

Peruvian scientific production on *Helicobacter pylori*: a bibliometric analysis

Producción científica peruana sobre *Helicobacter pylori*: un análisis bibliométrico

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ABSTRACT

Objective: To evaluate the Peruvian scientific production on *Helicobacter pylori*. **Materials and methods:** Bibliometric analysis of original articles published until September 8, 2020, in journals indexed in PubMed, Scopus, Web of Science, LILACS, and SciELO. Bibliometric indicators were obtained. Likewise, analysis of the co-citation of authors and co-occurrence of terms with the terms included in the title and the abstract of publications was performed. **Results:** Data from 180 original articles were analyzed. An increase in the number of articles on *H. pylori* was found ($R^2 = 0.64$, an average annual growth rate of 8.01%). A total of 777 authors were identified, with an average number of articles per author of 0.18, and a collaboration index of 5.64. The average number of citations per original article was 1.91. The Universidad Peruana Cayetano Heredia was the institution with the highest number of original articles (63.2%). The analysis of co-occurrence of terms found terms related to gastric cancer during the whole study period and, for recent years, terms related to the treatment of *H. pylori* infection and water sources. **Conclusion:** There is an increase in Peruvian production in original articles on *H. pylori*. In recent years, the study of the eradication of *H. pylori* and the transmission of the agent from water sources have been topics of interest.

Keywords: *Helicobacter pylori*; Research; Bibliometrics; Publications; Peru (Source: MeSH).

RESUMEN

Objetivo: Evaluar la producción científica peruana sobre *Helicobacter pylori*. **Materiales y métodos:** Análisis bibliométrico de artículos originales publicados hasta el 8 de setiembre de 2020 en revistas indexadas en PubMed, Scopus, Web of Science, LILACS y SciELO. Se obtuvieron indicadores bibliométricos. Asimismo, se realizó un análisis de la co-citación de autores y co-ocurrencia de términos con los términos incluidos en el título y el resumen de las publicaciones. **Resultados:** Se analizaron datos de 180 artículos originales. Se encontró un aumento en el número de artículos sobre *H. pylori* ($R^2 = 0,64$, una tasa de crecimiento anual promedio de 8,01%). Se identificaron un total de 777 autores, con una media de artículos por autor de 0,18 y un índice de colaboración de 5,64. El número medio de citas por artículo original fue de 1,91. La Universidad Peruana Cayetano Heredia fue la institución con mayor número de artículos originales (63,2%). El análisis de co-ocurrencia de términos encontró términos relacionados con el cáncer gástrico durante todo el período de estudio y, en los últimos años, términos relacionados con el tratamiento de la infección por *H. pylori* y fuentes de agua. **Conclusión:** Existe un aumento en la producción peruana de artículos originales sobre *H. pylori*. En los últimos años, el estudio de la erradicación de *H. pylori* y la transmisión del agente desde fuentes de agua han sido temas de interés.

Palabras clave: *Helicobacter pylori*; Investigación; Bibliometría; Publicaciones; Peru (Fuente: DeCS).

INTRODUCTION

Helicobacter pylori (*H. pylori*) initially known as *Campylobacter pylori*, is one of the bacterial pathogens that most frequently colonizes the gastrointestinal tract of humans, considering that it is found in more than half of the world population⁽¹⁾. Its discovery, 38 years ago, revolutionized medicine by being the first bacteria with carcinogenic properties formally recognized⁽²⁾. *H. pylori* infection is a key factor in the pathogenesis

of various gastrointestinal diseases such as chronic gastritis, peptic ulcer, gastric adenocarcinoma, and lymphoma^(1,2), hence the importance of its study for the control of various clinical conditions.

From the description of this bacterium in 1992, there has been an increase in the studies published worldwide on this pathogenic agent, motivated by the importance that this microorganism represents for Public Health⁽³⁾. For this reason, the number of publications related to *H.*

pylori has progressively increased, with the approaches evolving based on the knowledge acquired^(3,4). In this regard, in recent decades, various studies have been using bibliometric methods to evaluate scientific productivity in various biomedical fields, the study of scientific production in the field of gastroenterology and specifically in *H. pylori*^(1,2,5,6).

