

Global trends in *Helicobacter pylori* research from 1991 to 2008 analyzed with the Science Citation Index Expanded

Fat-Moon Suk^a, Gi-Shih Lien^a, Te-Chen Yu^b and Yuh-Shan Ho^{b,c}

Objective In this study, we aim to evaluate the global scientific production of *Helicobacter Pylori* (*H. pylori*) research, study the characteristics of *H. pylori* research activities, and identify patterns, tendencies, and regularities of *H. pylori*-related articles.

Methods Data were based on the online version of Science Citation Index Expanded, from the Web of Science database. Articles referring to *H. pylori* were assessed by the trend of publication output during 1991–2008, and analysis of the distribution of words in the article title, author keyword, and KeyWords Plus was carried out.

Results Globally, 37451 papers were published during the 18-year study period, including 19 080 articles, 10 396 meeting abstracts, 2625 reviews, 1943 proceedings papers, and 1866 letters. There were totally 1727 journals listed in the 122 Science Citation Index subject categories. The mainstream research on *H. pylori* was in the clinical gastroenterology and hepatology, microbiology, and pharmacology and pharmacy fields. The G7 industrial countries held the majority of total world production. Research on the *H. pylori*-related topic ‘ulcer’ remained the hotspot of *H. pylori* research, whereas that on the related

topic ‘gastric cancer’ increased during the 18-year study period.

Conclusion With synthetic analysis of word in article title, author keyword, and KeyWords Plus, it can be concluded that application of *H. pylori* in clinical gastroenterology, especially research related to ‘cancer’ is the orientation of all the *H. pylori* research in the 21st Century. This bibliometric method can help relevant researchers understand the panorama of global *H. pylori* research, and establish the direction of further research. *Eur J Gastroenterol Hepatol* 23:295–301 © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins.

European Journal of Gastroenterology & Hepatology 2011, 23:295–301

Keywords: cancer, *Helicobacter pylori*, research trend, Science Citation Index, scientometrics

^aDepartment of Internal Medicine, Taipei Medical University, Wan-Fang Hospital, Taipei, ^bTrend Research Centre, Asia University, Taichung County and ^cDepartment of Public Health, China Medical University, Taichung, Taiwan

Correspondence to Yuh-Shan Ho, PhD, Trend Research Centre, Asia University, No. 500, Lioufeng Road, Wufeng, Taichung County 41354, Taiwan
Tel: +866 4 2332 3456 x1797; fax: +866 4 2330 5834;
e-mail: ysho@asia.edu.tw

Received 25 October 2010 Accepted 4 February 2011

Introduction

Since the isolation of *Helicobacter pylori* (*H. pylori*) from gastric biopsies in 1983 by Warren and Marshall [1,2] in Perth, Australia, a new era of understanding of gastro-duodenal disorders has opened. *H. pylori* infection is almost always associated with inflammation of the gastric mucosa and peptic ulcer disease. However, gastric carcinoma and mucosa-associated lymphoid tissue lymphoma occur in a subset of individuals chronically infected with *H. pylori* [3]. The organism was previously included in the *Campylobacter* genus and the name *Helicobacter* was reported in October 1989 [4].

Despite the importance of *H. pylori* infection in gastro-duodenal disease, there have been few attempts to gather systematic data on the global scientific production of *H. pylori* research. A common research tool for this analysis is the bibliometric methods, which have already been widely applied for scientific production and research trends in many disciplines of science and engineering [5–7]. Furthermore, the Science Citation Index Expanded (SCI Expanded), from the Institute for Scientific Information (ISI), Web of Science database is the

most important and frequently used source database for a broad review of scientific accomplishment in all fields of study [8,9]. Conventional bibliometric methods often evaluate research trends by the publication output of countries, research institutions, journals, and research fields [10–12] or by citation analysis [13–15]. However, merely depending on changes in citations or publication counts from countries and organizations cannot completely indicate the development of trends or future orientation of a research field. More information, closer to the research itself, such as article titles, author keywords, KeyWords Plus, and abstracts, should be introduced in the study of research trends. KeyWords Plus in the SCI Expanded database supplies additional search terms extracted from the titles of articles cited by authors in their bibliographies and footnotes [16]. In recent years, words in article titles, author keywords, KeyWords Plus, and abstracts have been separated into different time periods to analyze variations in research trends [7,17,18]. Furthermore, a method called ‘word-cluster analysis’ has been successfully applied to find research hotspots in the risk assessment field [19].

