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Review article: the prevalence of *Helicobacter pylori* and the incidence of gastric cancer across Europe

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SUMMARY

Background
There is little up-to-date review evidence on the prevalence of *Helicobacter pylori* across Europe.

Aim
To establish regional and national patterns in *H. pylori* prevalence across Europe. Secondly, to establish trends over time in *H. pylori* prevalence and gastric cancer incidence and, thirdly, to report on the relationship between *H. pylori* prevalence and age group across Europe.

Methods
A review of *H. pylori* prevalence from unselected surveys of adult or general populations across 35 European countries and four European regions since 1990. Secondly, an analysis of trends over time in *H. pylori* prevalence and in gastric cancer incidence from cancer registry data.

Results
Helicobacter pylori prevalence was lower in northern and western Europe than in eastern and southern Europe ($P < 0.001$). In 11 of 12 European studies that reported on trends, there were sharp reductions in *H. pylori* prevalence (mean annual reduction = 3.1%). The mean annual reduction in the incidence of gastric cancer across Europe from 1993 to 2007 was 2.1% with little variation regionally across Europe (north 2.2%, west 2.3%, east 1.9% and south 2.0%). Sharp increases in age-related prevalence of *H. pylori* often levelled off for middle age groups of about 50 years onwards, especially in areas with high prevalence.

Conclusions
This review shows that *H. pylori* prevalence is much higher in less affluent regions of Europe and that age-related increases in prevalence are confined to younger age groups in some areas. There were sharp reductions in both *H. pylori* prevalence and gastric cancer incidence throughout Europe.

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INTRODUCTION

Helicobacter pylori is a Gram-negative, microaerophilic bacterium that was first discovered in 1982. It is a grade I carcinogen, a causal factor in gastric cancer, gastric and duodenal ulcers and gastritis,[1] and is more common in developing than in developed regions of the world.

There have been several reviews of the prevalence of *H. pylori*,[2–8] although they have usually been global rather than European, have often focused on developing regions of the world, have been confined to the small volume of national surveys of *H. pylori* prevalence or have included selected patient groups with increased risks of *H. pylori* infection (for example through specific disease associations) or are now dated, so that there is limited up-to-date information on *H. pylori* prevalence from unselected surveys systematically across Europe.

In 2013, United European Gastroenterology commissioned the authors to review the burden of gastrointestinal and liver disorders and the organisation and delivery of gastroenterology services across Europe.[9] This study provides an additional systematic review and meta-analysis of *H. pylori* prevalence across Europe and its association with the incidence of gastric cancer across Europe and over time.

The main objectives of this study were, firstly, to establish regional and national patterns in the prevalence of *H. pylori* in general unselected populations across Europe. Secondly, to establish trends over time in the prevalence of *H. pylori* and the incidence of gastric cancer across Europe. Thirdly, to report on the relationship between *H. pylori* prevalence and age group across Europe.

METHODS

Scope

The coverage of this European review of *H. pylori* and gastric cancer, as agreed with United European Gastroenterology, was the 31 countries that were member states of the European Union (as of 1 January 2014) along with four other European countries; Liechtenstein, Norway, Russia and Switzerland. The review covers the time period from January 1990 to December 2014 and includes studies written in English and in all other European languages.

Inclusion and exclusion criteria

For the first study objective, to establish the prevalence of *H. pylori* in general populations across Europe, the review was based on unselected population surveys, including primary care and blood donor surveys of adult or general population age groups, providing that the demographic inclusion criteria of the surveys covered people of age groups that spanned at least 45 years. For example, this included people of all working ages 16–64 years or people of all adult age groups.

For the second study objective, to establish trends over time in *H. pylori* prevalence across Europe, because of a lack of longitudinal survey evidence, this part of the review included studies of all types of design and of all demographic groups that have reported on trends in *H. pylori* prevalence using the same methodology at different time points. We also included studies with an earlier time period that occurred before 1990, including 'repeat surveys' on the prevalence of *H. pylori* in the same city/region using similar methodology and population demographics.

Literature search

The review was based on PubMed and Embase information sources; reports, publications and data collected by the World Health Organization; grey literature information sources including Sigle and Google Scholar; extensive hand searching of reference lists of papers and reports for further studies on *H. pylori* prevalence across Europe; and an e-mail survey of 30 United European Gastroenterology national representatives across Europe. The search terms used were '*H. pylori*', 'Helicobacter pylori' or 'pylori' combined with 'prevalence', 'seroprevalence' or 'survey' and 'Europe' or the names of the individual 35 European countries included in the review.