In Peru, various series describe prevalence of *H. pylori* greater than 30%, postulating that infection by this pathogen is acquired in the early stages of life and that it would be higher in groups with a lower socioeconomic level⁽⁷⁻⁹⁾. However, to date, there are no studies on the Peruvian scientific production in *H. pylori*. The study of the scientific production of a country on a health topic is important to know the state of research development in a specific area and to identify opportunities to direct the research according to the needs of the country. Therefore, the objective of this bibliometric analysis was to evaluate the Peruvian productivity, in original articles published until 2019, on *H. pylori*, considering the quantity and quality of the published articles, as well as an analysis of citations by authors and co-occurrence of terms in documents. This analysis has the purpose of determining whether or not there has been an increase in publications on *H. pylori* by evaluating the Peruvian scientific production regarding this pathogenic agent.

MATERIALS AND METHODS

Study design

A bibliometric analysis of original articles on *Helicobacter pylori* in journals indexed in PubMed, Scopus, Web of Science (WOS), LILACS, and SciELO was carried out.

Data source

The bibliographic databases PubMed, Scopus, and WOS were used, given that they collect the largest number of indexed journals in the health field. Likewise, the bibliographic databases LILACS and SciELO were used since they index journals from countries in the Latin American and the Caribbean region, such as Peru.

PubMed is an open-access search engine, offered by the United States National Library of Medicine, which allows access to abstracts and references of biomedical research articles contained in Medline (the most widely used open access citation database), and additionally in a variety of scientific journals not included in this database, but of similar quality⁽¹⁰⁾. Scopus is a bibliographic database published by Elsevier and accessible by subscription, contains abstracts and citations of scientific articles from more than 16,500 journals (including all Medline documents)

and information, author profiles, and details of the citations that each published document has received. The data offered by Scopus are useful for quantity and quality measurements in studies that evaluate institutional scientific production⁽¹¹⁾. WOS is an online scientific information service, integrated into ISI Web of Knowledge; allows access to a set of databases to access documents that cite different scientific articles, as well as access to previous publications of research through their bibliographic references; in this way, the impact of scientific work can be evaluated⁽¹²⁾. LILACS is a bibliographic database supported by the Latin American and the Caribbean Center for Information on Health Sciences (BIREME) of the Pan American Health Organization and World Health Organization, which contains more than 900 thousand records of journal articles, peer-reviewed theses and dissertations, government documents, conference papers, and books from the Latin America and the Caribbean region⁽¹³⁾. SciELO is a bibliographic database of open access journals from the Latin American and Caribbean region with more than 1,000 indexed journals and a collection of more than 400,000 articles from this region⁽¹⁴⁾.

Search strategy

The search strategies used were developed on September 8, 2020, following the search strategy developed by Taype-Rondán *et al.*⁽¹⁵⁾. The search strategies included controlled and free terms to be searched in the title, abstract, and keywords of the documents indexed in PubMed, Scopus, WOS, LILACS, and SciELO. In Table 1, the search strategies used for each of the databases are presented. The review and selection of the retrieved articles were carried out by two authors (GBQ and ABP) independently.

Identification of original articles

The complete records of each publication retrieved in the searches in each bibliographic database are downloaded as .csv or .ris files and imported into EndNote X9 for the identification and elimination of duplicates following the methodology of Bramer *et al.*⁽¹⁶⁾. Subsequently, the publications were imported into Rayyan (<https://rayyan.qcri.org>), where two authors (GBQ and ABP) selected the articles that met the inclusion criteria: be original articles whose main topic was on *H. pylori* or that the measurement of data on *H. pylori* be identified in the title or abstracts, that at least one researcher has a Peruvian institutional affiliation and has been published until 2019. It was considered to include only articles published until 2019 because the year 2020 is still in progress, and the numbers of the journals during this year, in many cases, have been affected in their publication times due to the COVID-19 pandemic.