In this study, we aim to synthetically use the traditional method, with study field and country analysis, and the innovative method, with article title, author keyword, and KeyWords Plus analysis, to map trends in global *H. pylori* research from 1991 to 2008, to help researchers understand the panorama of global *H. pylori* research, and establish the direction of further research.

Methods

These data were based on the online version of the SCI Expanded, Web of Science. SCI Expanded is the multi-disciplinary database of the ISI, Philadelphia, Pennsylvania, USA. According to the Journal Citation Reports (JCR), it indexed 6620 major journals with citation references across 173 scientific disciplines in 2008. The online version of SCI Expanded was searched under the keywords '*Helicobacter Pylori*', '*H. pylori*', '*campylobacter pylori*', and '*C. pylori*' to compile a bibliography of all papers related to *H. pylori* research. Articles originating from England, Scotland, Northern Ireland, and Wales were reclassified as being from the UK. In addition, the reported impact factor of each journal was obtained from the 2008 JCR. Contributions of different institutions and countries were estimated by affiliation with at least one researcher of the publications. Collaboration type was determined by the researchers' addresses, where the term 'single-country article' was assigned if the researchers' addresses were all from the same country. The term 'internationally collaborative article' was designated for those articles coauthored by researchers from multiple countries. The term 'single-institution article' was assigned if the researchers' addresses were all from the same institution. The term 'interinstitutionally collaborative article' was assigned if researchers were from different institutions. The document type, language of publication, characteristics of publication output, subject categories, journals as well as distribution of words in the article title, author keywords, and KeyWords Plus were assessed in all articles from 1991 to 2008 referring to *H. pylori*.

Results

Document type and language of publication

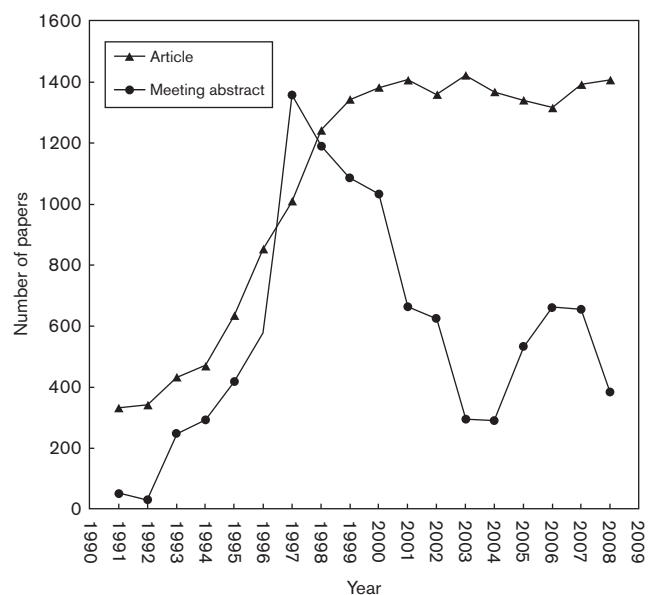
The distribution of the document type identified by ISI was analyzed. From this study, 13 document types were found in the total 37 451 publications during the 18-year study period. An article (19 080) was the most frequently used document type comprising 51% of the total production, followed by meeting abstracts (10 396; 28%), reviews (2625; 7.0%), proceedings papers (1943; 5.2%), letters (1866; 5.0%), and editorial materials (1068; 2.9%). The others showing less significance were notes (228), corrections (119), new items (77), addition corrections (22), discussions (12), reprints (12), and biographical-items (3). Three hundred and thirty-two articles were published in 1991. The number of articles increased progressively to a plateau of 1244 articles in 1998 and