Data extraction

Eligible studies were reviewed and the following data items extracted: country, centre(s) and/or city or region, study time period, year of publication, type of unselected survey or (other) type of study design and type of patient group, study size, subject or patient age group range, and the prevalence of *H. pylori*. When extracting information from the studies, pairs of investigators/researchers consulted to compare findings and reach consensus. Where consensus was not reached, an independent investigator was consulted. Prevalence rates for *H. pylori* were expressed as percentages of study surveys or patient populations.

Incidence of gastric cancer across Europe

Figures on the incidence of gastric cancer with the most complete coverage across the European countries included in this review were obtained from the World Health Organization International Association for

Research on Cancer.[10] Annual trends over time in gastric cancer incidence were also obtained from the same information source, although the annual trends were available up to 2007 and with more variable population and yearly coverage from cancer registries for different countries.[11] We extracted the annual incidence trend data that was available for each country from 1980 onwards. The cancer incidence rates were standardised using the world population and were expressed per 100 000 population for each country.

Other methods

When comparing the prevalence of *H. pylori* regionally across Europe, the Fisher's Exact test was used to compare the numbers of studies reporting high (45%+) or low prevalence (<45%), based on the following four regions and 35 countries across Europe: northern Europe (Denmark, Finland, Ireland, Norway, Sweden and the UK – England, Wales, Scotland and Northern Ireland); western Europe (Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, the Netherlands and Switzerland); eastern Europe (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia and Slovakia) and southern Europe (Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia and Spain). When assessing longitudinal or repeated studies of the same region, the prevalence rate from the most recent time point was included, in order to ensure that the meta analyses were based on the most up-to-date information across Europe.

Time trend analysis and mean annual percentage reductions were used to assess changes over time in the prevalence of *H. pylori* and the incidence of gastric cancer nationally and regionally across Europe. For *H. pylori*, prevalence rates were presented as time points that were spaced at least 5 years apart. For gastric cancer, incidence rates were presented annually and smoothed using 3-year moving averages. Geographical Information System (GIS) mapping was used to map the incidence of gastric cancer across Europe. In these maps, incidence rates were grouped into quintiles, which were based on clinically meaningful thresholds as well as similar numbers of countries within each quintile. Significance was measured at the conventional 5% level.

RESULTS

Prevalence of *H. pylori* across Europe

Table 1 shows the prevalence rates for *H. pylori* identified from unselected surveys of adult or general age populations spanning at least 45 years across Europe since 1990. It covers 22 of the 35 European countries, based on 44 studies. Prevalence from these surveys ranged from 17% in Aarhus, Denmark to 88% in St Petersburg, Russia. Most studies with low *H. pylori* prevalence were from Northern or Western Europe and most with high prevalence were from Southern or Eastern Europe ($P < 0.001$): of 22 studies with 'low' prevalence of <45%, 20 were from Northern (12) or Western (7) Europe with only three from Southern (2) or Eastern (1) or Europe and of 22 studies with 'high' prevalence of ≥45%, 20 were from Southern (12) or Eastern (8) Europe with only two from Northern (2) or Western (none) Europe.

A number of the 44 studies have reported on the prevalence of *H. pylori* according to decade of life or 10-year age groups (Figure 1). These show increases in prevalence with age in all studies among younger age groups although, in many studies, with a plateau or levelling off in prevalence for middle age groups of about 50 years onwards, especially in areas with high prevalence.

Trends in *H. pylori* prevalence across Europe

Studies, of any population age groups and study designs, that have reported on trends over time in *H. pylori* prevalence, cover 12 European countries (Table 2). All but one show large significant reductions in the prevalence of *H. pylori* over time (Figure 2). The study that reported no reduction in prevalence, from Leipzig, Germany, had the lowest prevalence of all studies (5.9% in 1998–2000 and 6.5% in 2006) and was a study of children with an age group that increased from 4–8 years to 12–14 years over the two study time points (Table 2).[12] Studies that reported the highest initial prevalence rates of *H. pylori* in Europe were, specifically, studies of 70-year-old people from Gothenburg in 1971–1972 (78%),[13] adults from Budapest in 1997–2002 (60%),[14] people aged 15–82 years from Athens in 1997 (60%)[15] and people aged 15–74 from Vammala in 1973 (56%).[16] All four studies reported large significant subsequent reductions in prevalence to 55%, 42%, 49% and 31% respectively. Across all 12 studies, the overall mean reduction in *H. pylori* prevalence was 3.1% per annum.

