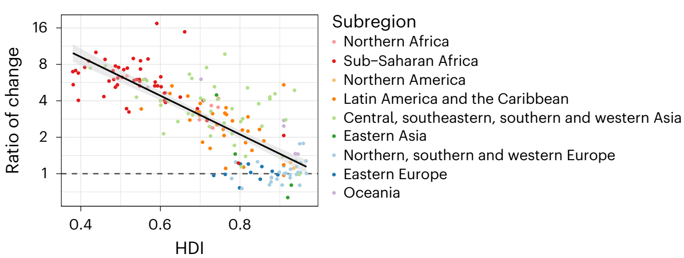

Fig. 4 | Correlation between the ratio of change and country-specific HDI. The *y* axis is $\log_2$ transformed. The black line and the gray shaded area represent the mean and the 95% confidence interval for the prediction of the fitted linear model.

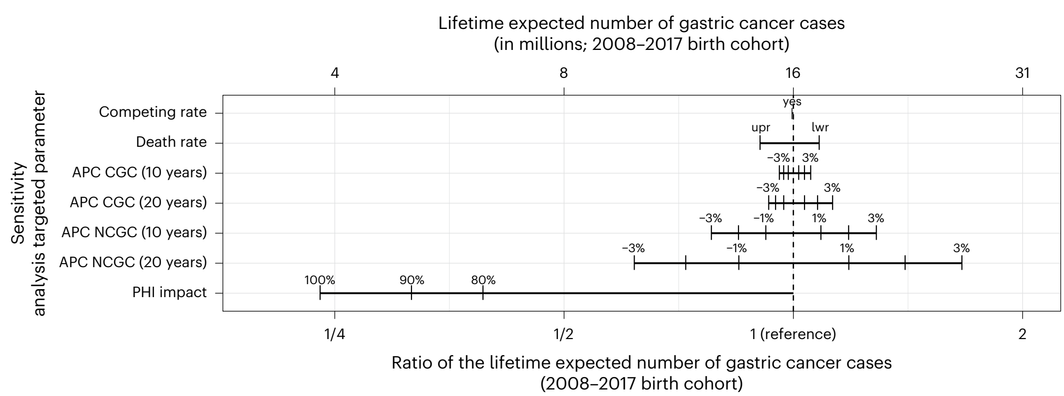

Fig. 5 | Global analysis outcomes by various tested parameters. This figure shows the variation in the overall lifetime expected number of gastric cancer cases in individuals born between 2008 and 2017 according to changes in the model parameters. The variation could be read in terms of the absolute number of cases (top *x* axis) or the ratio of the lifetime expected number of gastric cancer cases (bottom *x* axis). The reference model parameters are the same as the ones assumed in the main text (that is, no competitive risk between CGC and NCGC, median UN death rate scenario, no annual percentage change (APC) for CGC and NCGC, no changes in the current public health intervention (PHI) for gastric cancer control). Each line on the *y* axis represents the specific parameter changed compared to the reference while all the other parameters remain unchanged. The tested parameters are as follows: (1) competing rate: including the CGC competing rate in the NCGC burden calculation and vice versa 2 (yes). (2) Death rate: changing the overall cause of death competing risk for the UN lower (lwr) or upper (upr) scenario. (3) APC CGC (10 years): applying APCs of −3%, −2%, −1%, 1%, 2% and 3% for 10 years to the CGC incidence rate. (4) APC CGC (20 years): applying APCs of −3%, −2%, −1%, 1%, 2% and 3% for 20 years to the CGC incidence rate. (5) APC NCGC (10 years): applying APCs of −3%, −2%, −1%, 1%, 2% and 3% for 10 years to the NCGC incidence rate. (6) APC NCGC (20 years): applying APCs of −3%, −2%, −1%, 1%, 2% and 3% for 20 years to the NCGC incidence rate. (7) PHI impact: applying the population-level impact of *H. pylori* screen-and-treat strategies by 80–100%.

Based on data from randomized controlled trials, Ford et al.[32] estimated that more than 8.7 million disability-adjusted life-years would be gained if population-based *H. pylori* screening and treatment are implemented globally. Their review of four randomized controlled trials with long-term follow-up reconfirmed the long-term efficacy of *H. pylori* eradication in preventing gastric cancer cases and deaths among healthy individuals with *H. pylori* infection and also showed that the benefits were not limited to very old adults[33]. Despite the accumulating evidence, very few countries have piloted *H. pylori* screen-and-treat programs at the population level. Our projections of the potentially modifiable gastric cancer burden provide policymakers with critical information relevant to cancer control planning. In addition, effective strategies will have additional benefits in reducing other important clinical conditions, including peptic ulcer disease, dyspepsia, iron deficiency and idiopathic thrombocytopenic purpura[15].

In Europe, with the adoption of Europe's Beating Cancer Plan in 2021 and subsequent recommendations on gastric cancer prevention made by the European Council, population-based *H. pylori* screen-and-treat programs are emphasized as an important tool for gastric cancer prevention, especially for those with an intermediate to high gastric cancer burden[34].

The implementation outcomes of such programs in Europe, including the collection of cost data, are currently being analyzed in two European Union projects focusing on gastric cancer prevention: EUROHELICAN ('Accelerating gastric cancer reduction in Europe through *H. pylori* eradication') and TOGAS ('Towards gastric cancer screening implementation in the European Union')[35]. The IARC/WHO has developed global guidance on the implementation of population-based *H. pylori* screen-and-treat strategies for gastric cancer prevention by convening an international expert working group[36]. The group sought to examine various aspects, including concerns surrounding a potential increase in antibiotic resistance, to tailor future gastric cancer prevention efforts accordingly[36].

While our study findings highlight the potential public health impact of *H. pylori* screen-and-treat approaches that are evidence-based, relatively simple and effective, and safe and inexpensive to implement, relative to cancer treatment, in mitigating the increasing gastric cancer burden, the importance of continued efforts to develop an *H. pylori* vaccine needs to be stressed. As shown in the sensitivity analyses, the population-level impact of *H. pylori* treatment has substantial potential in determining the future burden of gastric cancers. This indicates that, as in human papillomavirus vaccine programs for cervical cancer prevention or hepatitis B vaccine programs to reduce the risk of liver cancer, an *H. pylori* vaccine would greatly advance the fight against gastric cancer, given that vaccination is one of the most context-responsive prevention strategies and is highly adaptable, especially in low- and middle-income settings where we expect to see a high number of *H. pylori*-attributable gastric cancer cases. Currently, only one *H. pylori* vaccine has passed phase 3 of a clinical trial (NCT02302170)[37]. More investment in future vaccine trials focusing on pediatric populations should be made, clarifying the mechanisms of vaccine-associated immunoprotection[38]. The accelerated development of vaccines against SARS-CoV-2 may facilitate new approaches for developing *H. pylori* vaccines[39]. An *H. pylori* vaccine could then take advantage of well-established existing financing and logistical support mechanisms[40], which would help reduce barriers and challenges in reaching target populations and therefore bridge the inequity gap and ensure sustainability.