Table 1. Search strategies in PubMed, Scopus, WOS, LILACS, and SciELO for the identification of original articles on *Helicobacter pylori* from Peruvian institutions.

Bibliographic database	Search strategy	Results
PubMed	("Helicobacter pylori" OR "H. pylori" OR "Campylobacter pylori") AND (peru*)	221
Scopus	TITLE-ABS-KEY("Helicobacter pylori" OR "H. pylori" OR "Campylobacter pylori") AND AFFILCOUNTRY(peru)	114
Web of Science	TS=(Helicobacter pylori OR H. pylori OR Campylobacter pylori) AND CU=(peru)	101
LILACS	("Helicobacter pylori" OR "H. pylori" OR "Campylobacter pylori") AND (peru\$)	52
SciELO	("Helicobacter pylori" OR "H. pylori" OR "Campylobacter pylori") AND (peru*)	72

Bibliometric analysis

The VOSviewer software (Leiden University, Leiden, The Netherlands) was used to develop bibliometric networks based on co-authorship, using the information on the names of the authors associated with the original articles retrieved from the total bibliographic databases used.

The Biblioshiny and Bibliometrix packages were used in the R programming language to obtain bibliometric indexes. For this analysis, only the original articles retrieved from Scopus were used, since Bibliometrix R-package uses the data reported by Scopus for each document retrieved in order to calculate bibliometric indices.

Prior to the analysis, one of the authors (AHV) performed a manual standardization of the author's name and affiliation domains, since documents with

erroneous attribution of these data were detected. As results of this analysis, the average number of publications per author, number of publications with one or more authors, average number of authors per article, average number of citations per article, number of original articles were reported, as well as the following bibliometric indexes: index of authors per article (ratio between the total number of articles and the total number of authors), co-author index per article (average number of co-authors per article) and the collaboration index (ratio between the total number of authors of articles with several authors / total articles with several authors). More information on the calculation of these bibliometric indices is available on the Bibliometrix website (<http://www.bibliometrix.org/>).

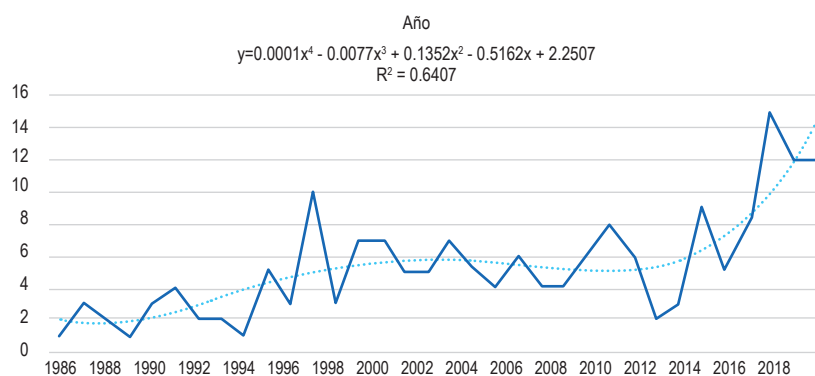
For the analysis of co-occurrence of terms in titles and abstracts of the original articles retrieved from Scopus, the Biblioshiny and Bibliometrix packages in the R programming language (Bibliometrix R-package) were also used. A threshold for the co-occurrence of terms in titles and abstracts of five mentions was used, with terms that did not have at least five mentions in the total of articles were excluded.

Ethical considerations

For the development of this study, approval by an ethics committee was not requested since data from publications in databases of bibliographic citations were used.