The incidence of gastric cancer across Europe

The incidence of gastric cancer across Europe is shown separately for men (Figure 3a) and women (Figure 3b) with highest rates in parts of eastern Eur-

Table 1 | Prevalence rates for *Helicobacter pylori* from unselected population surveys of adults or people of all age groups across Europe, 1990–2014: studies ordered by country and then chronologically in reverse order

Country	Region	Study period	Patient group/ study design	Study size	Patient age group	Mean age (95% CI)	Prevalence (% of population)	Authors and reference
Czech Republic	22 centres	2011	Population survey	1826	5–98	*	24	Bureš *et al.*[27]
Czech Republic	South Moravia	1998†	Population survey	309	18+	*	59	Dite *et al.*[28]
Croatia	Zagreb	2008–2011	Population survey	3000	18+	*	47	Marušić *et al.*[29]
Croatia	Three areas	1997	Population survey	3082	20–70	*	60	Babus *et al.*[30]
Croatia	Zagreb	1997†	Blood donor survey	2492	18+	*	59	Presecki *et al.*[31]
Denmark	Aarhus	2009	Population survey	7764	2–95	42‡	17	Dahlerup *et al.*[32]
Estonia	Karksi-Nuia	1993	Population survey	1461	15+	43‡	87	Uibo *et al.*[33]
Finland	Helsinki	2007–2009	Population survey	4256	18–92	56	19	Telaranta-Keerie *et al.*[34]
Finland	Vammala	1994	Population survey	504	15–74	*	31	Kosunen *et al.*[16]
France	National	1999†	Primary care survey	1586	18+	*	22	Broutet *et al.*[35]
Germany	Hannover	2007†	Population survey	563	18+	46.6 (45.6–47.6)	21	Stettin *et al.*[36]
Germany	National	1997–1999	Population survey	6545	18–79	45.5	41	Kuepper-Nybelen *et al.*[37]
Germany	Ulm	1996	Primary care survey	447	15–79	42.8	21	Brenner *et al.*[38]
Germany	Essen	1994†	Blood donor survey	180	18–62	*	32	Holtmann *et al.*[39]
Greece	Athens	1997	Blood donor survey	120	18–62	40.1 (38.2–42.0)	48	Apostolopoulos *et al.*[15]
Hungary	Szabolcs-Szatmár-Bereg county	2000	Population survey	756	18–69	42.4	59	Iszlai *et al.*[22]
Italy	San Marino	1990-1991	Population survey	2237	18+	*	51	Gasbarrini *et al.*[40]
Italy	*	2012†	Population survey	100	18+	*	30	Shapira *et al.*[41]
Italy	Florence	1995-1997	Blood donor survey	2598	All	*	45	Russo *et al.*[42]
Italy	Loiano/ Monghidoro	1996	Population survey	1533	28–80	52	68	Bazzoli *et al.*[43]
Latvia	National	2008-2009	Population survey	3564	17–99	54‡	79	Leja *et al.*[44]
The Netherlands	Four regions, south	2005	Blood donor survey	1550	18–70	*	32	van Blankenstein *et al.*[45]
Norway	Sørreisa	2004	Population survey	1193	18–85	*	24	Asfeldt *et al.*[46]
Norway	Bodø and Sørreisa	2004	Population survey	1731	18–85	51.1 (50.3–51.9)	21	Breckan *et al.*[47]
Norway	Nord-Trondelag	1995–1997	Population survey	472	20–92	47‡	33	Nordenstedt *et al.*[48]
Poland	Lublin	2000–2003	Population survey	585	18+	*	72	Celinski *et al.*[49]
Poland	Kraków	1996–1999	Population survey	7060	18–76	46.3	69	Bielański *et al.*[50]
Portugal	Porto	2013†	Population survey	2067	18+	*	84	Bastos *et al.*[51]
Russia	Siberia & Far East	1994–1995	Population survey	438	18+	*	86	Reshetniko *et al.*[52]
Russia	St. Petersburg	1996†	Primary care survey	520	1–75	*	88	Malaty *et al.*[20]
Spain	Madrid	2004–2006	Population survey	618	4–82	37.5‡	60	Sánchez Ceballos *et al.*[53]
Spain	Ourense	2006†	Population survey	383	18+	*	71	Macenlle García *et al.*[54]
Spain	Ubrique, Cadiz	1997	Population survey	332	18+	*	43	Senra-Varela *et al.*[55]
Spain	Asturias	1997†	Population survey	480	All	*	50	Rodrigo Saez *et al.*[56]
Spain	Madrid	1996†	Population Survey	381	5–77	34.3 (33.0–35.6)	53	Martin-de-Argila[57]
Sweden	Kalix & Haparanda	1998–2001	Population survey	1000	20–81	53.5 (52.7–54.3)	34	Ronkainen *et al.*[58]
Sweden	Stockholm County	1995	Population survey	1030	18+	49.9 (48.9–50.9)	25	Sorberg *et al.*[59]
Sweden	Linköping	2000†	Population survey	501	35–85	*	42	Borch *et al.*[60]
Sweden	Lund	1991–1992	Population survey	443	20–70	*	30	Bergenzaun *et al.*[61]
Switzerland	Basel	2000†	Population survey	175	18+	*	19	Lehmann *et al.*[62]