maintained a steady rate over the following years (Fig. 1). The number of meeting abstracts increased after 1991 and reached a peak of 1358 in 1997, then rapidly decreased to a nadir of 289 in 2004. However, there has been a slow increase in the number of meeting abstracts since 2004. Journal articles represent the majority of document types. Only 19 080 articles were used for further analysis. Ninety-six percent of all of these journal articles were published in English. Several other languages also appeared, containing German (263; 1.4%), French (201; 1.1%), Spanish (142; 0.74%), and Russian (80; 0.42%). Languages, which were generally less used included Chinese (16), Japanese (13), Polish (11), Portuguese (4), Korean (3), Turkish (2), Hungarian (2), and one for each in Arabic, Rumanian, Lithuanian, Italian, Dutch, and Serbian.

Publication distribution by country

The contribution of different countries was estimated by the location of the affiliation of at least one author of the published articles. There were 84 articles without any researcher address information on the ISI, Web of Science. Of the 18 996 articles with researcher addresses, 15 612 (82%) were single-country articles and 3384 (18%) were internationally collaborative articles. The top 20 countries were ranked by number of articles, including the number and percent of single country articles, internationally collaborative articles, first author articles, and corresponding author articles (Table 1). Two North American countries, 11 European countries, six Asian

Fig. 1



Trends of articles and meeting abstracts on *Helicobacter pylori* from 1991 to 2008.

Table 1 Top 20 most productive countries of articles during 1991–2008

Country	Total number of articles (%)	Number of independent articles	Rank (%)	Number of internationally collaborative articles	Rank (%)	Number of first author articles	Rank (%)	Number of corresponding author articles	Rank (%)	%C
USA	4376 (23)	2804	1 (18)	1572	1 (46)	3519	1 (19)	3223	1 (19)	36
Japan	2707 (14)	2269	2 (15)	438	4 (13)	2508	2 (13)	2416	2 (14)	16
UK	1883 (9.9)	1224	4 (7.8)	659	2 (19)	1476	3 (7.8)	1248	5 (7.2)	35
Germany	1754 (9.2)	1135	5 (7.3)	619	3 (18)	1406	5 (7.4)	1299	3 (7.5)	35
Italy	1671 (8.8)	1240	3 (7.9)	431	5 (13)	1449	4 (7.6)	1281	4 (7.4)	26
France	850 (4.5)	512	6 (3.3)	338	7 (10)	647	6 (3.4)	593	6 (3.4)	40
Sweden	805 (4.2)	387	12 (2.5)	418	6 (12)	575	7 (3.0)	506	7 (2.9)	52
Canada	717 (3.8)	413	11 (2.6)	304	8 (9.0)	559	8 (2.9)	482	9 (2.8)	42
Netherlands	665 (3.5)	420	10 (2.7)	245	9 (7.2)	520	9 (2.7)	494	8 (2.8)	37
South Korea	554 (2.9)	457	7 (2.9)	97	19 (2.9)	490	10 (2.6)	469	10 (2.7)	18
Australia	547 (2.9)	311	14 (2.0)	236	10 (7.0)	411	13 (2.2)	374	13 (2.2)	43
Spain	535 (2.8)	421	9 (2.7)	114	17 (3.4)	458	11 (2.4)	406	11 (2.3)	21
China	532 (2.8)	308	15 (2.0)	224	11 (6.6)	386	14 (2.0)	360	14 (2.1)	42
Taiwan	466 (2.5)	422	8 (2.7)	44	30 (1.3)	442	12 (2.3)	403	12 (2.3)	9
Turkey	363 (1.9)	330	13 (2.1)	33	35 (1.0)	347	15 (1.8)	337	15 (1.9)	9
Finland	360 (1.9)	243	16 (1.6)	117	16 (3.5)	285	16 (1.5)	249	16 (1.4)	33
Switzerland	302 (1.6)	117	26 (0.75)	185	12 (5.5)	191	22 (1.0)	188	20 (1.1)	61
Ireland	289 (1.5)	143	21 (0.92)	146	13 (4.3)	197	21 (1.0)	158	22 (0.91)	51
Poland	284 (1.5)	146	20 (0.94)	138	14 (4.1)	219	19 (1.2)	202	19 (1.2)	49
Hong Kong	280 (1.5)	174	19 (1.1)	106	18 (3.1)	235	17 (1.2)	222	17 (1.3)	38