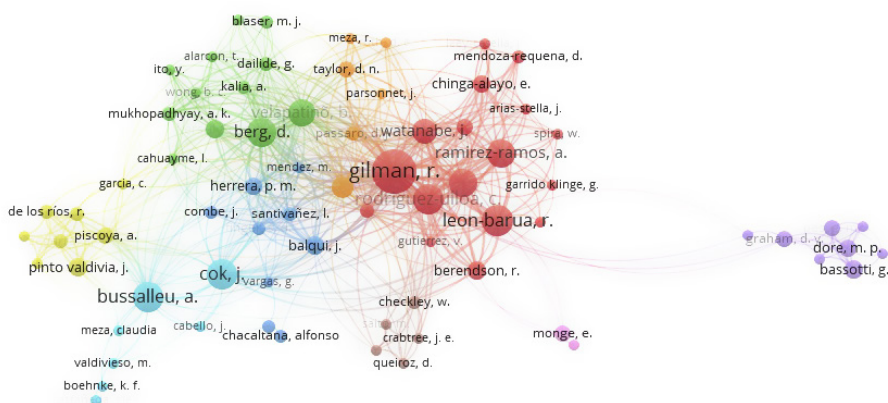
RESULTS

After eliminating duplicates, data from 289 publications (PubMed: 221, Scopus: 114, WOS: 101, LILACS: 52 and SciELO: 72) were analyzed. Of these publications, 180 (64.36%) were original articles published until 2019, which were included for the analysis. In general, an increase in Peruvian scientific production was found in original articles on *H. pylori* ($R^2 = 0.64$), with an average annual growth rate of 8.01% (Figure 1).



Source: PubMed, Scopus, Web of Science (WOS), LILACS, and SciELO databases.

Figure 1. Scientific production of original articles on *Helicobacter pylori* from Peruvian institutions.



Source: PubMed, Scopus, Web of Science (WOS), LILACS and SciELO databases.
 Legend: Authors with more than five original articles were included in the co-authorship analysis. Each circle represents an author. The size of the circle indicates the size of their productivity (the larger the circle, the greater number of documents), and the closeness of the circles indicates a closer collaboration.

Figure 2. Author co-authorship analysis Peruvian scientific production on *Helicobacter pylori*.

As part of the bibliometric analysis, 777 authors were found in original articles on *H. pylori* found in the five bibliographic databases included. An average of the number of articles per author of 0.23 was found. The authors with the highest number of publications were Gilman RH (45 articles), León-Barúa R (23 articles), Cok J (22 articles), and Bussalleu A (22 articles). In Figure 2, the co-authorship analysis in VOSviewer is presented, evidencing the formation of collaboration networks around the authors with the highest scientific production previously described.

Regarding the institutional affiliations of the authors of the publications on *H. pylori*, the analysis carried out with the Biblioshiny and Bibliometrix packages

of original articles recovered from Scopus, found that the Universidad Peruana Cayetano Heredia was the most frequent institutional affiliation with 55 (63.2%), followed by Johns Hopkins University with 30 (34.5%) articles, and Washington University with 13 (14.9%). Regarding collaboration networks, it was found that the greatest collaboration of Peruvian institutions occurred with institutions from the United States, also including collaborations with European and Latin American institutions (Figure 3). Likewise, it was found that the original articles retrieved from Scopus had an average number of citations of 1.91, being the documents of Kelin PD *et al.* and Aspholm-Hurtig M *et al.*, presented the highest number of citations (466 and 274, respectively), with an average citation per year (15.53 and 16.12, respectively).



Legend: Elaborated with the Biblioshiny and Bibliometrix packages in the R language environment using original articles retrieved from the Scopus database.

Figure 3. Worldwide institutional collaboration networks in original articles on *Helicobacter pylori* that included at least one Peruvian institutional affiliation.

Table 2. Top ten journals publishing Peruvian scientific production on original articles about *Helicobacter pylori*.

Journal	Frequency
Revista de Gastroenterología del Perú	55
Journal of Clinical Microbiology	7
Acta Gastroenterológica Latinoamericana	6
American Journal Of Gastroenterology	6
Gastroenterology	5
Helicobacter	5
Journal of Bacteriology	5
Clinical Infectious Diseases	4
Journal of Clinical Gastroenterology	4
Digestive Diseases and Sciences	3
PLoS ONE	3
Revista Peruana de Medicina Experimental y Salud Pública	3
Scandinavian Journal of Gastroenterology	3
Transactions of the Royal Society of Tropical Medicine and Hygiene	3

Source: PubMed, Scopus, Web of Science (WOS), LILACS, and SciELO databases.