Table 1 | (Continued)

Country	Region	Study period	Patient group/ study design	Study size	Patient age group	Mean age (95% CI)	Prevalence (% of population)	Authors and reference
UK – England	National	1991	Population survey	2437	18+	44.6 (46.1–47.1)	26	Fullerton *et al.*[63]
UK – England	London	1992†	Primary care survey	215	18–82	46‡	33	Mendall *et al.*[64]
UK – N Ireland	National	1997†	Population survey	4724	12–64	*	51	Murray *et al.*[65]
UK – Scotland	Glasgow	1992	Population survey	1428	25–74	*	66	McDonagh *et al.*[66]

For studies that reported on prevalence at different time points, the most recent is included in this table.

* Not available.

† Year of publication, where study period was not specified.

‡ Median rather than mean age.

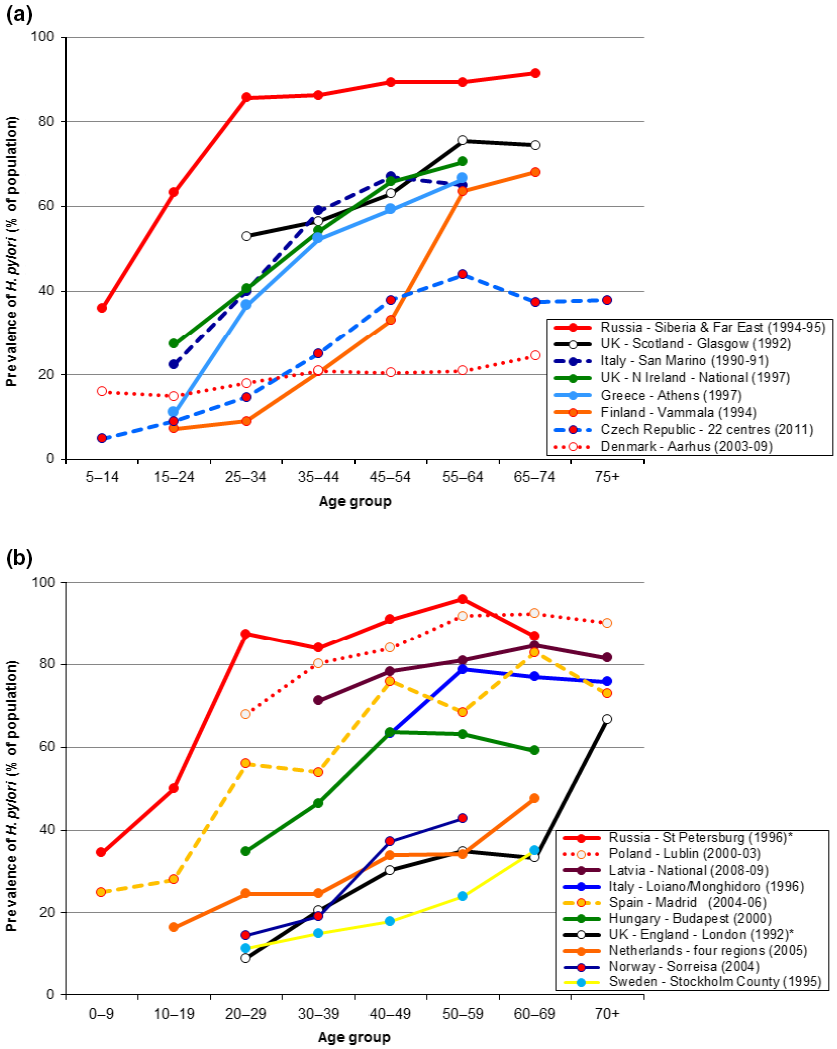

Figure 1 | Prevalence rates for *Helicobacter pylori* according to age group, from unselected population surveys of adults or people of all age groups across Europe, 1990–2014. Study period is denoted in brackets. *Year of publication where study period was not specified). The figure is split into (a) and (b) through differential age groupings used in the studies. References for the studies included in this figure are provided in Tables 1 and 2.

ope and Portugal (>15 per 100 000 population for men and >8 per 100 000 for women) and lowest rates in northern and parts of western Europe.