Some important limitations of the study need to be highlighted. Our analyses were based on data from GLOBOCAN, Cancer Incidence in Five Continents (CI5) and UN World Population Prospects, whose quality and accuracy depend on the availability and reliable and timely collection of data. There is likely an underestimation of *H. pylori*-attributable gastric cancers that are not captured in local and national registries, especially in lower-resource settings due to the relative paucity of high-quality population-based cancer registries. The information on gastric cancer and its subsite as extracted from population-based registries available from the IARC's CI5 Volume XII (CI5-XII) database, a compilation of high-quality cancer incidence data at the national or subnational level, is particularly sparse in Africa[41]. Similarly, a marked proportion of all gastric cancers was categorized as having an overlapping (4%) or unspecified (26%) location, demonstrating the difficulty in estimating the site-specific proportions of gastric cancer. In an attempt to mitigate potential misclassification, we included only registries with at least 25% of topographically specified cases (C16.0 to C16.8) in this study for subsite-specific analyses, although the extended inclusion of cancer registries not meeting this criterion did not materially affect the results. Likewise, the HDI also relies on available national data and may mask subnational inequalities. Nevertheless, these reference data represent the best of what is currently available worldwide, and the results thus reflect the current knowledge on the expected and preventable burden.

In conclusion, we have projected the regional and country-specific burden of gastric cancer and estimated the burden attributable to *H. pylori* infection, assuming no change in the current age-specific rates of gastric cancer and no change in the current gastric cancer control measures. Our future estimates highlight an increasing burden of gastric cancer in areas traditionally considered to have low incidence, including Africa, and are of immediate relevance to public health decision-makers seeking to recalibrate prevention strategies based on local cancer profiles. Shifting the focus of gastric cancer burden projections from the traditional cross-sectional viewpoint toward the expected gastric cancer burden in young cohorts across their life course can aid policymakers in implementing effective interventions as part of a gastric cancer prevention program.

Online content

Any methods, additional references, Nature Portfolio reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at https://doi.org/10.1038/s41591-025-03793-6.

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Methods

Country classification

We present the contribution to the expected absolute burden of gastric cancer in the year 2022 of the 185 countries included in IARC's GLOBOCAN database hosted at the Global Cancer Observatory[42], grouped by continent, UN world region and level of HDI. The HDI is reported by the UN Development Programme (https://hdr.undp.org/data-center) as a measure of the social and economic development of countries; details on the data sources and methods used in developing the GLOBOCAN estimates at the national level are available elsewhere[43]. Countries were sorted by the expected number of cases and subsequently grouped into the following five categories of incidence burden: >1,000,000, 100,000–1,000,000, 35,000–100,000, 10,000–35,000 and <10,000. We also grouped countries based on their age-standardized incidence rates to illustrate the gastric cancer burden: 0–5 in 100,000, >5–10 in 100,000 and >10 in 100,000. The HDI was further stratified by the predefined UN Development Programme four-tier categories into the low (<0.55), middle (0.55–0.70), high (0.70–0.79) and very high (≥0.80) levels.

Site-specific proportions of gastric cancer

To take into account the current evidence on potentially differential relationships between *H. pylori* infection and gastric cancer subsite by region[28], we obtained the site-specific proportions of gastric cancer from the CI5-XII database[44] for 52 countries where subsite classification is available, including a 'cardia' category (C16.0). Previous versions of the CI5 were used if no information was available in CI5-XII at the country level (ten countries), and other cancer registry data were used for eight other countries (see below for details).

Source of gastric cardia and noncardia cancers

Country-specific (when available) and subregional proportions of CGC versus NCGC were based on the following:

- CI5-XII for Algeria, Australia, Austria, Belarus, Belgium, Benin, Brazil, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czechia, Denmark, Ecuador, Estonia, Finland, France, Germany, Guadeloupe, Iceland, Iran, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Malta, Martinique, Netherlands, New Caledonia, New Zealand, Norway, Peru, Poland, Portugal, Puerto Rico, Russia, Réunion, Singapore, Slovenia, South Korea, Spain, Sweden, Switzerland, Turkey, Ukraine, the UK and the USA
- CI5-XI for Bulgaria, French Guiana, Jamaica, Jordan, Saudi Arabia, Slovakia and Vietnam
- CI5-X for Egypt, Qatar and Tunisia
- Other cancer registry data with at least 25% of topographically specified cases for French Polynesia, Kazakhstan, Nigeria, South Africa, Pakistan, Romania, Serbia and Vanuatu

When country-specific estimates from the proportions of cardia and noncardia cancers were not available, we attributed the mean values of the UN subregional proportions estimated from a hierarchical logistic random-effects model.

The 'noncardia' category includes six different topographic locations (C16.1 to C16.6), plus an overlapping category (C16.8) and a 'not otherwise specified' category (C16.9). The estimated numbers of noncardia cancer cases were obtained by applying the proportion of NCGC cases in existing local cancer registries (that is, C16.1 to C16.9) to the total number of gastric cancer cases by sex, age groups (<65 and 65+ years) and world area as estimated in the GLOBOCAN database, given that subsite data are not available. Using this method, we made the strong assumption that all cases in C16.8 and C16.9 are noncardia. To compute the proportions, we considered only the registries with at least 25% of topographically specified cases (C16.0 to C16.8). The proportions of CGC and NCGC were estimated using country-specific data for those with more than four cases of gastric cancer per age group and sex. Country-specific data were pooled at the UN subregional level to estimate the proportion of cardia and noncardia cases for countries with insufficient data. More details are available elsewhere[45]. To assess the robustness of our estimates to the cancer registry selection, we reconducted the analysis including the following 30 additional countries where registries had <25% of topographically specified cases: Argentina, Bahrain, Bosnia and Herzegovina, Botswana, Brunei, Congo (Brazzaville), Cuba, Côte d'Ivoire, Ghana, Guinea, India, Kenya, Kuwait, Lebanon, Libya, Malawi, Malaysia, Mali, Mauritius, Morocco, Namibia, Oman, Philippines, Seychelles, Thailand, Trinidad and Tobago, Uganda, Uruguay, Zambia and Zimbabwe. The results did not materially change.

Number of gastric cancers attributable to *H. pylori* infection

Accurate quantification of the fraction of gastric cancer cases attributable to *H. pylori* is highly dependent on obtaining accurate estimates of relative risk. In this study, we used data from improved studies that assessed the relative risk using prediagnostic samples with long-term follow-up, as well as studies using more sensitive immunoblotting than ELISA, to be consistent with our previous work on the global burden of cancer attributable to infections[12,46]. The estimated number of gastric cancer cases attributable to chronic infection with *H. pylori* was obtained using the attributable fractions previously calculated from prospective studies that applied immunoblotting to detect *H. pylori* at least 10 years before cancer diagnosis[46], separately for NCGC (89% worldwide) and CGC (29% in eastern Asia, 0% in the rest of the world)[12], except for China for which we used the latest estimates from a more recently published large-scale prospective study (78.5% for NCGC and 62.1% for CGC)[29]. These *H. pylori*-attributable cases are assumed to be potentially preventable through implementing population-based *H. pylori* screen-and-treat programs. Of note, *H. pylori* infection rates were not incorporated into our analyses, as we assumed no change in the current practices of gastric cancer prevention and no change in age-specific gastric cancer incidence rates in future years.