%C, the percent of internationally collaborative articles in total articles for each country.

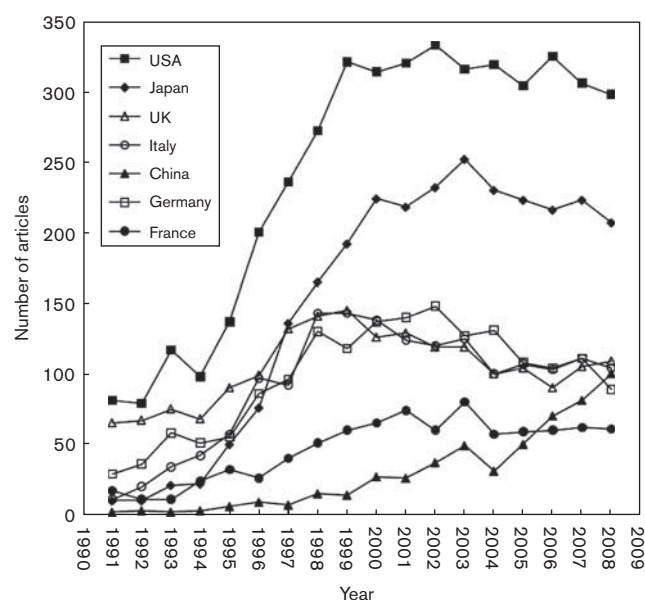
countries, and Australia were ranked in the top 20. Six of the seven major industrialized nations of the world (G7), the USA, Japan, the UK, Germany, Italy, and France were the top six countries of publication. Canada ranked the ninth. The United States most frequently collaborated with international partners, accounting for 46% of all internationally collaborative articles in the world. Compared with its total publications, the USA had a high percent (36%) of collaboration with outside researchers.

An obvious increase can be seen in the number of articles related to *H. pylori* research in all six countries, whereas the rapid development of global *H. pylori* research was partly driven by contributions of these countries (Fig. 2). Japan had the highest growth pace, with a lower share (16%) of internationally collaborative articles in its total articles among the top 20 productive countries. In addition, China ranked 13 but it was the only country with an increasing number of articles in recent years. Since the Chinese Society of Gastroenterology held the Chinese National Chronic Gastritis Meeting in 2000, advances have been made in the study of *H. pylori* infection in China [20].

Publication distribution by institution

The contributions of different institutions were estimated by the affiliation of at least one author. Of the 18996 articles with researcher address information in the ISI database, 7643 (40%) were independent articles and 11353 (60%) were collaborations by two or more institutions. Table 2 shows that among the top 20 institutions, six (30%) were in the USA. Leading institutions were Baylor College of Medicine, Veterans Affairs Medical Center, and Vanderbilt University in the USA, which published more than 300 *H. pylori*-related articles from 1991 to 2008. The University of Hong Kong

Fig. 2



Publication trends of the top six countries and China.

had the lowest percent of interinstitutional collaborative articles in total articles for each institute (%C), whereas Baylor College of Medicine had the highest value with 98%. Veterans Affairs Medical Center had the highest number of first and corresponding author articles.

Distribution of output by journal and subject category

In total, 19 080 articles in 122 SCI subject categories were published in 1727 journals. There were six journals with more than 500 published articles, which refer to *H. pylori*