Long-term trends in gastric cancer incidence show moderate to large reductions over time in each of 18 countries with national or nationally representative

Table 2 | Trends over time in prevalence rates for *Helicobacter pylori* reported from studies across Europe, 1990–2014: study time points ordered by country alphabetically and then chronologically in reverse order

Country	Region	Study period	Patient group/ study design	Study size	Patient age group (mean age)*	Prevalence (% of population)	Authors and reference
Belgium	Brussels	2007	Consecutive endoscopies	1130	2–90	15	Miendje Deyi *et al.*[67]
Belgium	Brussels	1988	Consecutive endoscopies	1130	2–90	36	Miendje Deyi *et al.*[67]
Czech Republic	22 centres	2011	Population survey	1826	5–98	24	Bureš *et al.*[27]
Czech Republic	22 centres	2001	Population survey	2509	5–98	42	Bureš *et al.*[27]
Denmark	Aarhus	2009	Population survey	7764	2–95 (42)†	17	Dahlerup *et al.*[32]
Denmark	Aarhus	2003	Population survey	4384	2–95 (42)†	20	Dahlerup *et al.*[32]
Estonia	Tartu	2002	Hospital clinic survey (sf)	296	0–14	28	Oona *et al.*[68]
Estonia	Tartu	1991	Hospital clinic survey (sf)	425	0–14	42	Oona *et al.*[68]
Finland	Vammala	1994	Population survey	504	15–74	31	Kosunen *et al.*[16]
Finland	Vammala	1973	Population survey	408	15–74	56	Kosunen *et al.*[16]
Germany	Leipzig	2006	Population survey	1905	12–14	6.5	Bauer *et al.*[12]
Germany	Leipzig	1998–2000	Population survey	1905	4–8	5.9	Bauer *et al.*[12]
Greece	Athens	1997	Outpatient series	201	16–85 (45.9)	49	Apostolopoulos *et al.*[15]
Greece	Athens	1987	Outpatient series	200	15–82 (44.3)	60	Apostolopoulos *et al.*[15]
Hungary	Budapest	2008–2012	Consecutive endoscopies	ns	18+	42	Buzas *et al.*[14]
Hungary	Budapest	2003–2007	Consecutive endoscopies	ns	18+	54	Buzas *et al.*[14]
Hungary	Budapest	1997–2002	Consecutive endoscopies	ns	18+	60	Buzas *et al.*[14]
The Netherlands	National	1993	Population survey	314	6–15	10	Roosendaal *et al.*[69]
The Netherlands	National	1978	Population survey	314	6–15	21	Roosendaal *et al.*[69]
Norway	Sørreisa	2004	Population survey	1193	18–85	24	Asfeldt *et al.*[46]
Norway	Sørreisa	1987	Population survey	1802	20–95	40	Asfeldt *et al.*[46]
Russia	St. Petersburg	2005	Population survey	370	0–18 (9)	13	Tkachenko *et al.*[70]
Russia	St. Petersburg	1995	Population survey	307	0–18 (5)	44	Tkachenko *et al.*[70]
Sweden	Gothenburg	1991–1992	Population survey	180	70	55	Gause-Nilsson *et al.*[13]
Sweden	Gothenburg	1971–1972	Population survey	230	70	78	Gause-Nilsson *et al.*[13]

sf, symptom free.

* Mean age not available unless indicated or specified.

† Median rather than mean age.

annual incidence data or data from at least six regional cancer registries (Figure 4).[11] Of four additional countries (Austria, Germany, Poland and Russia) with annual data from one or two regional cancer registries,[11] incidence decreased from 26.7 per 100 000 in 1993 to 11.0 in 2007 for men and from 9.7 to 6.6 for women in Austria (Tyrol and Vorarlberg), from 16.1 in 1993 to 11.0 in 2007 for men and from 10.0 to 6.6 for women in Germany (Saarland), from 20.3 in 1993 to 12.1 in 2006 for men and from 7.3 to 6.4 for women in Poland (Kraków) and from 38.7 in 1994 to 27.1 in 2007 for men and from 17.9 to 12.9 for women in Russia (St Petersburg).

Mean annual reductions in gastric cancer incidence over the 15-year period from 1993 to 2007 were strongest among men in Italy (3.0%), the Netherlands (2.9%), Finland and the UK (both 2.8%) and among women in

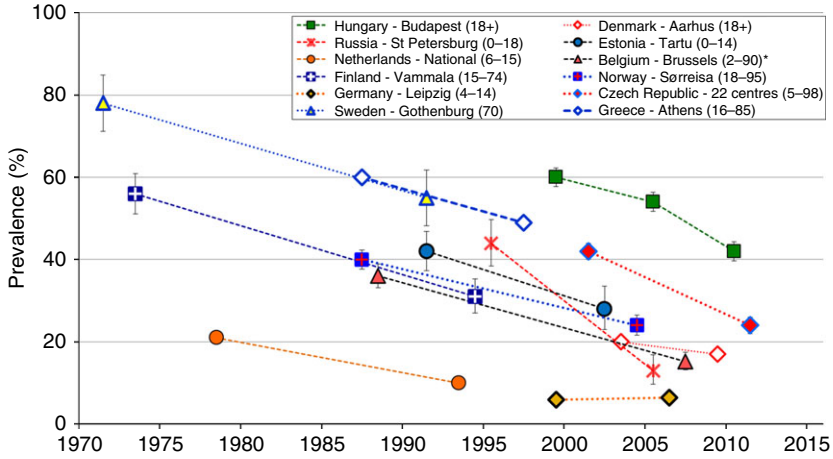

Figure 2 | Trends over time in prevalence rates for *Helicobacter pylori* reported from studies across Europe, 1970–2014. Numbers in brackets denote the age groups of the subjects studied. *Includes western Europeans only. Vertical bars represent 95% confidence intervals. Where they are not visible, they lie within the marker symbols.