Expected lifetime number of gastric cancers

We estimated the expected lifetime number of gastric cancers among ten birth cohorts aged 5–14 years in 2022 (that is, those born between 2008 and 2017), up to the time point when the individuals would reach 84 years old, by adapting ATLAS, a previously published cancer progression model[47]. The statistical package for the ATLAS model is implemented in the methis.atlas R package. More information about the model is available on the IARC's METHIS website (https://iarc-miarc.gitlab.io/methis/methis.website/docs/models/atlas.html). ATLAS combines the age-specific incidence estimates from the Global Cancer Observatory GLOBOCAN (https://gco.iarc.fr//today/en) project and the cohort-specific mortality rate projections by age from the UN Department of Economic and Social Affairs, Population Division, allowing for the competing risk of dying from any cause before being diagnosed with gastric cancer. Accounting for cohort-specific mortality rates by age enabled us to incorporate future demographic changes in our projections.

Briefly, for a given cohort, the expected cumulative number of gastric cancers between age 5 and 84 years was calculated using the 5-year age group-specific gastric cancer incidence rate projections from GLOBOCAN 2022, and 5-year age group-specific mortality rates were obtained from the UN Department of Economic and Social Affairs, Population Division[48].

Let A_5 be the age group 5 years and A_{84} the age group 84 years. Let us denote by λ_C and λ_M the gastric cancer incidence rate and mortality rate, respectively, both assumed to be piecewise constant functions in each 5-year age group. That is, for $i = 5, \ldots, 84$, $\lambda_{C,i}$ and $\lambda_{M,i}$ denote the constant A_i-specific gastric cancer incidence and mortality rates, respectively. Let us also designate by A_i^L and A_i^U the lower and upper bounds of age interval A_i, with, for $i > 0$, $A_i^L = A_{i-1}^U$. Then, the survival free from an event (that is, gastric cancer diagnosis or death) by age A_I^U for a cohort of individuals aged 5 years at the start of follow-up can be calculated according to the following formula:

$$S\left(A_I^U\right) = S\left(A_{I+1}^L\right) = \exp\left(-\int_{A_0^L}^{A_I^U} \left(\lambda_C(u) + \lambda_M(u)\right) du\right) = \exp\left(-5\sum_{i=0}^{I} \left(\lambda_{C,i} + \lambda_{M,i}\right)\right)$$

Now, the cumulative incidence of gastric cancer by age A_I^U can be calculated as

$$\mathrm{CumI}\left(A_I^U\right) = \int_{A_0^L}^{A_I^U} \lambda_C(u) S(u)\, du = \sum_{i=0}^{I} \lambda_{C,i} \int_{A_i^L}^{A_i^U} S(u)\, du = \sum_{i=0}^{I} \mathrm{CumI}_i$$

We then have

$$\begin{aligned}
\mathrm{CumI}_i &= \lambda_{C,i} \int_{A_i^L}^{A_i^U} S(u)\, du \\
&= \lambda_{C,i} \int_{A_i^L}^{A_i^U} \exp\left(-\int_{A_0^L}^{u} \left(\lambda_C(v) + \lambda_M(v)\right) dv\right) du \\
&= \lambda_{C,i} \int_{A_i^L}^{A_i^U} \exp\left(-\int_{A_0^L}^{A_i^L} \left(\lambda_C(v) + \lambda_M(v)\right) dv\right) \\
&\quad \exp\left(-\int_{A_i^L}^{u} \left(\lambda_C(v) + \lambda_M(v)\right) dv\right) du \\
&= \lambda_{C,i} \exp\left(-5\sum_{k=0}^{i-1} \left(\lambda_{C,k} + \lambda_{M,k}\right)\right) \int_{A_i^L}^{A_i^U} \\
&\quad \exp\left(-\int_{A_i^L}^{u} \left(\lambda_C(v) + \lambda_M(v)\right) dv\right) du \\
&= -\frac{\lambda_{C,i}}{\lambda_{C,i} + \lambda_{M,i}} \exp\left(-5\sum_{k=0}^{i-1} \left(\lambda_{C,k} + \lambda_{M,k}\right)\right) \\
&\quad \left(\exp\left(-5\left(\lambda_{C,i} + \lambda_{M,i}\right)\right) - 1\right) \\
&= -\frac{\lambda_{C,i}}{\lambda_{C,i} + \lambda_{M,i}} \left(S\left(A_i^U\right) - S\left(A_{i-1}^U\right)\right) \\
&= \frac{\lambda_{C,i}}{\lambda_{C,i} + \lambda_{M,i}} \left(S\left(A_i^L\right) - S\left(A_i^U\right)\right)
\end{aligned}$$

Based on the assumption that the age group-specific incidence rates were stable across birth cohorts, the cumulative incidence between ages 5–14 years in 2022 and age 84 years was then obtained by summing the age group-specific contributions: $\mathrm{CumI}_{5-84} = \sum_{i=5}^{84} \mathrm{CumI}_i$. Finally, the cumulative number of gastric cancer cases was calculated by multiplying this cumulative incidence by the size of the cohort at age 5–14 years in 2022, estimated from the UN database. UIs were estimated with Monte Carlo simulation combining the uncertainty about the overall gastric cancer incidence as reported in GLOBOCAN 2022 (central estimates and 95% UI), age-specific distribution of gastric cancer (GLOBOCAN 2022), proportions of CGC and NCGC, and mortality rate prediction uncertainties as reported by the UN Population Division (median estimates and 95% UI).

To illustrate the effect of future demographic changes on country-specific gastric cancer burden, we compared the average number of lifetime gastric cancer cases (up to age 84 years) that would be expected in an average single birth cohort born between 2008 and 2017—assuming no changes in the current practices of gastric cancer prevention—versus the total number of cases as estimated in the GLOBOCAN database, calculating a ratio between the two estimates (termed as the 'ratio of change'). We assumed no change in the annual incidence of gastric cancer attributable to modifications in *H. pylori* prevalence or gastric cancer screening practices. The correlation between the above-mentioned ratio of change and country-specific HDI was calculated using Pearson's coefficient (*r*). Country-specific 95% UIs for the average number of expected cases, obtained using simulation, combine the uncertainty in the gastric cancer incidence estimates from GLOBOCAN 2022 (central estimates and 95% UI) and all-cause mortality projections from the UN (median variant and 95% UI). These two sources of uncertainty are considered independent. No trends in age-specific gastric cancer incidence rates are considered.