the Czech Republic (2.8%), Finland and Italy (both 2.7%) and Estonia (2.5%). There was little regional variation in these mean annual reductions regionally across Europe (2.3% and 2.1% for men and women in northern Europe, 2.4% and 2.2% in western Europe, 1.7% and 2.0% in eastern Europe and 2.1% and 2.0% in southern Europe).

DISCUSSION

This study shows, firstly, that from unselected surveys since 1990, the prevalence of *H. pylori* has been much lower in northern and western regions of Europe than in eastern and southern Europe. Secondly, there have been sharp reductions over time in the prevalence of *H. pylori* and in the incidence of gastric cancer throughout Europe. Thirdly, *H. pylori* prevalence increased over younger age groups, often sharply, but levelled off in many studies from ages of about 50 years onwards, especially in areas of high prevalence.

This study reviewed the prevalence of *H. pylori* across 35 European countries using surveys of unselected populations. The study also used the leading cancer data source (the World Health Organization International Association for Research on Cancer), with coverage throughout Europe to study the incidence of gastric cancer across Europe and over time.[10, 11] Limitations of the study are firstly, there are few national or nationally representative studies that have reported on the prevalence of *H. pylori*, so that the available evidence base used for establishing prevalence was confined mostly to single-centre studies or investigations of cities or small regions, which are often not representative of their respective countries. Many studies did not report on the demographic characteristics, hence it was not possible to adjust for age differences in the populations studied. The available information on *H. pylori* prevalence across Europe is therefore disappointing. Secondly, differences in the prevalence of *H. pylori* reported across the studies to some extent reflects variation in methodology including the particular study assays used. Another limitation is that the information on trends in *H. pylori* prevalence in Europe through the 1990s was limited to 12 studies, while in some cases, the reported prevalence in later years of the studies may be affected by earlier *H. pylori* eradication therapy. Although the information source used to determine the incidence of gastric cancer across Europe is the best available, case ascertainment and the recording of cancers varies across cancer registries and across European countries.

We found that the prevalence of *H. pylori* was mostly higher in the studies from eastern and southern regions of Europe than in more affluent regions of the north and west. A strong association between *H. pylori* and socioeconomic status, poverty or social deprivation has been reported consistently for many years.[12, 17–23] Elevated prevalence rates in some eastern and southern European studies have been linked previously with high risks of infection among the most deprived groups in these countries, including people dwelling in slums.[21, 22] These risks are associated with lifestyle and environmental conditions, including overcrowded living conditions, sharing of beds and poor hygiene, with strong evidence that *H. pylori* is mostly colonised by young children from parents or siblings or through infected water supplies.[18, 19, 23] Historically, crowded living conditions in expanding cities during industrial expansion in the last few centuries led to the rapid increases in *H. pylori*.[19]

While the causal link between *H. pylori* and gastric cancer is well established over many years,[24, 25] gastric carcinogenesis is a complex multistage and multifactorial process involving other contributory factors, including diets deficient in antioxidants and high in salt, heavy