Sensitivity and stratified analyses

We additionally conducted sensitivity analyses to quantify how much our estimates are affected by varying patterns of disease burden, life expectancy and cancer control practice. We also performed stratified analyses by sex and world region. The lifetime number of gastric cancers was estimated according to different model parameter disruptions in the 2008–2017 birth cohorts. Model outcomes were compared to the reference scenario, that is, (1) no competitive risk between CGC and NCGC, (2) median UN death rate scenario, (3) no APC in the incidence of CGC and NCGC, and (4) no change in the current public health intervention for gastric cancer control. The estimates were expressed in terms of the ratio of change and the percentage of change in the lifetime number of gastric cancer cases expected. The tested parameters included the following: (1) competing rate of the CGC versus NCGC burden; (2) death rate incorporating the lower 95% (optimistic) versus the higher 95% (pessimistic) estimates of the probabilistic projection of crude death rate by country or area in 2024–2100 from the UN model; (3) APC in the incidence of CGC and NCGC for 10 and 20 years, separately, by applying varying levels of APC (−3% to 3%); and (4) population-level impact of *H. pylori* screen-and-treat strategies by 80–100%.

All analyses were conducted with R (version 4.4.1) and the methis.atlas package (version 0.3.0).

Ethics and inclusion statement

This study was conducted with a commitment to providing policymakers with evidence that is both globally comparable and regionally meaningful. GLOBOCAN and CI5 estimates are based on data from population-based cancer registries and vital statistics registries worldwide, including low- and middle-income countries, and are relevant to all countries. Global estimates generated through this research are designed to be actionable and relevant to regional policymakers, providing them with timely, high-resolution data to inform decision-making and prioritize interventions tailored to local needs.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

All data used in this analysis are publicly available. GLOBOCAN estimates are available from the International Agency for Research on Cancer's Global Cancer Observatory (https://gco.iarc.fr//today/en). The United Nations Development Programme's Human Development Index data are available at https://hdr.undp.org/data-center/documentation-and-downloads. The United Nations World Population Prospects 2022 Probabilistic Projections data are available at https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/wpp2022_summary_of_results.pdf.

Code availability

All custom code used for the analysis of the data is available on GitLab (https://gitlab.com/iarc-ice/miarc/atlas-hpylori). No restrictions on the availability of the code have been set. The statistical package for the ATLAS model is implemented in the methis.atlas R package.

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More information about the model is available on the IARC's METHIS website (https://iarc-miarc.gitlab.io/methis/methis.atlas/).

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Author contributions

The study was conceptualized by J.Y.P., G.C. and I.B. Analyses were conducted by D.G. under the supervision of I.B. and with input from J.Y.P., C.J.A., F.B. and G.C. The first manuscript draft was prepared by J.Y.P. and D.G. All authors contributed to the editing of the manuscript.

Competing interests

The authors declare no competing interests.

Additional information

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Extended Data Table 1 | Number of men at risk and number of gastric cancers expected in men born between 2008 and 2017 by continent, subregion, HDI, and incidence category

	Number of men at risk	Expected gastric cancer cases in absence of changes in the current control measures		Gastric cancer cases attributable to *H. pylori* infection		PAF	NCGC:CGC ratio
		N	%	N	%		
Continent							
Africa	183,098,399	916,174	8.79%	727,100	9.35%	79.36%	7.6
Americas	76,629,074	1,256,566	12.06%	944,073	12.14%	75.13%	4.1
Asia	390,242,266	7,381,877	70.85%	5,503,873	70.76%	74.56%	5.0
Europe	41,661,994	822,968	7.90%	579,300	7.45%	70.39%	3.7
Oceania	3,487,127	41,129	0.39%	24,007	0.31%	58.37%	1.6
Total	695,118,860	10,418,714	100.00%	7,778,352	100.00%	74.66%	4.7
Sub-region							
Northern Africa	28,219,335	188,919	1.81%	144,887	1.86%	76.69%	6.8
Sub-Saharan Africa	154,879,065	727,254	6.98%	582,214	7.49%	80.06%	8.2
Latin America and the Caribbean	53,122,480	1,046,321	10.04%	832,844	10.71%	79.60%	8.1
Northern America	23,506,595	210,245	2.02%	111,229	1.43%	52.90%	1.5
Central Asia	7,942,179	196,582	1.89%	141,579	1.82%	72.02%	4.5
Eastern Asia	105,438,130	4,239,505	40.69%	3,247,854	41.76%	76.61%	5.2
South-eastern Asia	57,978,670	558,376	5.36%	438,799	5.64%	78.58%	7.1
Southern Asia	189,885,944	1,957,341	18.79%	1,373,506	17.66%	70.17%	4.0
Western Asia	28,997,344	430,073	4.13%	302,135	3.88%	70.25%	3.7
Eastern Europe	17,338,322	456,710	4.38%	344,457	4.43%	75.42%	5.7
Northern Europe	6,531,789	75,544	0.73%	44,842	0.58%	59.36%	2.0
Southern Europe	7,314,865	144,147	1.38%	106,960	1.38%	74.20%	5.0
Western Europe	10,477,018	146,567	1.41%	83,041	1.07%	56.66%	1.7
Australia and New Zealand	1,995,084	26,367	0.25%	14,006	0.18%	53.12%	1.5
Melanesia	1,424,539	13,538	0.13%	9,082	0.12%	67.09%	2.9
Micronesia	15,902	221	0.00%	161	0.00%	72.87%	3.5
Polynesia	51,603	1,003	0.01%	757	0.01%	75.49%	5.8
Human development index							
Low	162,419,453	838,228	8.05%	661,881	8.51%	78.96%	7.4
Medium	210,133,446	1,991,270	19.11%	1,470,396	18.90%	73.84%	4.8
High	222,983,367	5,457,034	52.38%	4,095,569	52.65%	75.05%	4.4
Very high	99,582,594	2,132,183	20.46%	1,550,506	19.93%	72.72%	5.0
Age-Standardized Incidence Rate category							
0 to 5	399,550,855	2,537,563	24.36%	1,833,264	23.57%	72.25%	3.3
>5 to 10	119,555,233	1,653,360	15.87%	1,250,003	16.07%	75.60%	4.8
>10	175,996,871	6,227,571	59.77%	4,694,924	60.36%	75.39%	5.1

CGC: cardia gastric cancer; HDI: human development index; NCGC: non-cardia gastric cancer; PAF: population attributable fraction.

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Extended Data Table 2 | Number of women at risk and number of gastric cancers expected in women born between 2008 and 2017 by continent, subregion, HDI, and incidence category

	Number of women at risk	Expected gastric cancer cases in absence of changes in the current control measures		Gastric cancer cases attributable to *H. pylori* infection		PAF	NCGC:CGC ratio
		N	%	N	%		
Continent							
Africa	178,878,500	817,916	15.67%	671,874	16.46%	82.14%	10.6
Americas	73,548,468	715,351	13.71%	581,244	14.24%	81.25%	8.7
Asia	357,040,909	3,238,924	62.06%	2,484,519	60.85%	76.71%	7.3
Europe	39,505,383	419,999	8.05%	325,504	7.97%	77.50%	7.0
Oceania	3,277,137	26,703	0.51%	19,788	0.48%	74.10%	4.2
Total	652,250,396	5,218,892	100.00%	4,082,930	100.00%	78.23%	7.5
Sub-region							
Northern Africa	27,035,368	141,216	2.71%	114,368	2.80%	80.99%	10.1
Sub-Saharan Africa	151,843,132	676,700	12.97%	557,506	13.65%	82.39%	11.0
Latin America and the Caribbean	51,119,249	598,616	11.47%	496,961	12.17%	83.02%	13.4
Northern America	22,429,219	116,734	2.24%	84,284	2.06%	72.20%	4.3
Central Asia	7,493,820	108,351	2.08%	80,745	1.98%	74.52%	5.4
Eastern Asia	91,766,286	1,631,575	31.26%	1,268,763	31.07%	77.76%	8.0
South-eastern Asia	54,424,277	289,510	5.55%	238,131	5.83%	82.25%	12.0
Southern Asia	175,877,542	978,801	18.75%	719,731	17.63%	73.53%	4.9
Western Asia	27,478,985	230,687	4.42%	177,150	4.34%	76.79%	5.8
Eastern Europe	16,438,011	234,034	4.48%	182,345	4.47%	77.91%	7.2
Northern Europe	6,202,004	36,128	0.69%	25,846	0.63%	71.54%	4.4
Southern Europe	6,905,035	76,776	1.47%	62,958	1.54%	82.00%	11.8
Western Europe	9,960,334	73,061	1.40%	54,356	1.33%	74.40%	5.2
Australia and New Zealand	1,893,295	14,805	0.28%	10,458	0.26%	70.64%	3.9
Melanesia	1,320,665	11,113	0.21%	8,634	0.21%	77.69%	7.1
Micronesia	14,977	156	0.00%	136	0.00%	87.19%	-
Polynesia	48,201	628	0.01%	559	0.01%	89.00%	-
Human development index							
Low	157,845,183	709,942	13.60%	579,724	14.20%	81.66%	10.4
Medium	196,414,348	1,088,237	20.85%	843,738	20.67%	77.53%	6.4
High	203,425,751	2,408,630	46.15%	1,862,734	45.62%	77.34%	6.8
Very high	94,565,115	1,012,084	19.39%	796,733	19.51%	78.72%	8.7
Age-Standardized Incidence Rate category							
0 to 5	378,627,589	1,517,308	29.07%	1,188,833	29.12%	78.35%	6.0
>5 to 10	114,880,672	929,916	17.82%	748,552	18.33%	80.50%	9.0
>10	158,727,159	2,771,512	53.11%	2,145,409	52.55%	77.41%	7.6

CGC: cardia gastric cancer; HDI: human development index; NCGC: non-cardia gastric cancer; PAF: population attributable fraction.

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Extended Data Table 3 | Country-specific number of gastric cancer cases expected in persons born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer and the cases attributable to *H. pylori* infection

Country	Gastric cancer burden category	Number of persons at risk in individuals born between 2008 and 2017	Number of gastric cancer cases expected with no changes in the current control measures for gastric cancer	Number of gastric cancer cases attributable to *H. pylori*
China	A	178,578,384	4,892,230	3,690,065
India	A	244,569,925	1,657,670	1,212,346
Japan	B	10,223,283	637,000	536,763
Iran (Islamic Republic of)	B	14,352,235	552,864	335,338
Russian Federation	B	18,111,339	436,888	325,373
Brazil	B	29,589,674	424,426	343,431
Viet Nam	B	14,682,232	313,893	260,207
Türkiye	B	13,405,850	296,165	208,580
USA	B	41,842,211	287,935	172,340
Bangladesh	B	29,778,022	250,800	181,888
Pakistan	B	56,432,454	245,314	195,280
Mexico	B	21,583,598	233,623	185,892
South Korea	B	4,442,418	221,247	190,464
Colombia	B	7,420,078	183,094	150,120
Peru	B	5,928,085	172,615	145,890
Philippines	B	23,047,736	157,738	123,519
Afghanistan	B	11,129,000	149,877	110,362
Myanmar	B	8,882,846	136,956	106,599
Ethiopia	B	30,707,604	122,954	99,378
Democratic Republic of the Congo	B	27,876,852	118,701	96,161
Egypt	B	24,211,528	116,935	87,549
Kenya	B	13,470,300	116,130	94,353
United Republic of Tanzania	B	17,640,511	104,412	84,010
Nigeria	B	58,692,523	104,363	89,504
Indonesia	B	47,204,880	101,244	78,723
Mali	B	6,560,755	100,451	81,030
Germany	C	7,706,826	96,003	61,463
Uzbekistan	C	6,550,092	95,303	69,283
Algeria	C	8,963,190	92,327	75,503
Argentina	C	7,252,462	92,170	74,451
Italy	C	5,232,017	85,670	67,369
Kazakhstan	C	3,733,680	80,912	59,147
Ecuador	C	3,136,471	80,276	68,525
Guatemala	C	3,891,322	79,872	63,752
Iraq	C	11,058,166	79,573	59,148
North Korea	C	3,227,732	77,767	64,043
Chile	C	2,444,510	77,343	55,565
Ukraine	C	4,593,340	74,591	58,601
France	C	7,754,849	73,711	43,847
Venezuela (Bolivarian Republic of)	C	5,496,536	70,264	56,841
Tajikistan	C	2,340,744	68,681	50,167
Yemen	C	8,570,131	65,989	49,500
Poland	C	4,074,888	63,795	49,790

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Extended Data Table 3 (continued) | Country-specific number of gastric cancer cases expected in persons born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer and the cases attributable to *H. pylori* infection

Country	Gastric cancer burden category	Number of persons at risk in individuals born between 2008 and 2017	Number of gastric cancer cases expected with no changes in the current control measures for gastric cancer	Number of gastric cancer cases attributable to *H. pylori*
UK	C	8,238,486	62,930	38,925
Morocco	C	6,706,846	62,208	49,035
Nepal	C	5,857,170	59,550	43,403
Spain	C	4,720,818	58,641	44,436
Zimbabwe	C	4,316,978	51,651	42,096
South Africa	C	11,281,494	50,875	36,973
Uganda	C	13,290,181	49,896	40,307
Senegal	C	4,566,268	49,668	40,119
Azerbaijan	C	1,760,058	49,511	36,370
Madagascar	C	7,356,848	48,537	39,371
Ghana	C	8,037,560	47,708	38,638
Angola	C	9,905,139	46,663	37,961
Thailand	C	7,825,442	43,247	33,918
Mongolia	C	732,600	42,836	35,282
Canada	C	4,093,602	39,045	23,173
Malaysia	C	5,137,059	38,799	30,329
Sudan	C	11,992,782	37,761	30,156
Syrian Arab Republic	C	4,959,971	37,555	27,965
Côte d'Ivoire	C	7,416,860	37,132	30,181
Kyrgyzstan	C	1,486,084	36,625	26,640
Romania	D	2,094,959	34,943	29,123
Australia	D	3,231,558	34,863	20,724
Rwanda	D	3,385,598	32,802	26,639
Belarus	D	1,147,246	31,555	25,889
Bolivia (Plurinational State of)	D	2,494,072	31,406	25,563
Saudi Arabia	D	6,270,211	31,204	21,974
Honduras	D	2,081,146	29,279	23,139
Haiti	D	2,439,496	28,534	22,595
Burkina Faso	D	6,302,770	27,295	22,255
Cameroon	D	7,379,360	26,593	21,545
Niger	D	7,656,698	26,342	21,300
Somalia	D	5,022,247	25,966	21,041
Zambia	D	5,454,318	25,525	20,752
Portugal	D	928,484	24,725	18,578
Lao People's Democratic Republic	D	1,519,774	24,202	18,805
Benin	D	3,492,650	23,678	19,415
Turkmenistan	D	1,325,398	23,413	17,087
Burundi	D	3,833,084	22,804	18,478
Costa Rica	D	725,720	22,546	18,208
Papua New Guinea	D	2,259,752	22,159	15,783
Nicaragua	D	1,370,174	21,846	17,381
Dominican Republic	D	2,036,329	21,163	16,853
Cambodia	D	3,258,988	20,975	16,445
Jordan	D	2,428,906	20,788	15,982