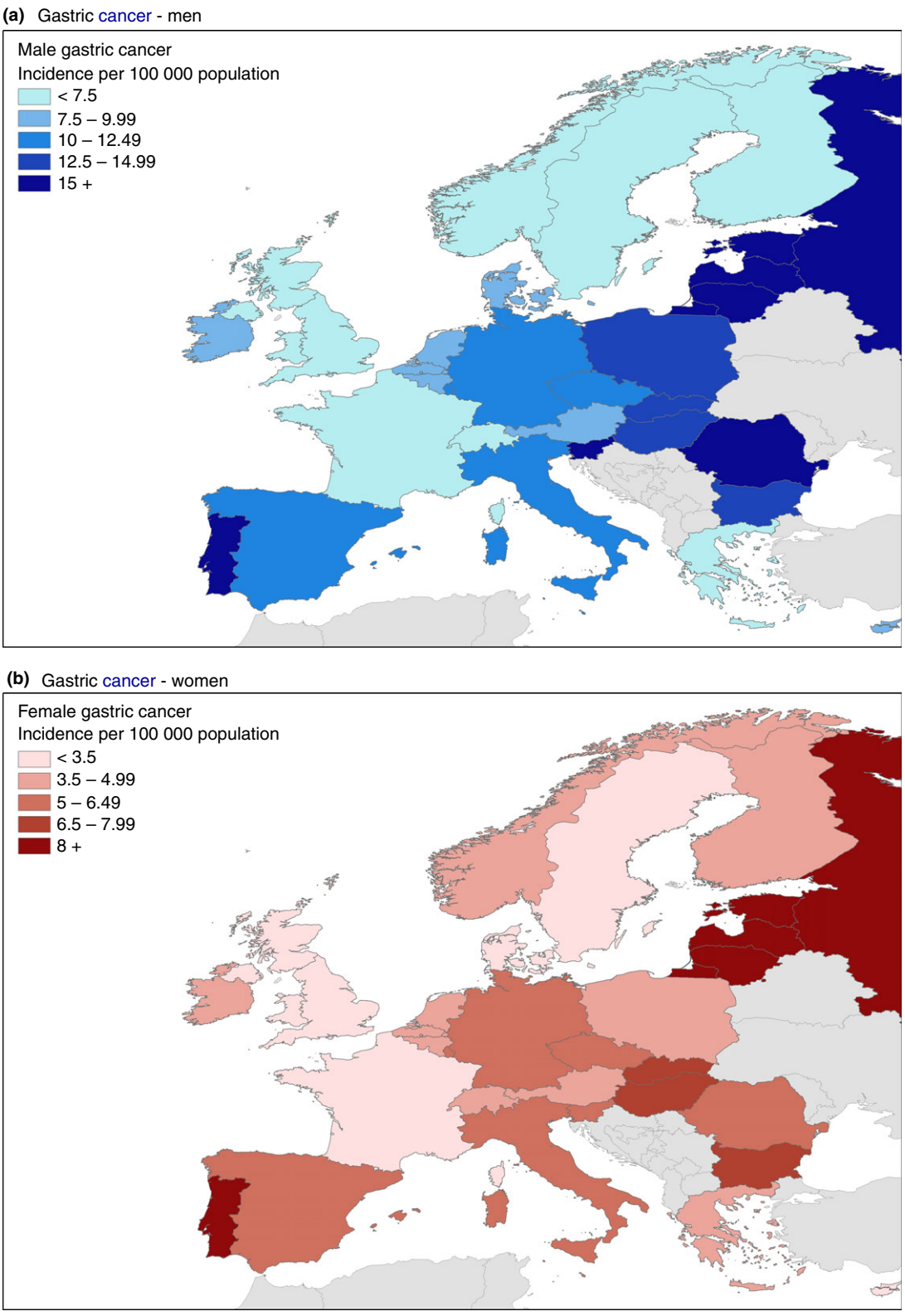

Figure 3 | Incidence of gastric cancer (per 100 000 population) across Europe, 2012. (a) Gastric cancer – men; (b) Gastric cancer – Women.