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Extended Data Table 3 (continued) | Country-specific number of gastric cancer cases expected in persons born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer and the cases attributable to *H. pylori* infection

Country	Gastric cancer burden category	Number of persons at risk in individuals born between 2008 and 2017	Number of gastric cancer cases expected with no changes in the current control measures for gastric cancer	Number of gastric cancer cases attributable to *H. pylori*
Malawi	D	5,604,858	20,623	16,716
Guinea	D	3,638,476	18,588	15,032
Israel	D	1,652,060	18,247	13,352
Netherlands	D	1,835,781	16,787	11,173
Sri Lanka	D	3,444,274	16,770	12,185
El Salvador	D	1,108,630	15,232	12,154
Belgium	D	1,333,050	14,048	8,390
Togo	D	2,250,215	13,891	11,233
Hungary	D	956,180	13,885	10,868
Cuba	D	1,225,534	13,518	10,722
Greece	D	1,019,412	13,313	10,038
South Sudan	D	3,342,355	13,007	10,560
Paraguay	D	1,276,692	12,947	10,520
Chad	D	5,115,564	12,852	10,391
Panama	D	769,523	12,564	9,960
Tunisia	D	2,058,483	12,226	10,118
Oman	D	803,512	11,548	8,586
Czechia	D	1,131,998	10,881	8,104
State of Palestine	D	1,323,802	10,809	8,040
Bulgaria	D	650,878	10,220	7,988
Mozambique	E	8,980,978	9,933	8,150
Austria	E	858,667	9,529	6,876
Sweden	E	1,266,612	9,387	5,736
Switzerland	E	879,430	9,074	5,320
Serbia	E	700,756	9,013	7,080
Armenia	E	393,268	8,996	6,638
Georgia	E	542,467	8,964	6,682
Libya	E	1,321,874	8,679	6,893
Mauritania	E	1,262,720	8,395	6,903
Singapore	E	468,248	8,081	6,047
Slovakia	E	592,426	8,065	6,426
Uruguay	E	467,548	7,833	6,345
Ireland	E	683,623	7,688	4,288
United Arab Emirates	E	956,948	7,554	5,753
Albania	E	319,402	7,535	5,697
Croatia	E	389,768	7,298	5,718
Liberia	E	1,397,440	6,859	5,621
Denmark	E	631,694	6,693	3,044
New Zealand	E	656,820	6,310	3,741
Lithuania	E	285,374	6,090	5,065
Republic of Moldova	E	423,076	5,921	4,640
Bosnia and Herzegovina	E	331,540	5,715	4,319
Norway	E	632,348	5,711	3,503
Sierra Leone	E	2,155,028	5,645	4,582
Congo	E	1,599,061	5,555	4,615

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Extended Data Table 3 (continued) | Country-specific number of gastric cancer cases expected in persons born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer and the cases attributable to *H. pylori* infection

Country	Gastric cancer burden category	Number of persons at risk in individuals born between 2008 and 2017	Number of gastric cancer cases expected with no changes in the current control measures for gastric cancer	Number of gastric cancer cases attributable to *H. pylori*
Lebanon	E	1,086,880	5,438	4,023
Central African Republic	E	1,671,055	5,426	4,568
Finland	E	602,322	4,934	3,481
Jamaica	E	395,476	4,308	3,547
Latvia	E	199,295	4,235	3,464
North Macedonia	E	232,312	4,059	3,047
Eritrea	E	953,494	3,986	3,386
Slovenia	E	221,442	3,798	2,786
Estonia	E	147,471	3,617	2,868
Bhutan	E	124,153	3,159	2,312
Kuwait	E	640,719	3,112	2,439
Guinea-Bissau	E	547,576	3,085	2,654
Réunion	E	150,929	2,908	2,425
Gambia	E	748,973	2,623	2,301
Qatar	E	286,388	2,020	1,695
Puerto Rico	E	310,614	1,678	1,327
Bahrain	E	203,418	1,666	1,344
Cyprus	E	133,572	1,620	1,214
Namibia	E	597,058	1,614	1,405
Trinidad and Tobago	E	201,061	1,493	1,202
Timor-Leste	E	308,048	1,483	1,258
Mauritius	E	145,788	1,415	1,157
Gabon	E	559,734	1,358	1,163
Brunei Darussalam	E	67,694	1,267	1,079
Cabo Verde	E	105,612	1,239	1,076
Guadeloupe	E	49,613	1,174	965
French Guiana	E	61,053	1,051	936
Samoa	E	54,320	965	766
Equatorial Guinea	E	413,107	942	838
Guyana	E	152,431	926	801
Botswana	E	561,498	923	821
Martinique	E	40,792	895	679
Suriname	E	107,792	880	757
Fiji	E	177,570	880	652
New Caledonia	E	43,610	762	565
Lesotho	E	508,792	730	650
Bahamas	E	55,010	721	616
Djibouti	E	223,748	714	636
French Polynesia	E	45,483	666	550
Sao Tome and Principe	E	59,250	650	575
Belize	E	75,598	623	535
Montenegro	E	77,432	590	462
Malta	E	46,516	566	388
Solomon Islands	E	181,104	528	430
Comoros	E	204,069	528	470

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Extended Data Table 3 (continued) | Country-specific number of gastric cancer cases expected in persons born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer and the cases attributable to *H. pylori* infection

Country	Gastric cancer burden category	Number of persons at risk in individuals born between 2008 and 2017	Number of gastric cancer cases expected with no changes in the current control measures for gastric cancer	Number of gastric cancer cases attributable to *H. pylori*
Luxembourg	E	68,750	476	329
Iceland	E	46,568	386	316
Guam	E	30,878	377	297
Saint Lucia	E	22,090	342	286
Vanuatu	E	83,168	323	287
Eswatini	E	278,224	321	285
Barbados	E	32,600	295	247
Maldives	E	76,253	138	123

Countries are grouped according to their contribution to the overall gastric cancer burden, with countries sorted according to the expected number of gastric cancer cases and subsequently grouped into the following categories: more than 1,000,000 (group A), 100,000 to 1,000,.000 (group B), 35,000 to 100,000 (group C), 10,000 to 35,000 (group D) and less than 10,000 (group E).

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Extended Data Table 4 | Global analysis outcomes by changes of various parameters[a]

Sensitivity Scenario Name	Sensitivity Scenario Value	Expected lifetime number of gastric cancer in cohorts 2008-2017 (main estimation n=15,716,639)	Ratio of change (expected cases in an average single birth cohort vs. total cases estimated in the GLOBOCAN 2022)	Ratio of lifetime expected number of gastric cancers vs. the main estimation	Percentage change of the main estimation
Competing Rate	yes	15,583,713	1.8	1.0	−0.34%
Death Rate	lwr	16,910,585	1.9	1.1	8.14%
Death Rate	upr	14,142,542	1.6	0.9	−9.56%
APC CGC (10 years)	−3%	14,992,594	1.7	1.0	−4.12%
APC CGC (10 years)	−2%	15,188,349	1.7	1.0	−2.87%
APC CGC (10 years)	−1%	15,402,832	1.8	1.0	−1.50%
APC CGC (10 years)	1%	15,894,348	1.8	1.0	1.64%
APC CGC (10 years)	2%	16,174,845	1.9	1.0	3.44%
APC CGC (10 years)	3%	16,481,014	1.9	1.1	5.39%
APC CGC (20 years)	−3%	14,517,094	1.7	0.9	−7.17%
APC CGC (20 years)	−2%	14,821,520	1.7	0.9	−5.22%
APC CGC (20 years)	−1%	15,190,741	1.7	1.0	−2.86%
APC CGC (20 years)	1%	16,177,311	1.9	1.0	3.45%
APC CGC (20 years)	2%	16,827,775	1.9	1.1	7.61%
APC CGC (20 years)	3%	17,610,078	2.0	1.1	12.61%
APC NCGC (10 years)	−3%	12,207,109	1.4	0.8	−21.94%
APC NCGC (10 years)	−2%	13,249,813	1.5	0.8	−15.27%
APC NCGC (10 years)	−1%	14,390,688	1.6	0.9	−7.97%
APC NCGC (10 years)	1%	16,998,933	1.9	1.1	8.71%
APC NCGC (10 years)	2%	18,483,542	2.1	1.2	18.20%
APC NCGC (10 years)	3%	20,100,833	2.3	1.3	28.54%
APC NCGC (20 years)	−3%	9,670,238	1.1	0.6	−38.16%
APC NCGC (20 years)	−2%	11,296,040	1.3	0.7	−27.76%
APC NCGC (20 years)	−1%	13,263,300	1.5	0.8	−15.18%
APC NCGC (20 years)	1%	18,495,565	2.1	1.2	18.28%
APC NCGC (20 years)	2%	21,926,188	2.5	1.4	40.21%
APC NCGC (20 years)	3%	26,032,299	3.0	1.7	66.47%
PHI Impact	100%	3,740,662	0.4	0.2	−76.08%
PHI Impact	90%	4,930,357	0.6	0.3	−68.47%
PHI Impact	80%	6,120,051	0.7	0.4	−60.86%

[a]This table contains information displayed in Fig. 5. It contains the lifetime number of gastric cancer cases expected in 2008–2017 birth cohorts according to different model parameters disruption. Models outcomes are compared to the reference (i.e. no competitive risk between cardia (CGC) and non-cardia (NCGC) gastric cancer, median UN death rate scenario, no annual percentage change (APC) for CGC and NCGC, no change in the current Public Health Intervention (PHI) for gastric cancer control) and the results are expressed in terms of lifetime expected number of gastric cancer cases, ratio of change (expected cases in an average single birth cohort vs. total cases estimated in the GLOBOCAN 2022), ratio of lifetime expected number of gastric cancers vs. the main estimation, and percentage change of the main estimation. The tested parameters are: 1. Competing Rate: Including CGC competing rate in the NCGC burden calculation and vice and versa 2 (yes) 2. Death Rate: Changing the overall cause of death competing risk for UN lower (lwr) or upper (upr) scenario 3. APC CGC (10 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 10 years to the CGC incidence rate 4. APC CGC (20 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 20 years to the CGC incidence rate 5. APC NCGC (10 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 10 years to the NCGC incidence rate 6. APC NCGC (20 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 20 years to the NCGC incidence rate 7. PHI Impact: Applying population-level impact of *H. pylori* screen-and-treat strategies by 80–100%.