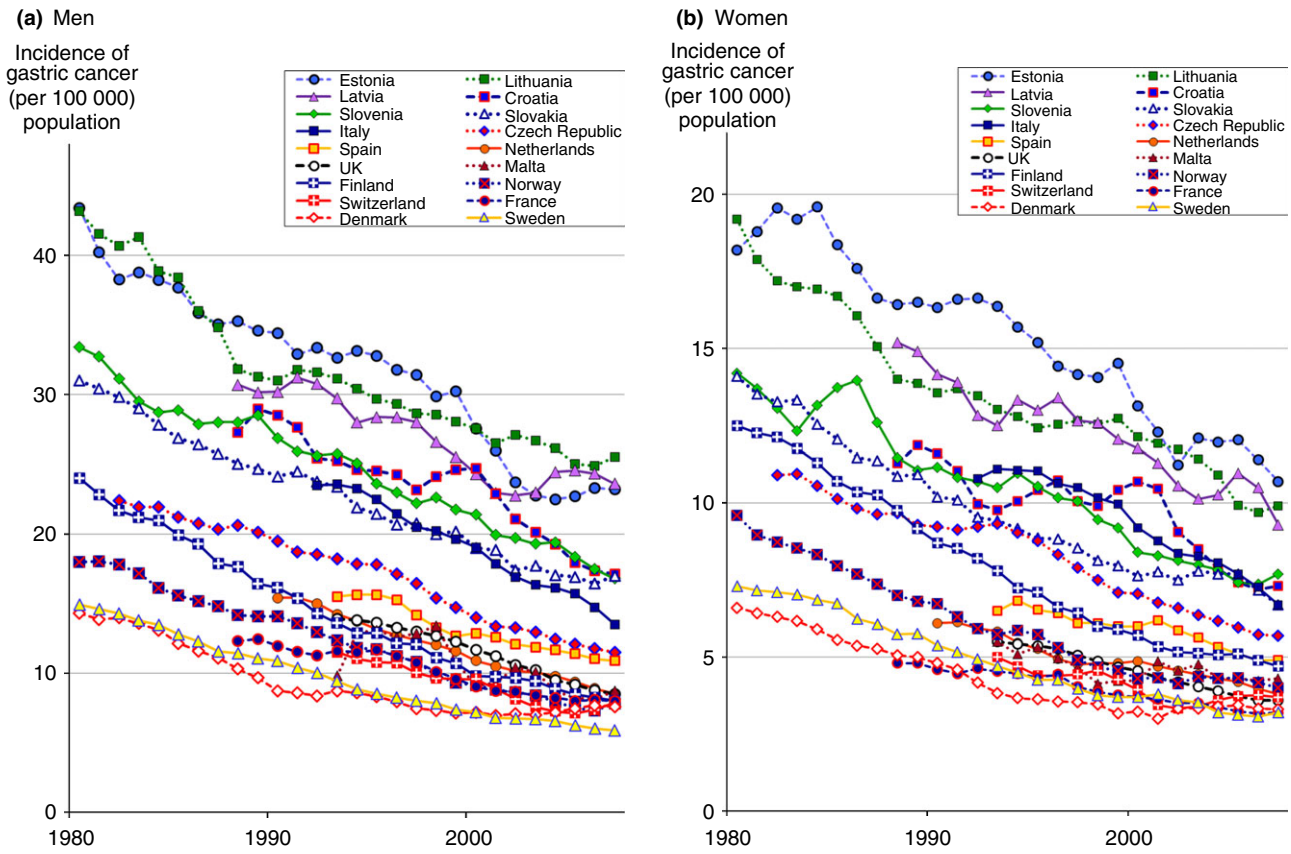

Figure 4 | Trends over time in the incidence of gastric cancer (per 100 000 population) across Europe: (a) Men and (b) Women.

tobacco and alcohol consumption, and personal hygiene. The wide variation in gastric cancer incidence across Europe, with lower rates in more affluent regions also reflects variation in the prevalence of these factors as well as *H. pylori*. For example, alcohol consumption in litres per capita in 2008 was approximately 50% higher in eastern Europe than in northern and southern Europe and about 25% higher than in western Europe, while smoking prevalence in eastern Europe was about 50% higher than in northern Europe and about 25% higher than in western and southern Europe.[26] We had considered investigating a link between *H. pylori* and both peptic ulcer and gastritis across Europe. However, incidence data on peptic ulcer and gastritis are not available across most of Europe.

Globally there are more than 1.1 million new cases of gastric cancer and approximately 470 000 deaths each year.[10] The prevalence of antral atopic gastritis has been shown to be a major risk factor in distinguishing populations at high risk of gastric cancer from those at low risk.[17] The reductions over time in *H. pylori* prevalence over the last 35 years from studies of trends in our review have coincided with strong reductions in the incidence of gastric cancer throughout Europe, with little regional variation in these reductions across Europe. Based on the limited available data on trends in *H. pylori* prevalence, the mean overall reduction for *H. pylori* (3.1%) is larger than the overall reduction in gastric cancer incidence across Europe from 1993 to 2007 (2.1%). These reductions were also quite comparable. Although there are major data limitations for *H. pylori* trends in particular, this would indicate that there have been less improvements over time across Europe in other causative factors involved in gastric carcinogenesis.

The very high prevalence of *H. pylori* in parts of eastern Europe suggests that more widespread test and treat for symptomatic dyspepsia would be appropriate. This strategy should prove cost effective in avoiding excessive endoscopic demand and would contribute significantly to cancer prevention strategies. *Helicobacter pylori* is a major causative factor for gastric cancer, duodenal ulcers and atrophic gastritis, which carry significant mortality, morbidity and health care resource

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utilisation. However, the test and treat strategy requires careful implementation and focus must be given to ensuring that treatment programmes are tailored to bacterial sensitivities to ensure that infection does not persist, either providing false re-assurances for doctor and patient, or worse continuing to cause more serious pathologies. Future research should be aimed at this and improving the evidence base for establishing the burden of *H. pylori* across Europe, in particular through national or nationally representative surveys and, preferably, through multinational studies that use standardised methodology.

AUTHORSHIP

Guarantor of the article: SER and SMR.

Author contributions: SER designed the study; JGW and DGS advised on the study design; SER, SMR and KT reviewed the literature and provided the analysis; AA provided the GIS mapping; SER wrote the manuscript; all authors interpreted the study findings and reviewed or edited the manuscript. All authors approved the final version of the article, including the authorship list.

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