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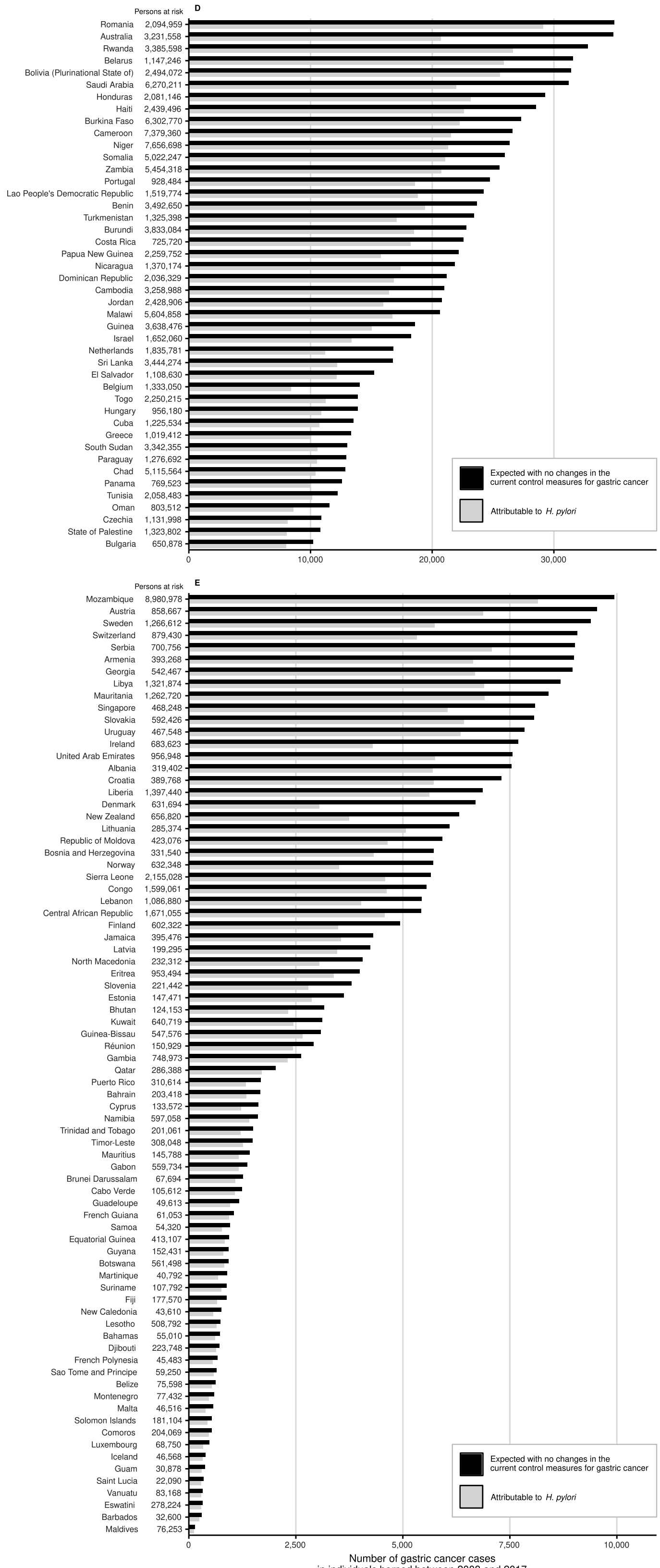
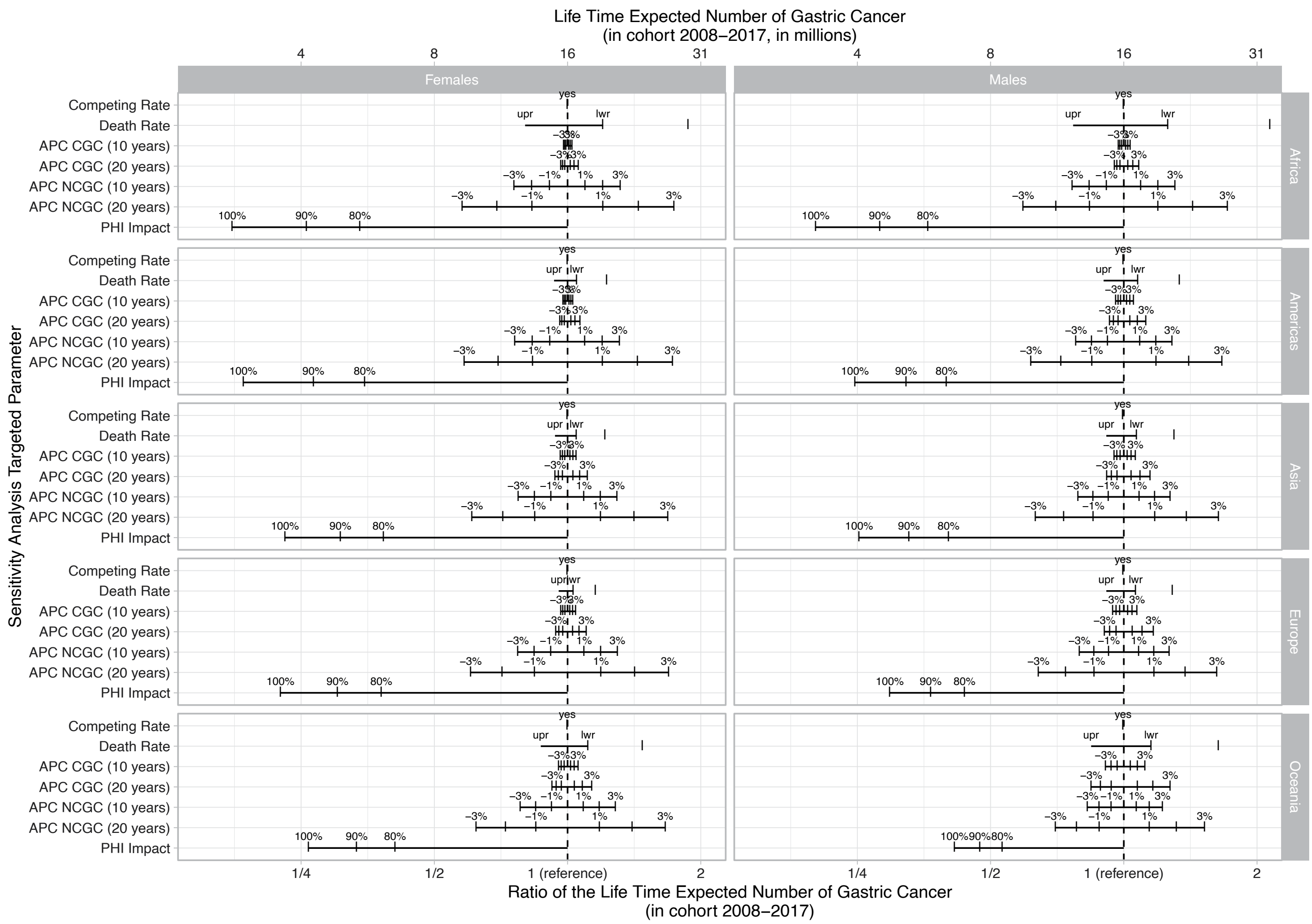


Extended Data Fig. 1 | Country-specific number of gastric cancer cases expected in persons born between 2008 and 2017 in the absence of changes in the current control measures for gastric cancer (dark grey bar) and the cases attributable to *H. pylori* infection (light grey bar). Countries are grouped according to their contribution to the overall gastric cancer burden, with countries sorted according to the expected number of gastric cancer cases and subsequently grouped into the following categories: 10,000 to 35,000 (group D) and less than 10,000 (group E).



Extended Data Fig. 2 | Global analysis outcomes by various tested parameters by region and sex*. *This figure shows variation of the overall lifetime expected number of gastric cancers born between 2008 and 2017 according to changes of the model parameters. The variation could be read in terms of absolute number of cases (upper x-axis) or ratio of the lifetime expected number of gastric cancers (lower x-axis). The reference model parameters are the same as the ones assumed in the main text (that is no competitive risk between cardia (CGC) and non-cardia (NCGC) gastric cancer, median UN death rate scenario, no annual percentage change (APC) for CGC and NCGC, no changes in the current public health intervention (PHI) for gastric cancer control). Each line on the y-axis represents the specific parameter changed compared to the reference while all the other parameters remain unchanged. The tested parameters are: 1. Competing Rate: Including CGC competing rate in the NCGC burden calculation and vice and versa 2 (yes). 2. Death Rate: Changing the overall cause of death competing risk for UN lower (lwr) or upper (upr) scenario. 3. APC CGC (10 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 10 years to the CGC incidence rate. 4. APC CGC (20 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 20 years to the CGC incidence rate. 5. APC NCGC (10 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 10 years to the NCGC incidence rate. 6. APC NCGC (20 years): Applying −3%, −2%, −1%, 1%, 2% and 3% APC for 20 years to the NCGC incidence rate. 7. PHI Impact: Applying population-level impact of *H. pylori* screen-and-treat strategies by 80–100%.

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Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	The code to collect and transform the publicly available data is available here: https://gitlab.com/iarc-ice/miarc/atlas-hpylori/-/tree/main/scripts
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All data used in this analysis are publicly available. GLOBOCAN (https://gco.iarc.fr//today/en), United Nations Development Programme's Human Development

Index (https://hdr.undp.org/data-center/documentation-and-downloads) and United Nations World Population Prospects 2022 (https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/wpp2022_summary_of_results.pdf.)

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Sample size	All the persons at-risk were included in the analysis (all the persons born between 2008 and 2017)
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