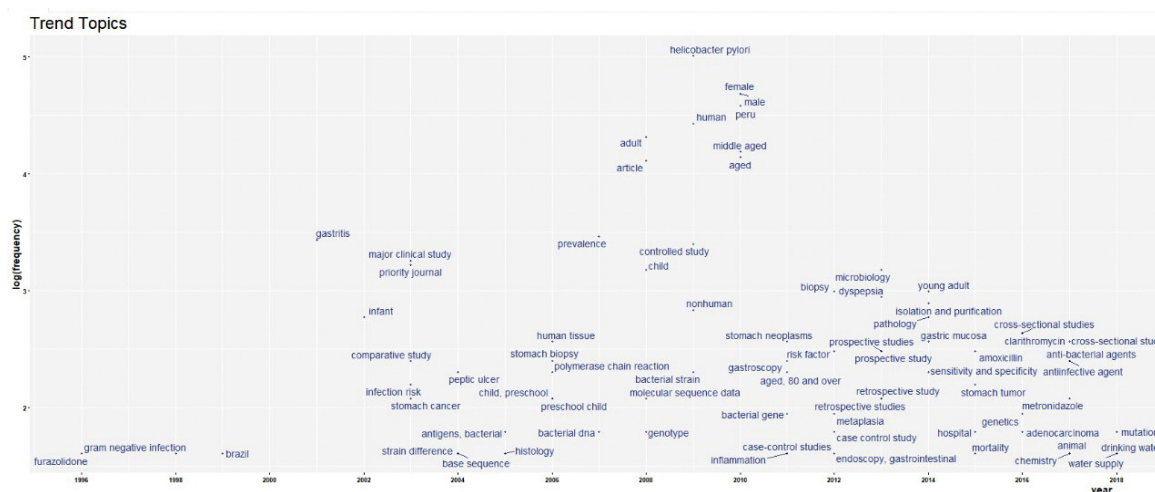
In relation to scientific journals, in the analysis of the total original articles retrieved from the five bibliographic databases included, it was found that about half of the publications (47.85%) were published in the seven journals with the highest number of original articles. On the other hand, the Revista de Gastroenterología del Perú, with 55 original articles (29.57%), published the highest number of publications on *H. pylori*, followed by the Journal of Clinical Microbiology with seven (3.76%), Acta Gastroenterológica Latinoamericana with six (3.23%) and the American Journal of Gastroenterology with also six publications (3.23%) (Table 2).

Regarding the analysis of co-occurrence of terms (Figure 4), in mid-2000, where an increase in the number of articles on *H. pylori* was evidenced, terms such as stomach cancer, stomach biopsy, human tissue, prevalence, polymerase chain reaction, strain difference, molecular sequence data, and bacterial strain. For recent years, terms such as drinking water, water supply as well as clarithromycin, metronidazole, anti-bacterial agents, and anti-infective agents have been found. In general, the terms in relation to gastric cancer have been maintained during the years of study.

DISCUSSION

Evaluating the scientific production of a country on a health topic makes it possible to identify the state of scientific production and guide the development of future research. This study aimed to determine the Peruvian scientific production in *H. pylori* and its characteristics. As results, there is evidence of an increase in the number of original articles on *H. pylori* by authors with Peruvian institutional affiliation during the last decades, identifying institutions that lead research on *H. pylori* in Peru, inter-institutional collaboration networks, and thematic on *H. pylori* that have been more studied in recent years.

Regarding the Peruvian production in publications on *H. pylori*, in the study period, an increase in the number of original articles published was evidenced. In line with this, various previously published bibliometric studies indicate an increase in scientific production on *H. pylori* from previous decades ^(1,2,5). Given the need to promote research for decision-making and development of strategies for disease control, the increase in the original production of *H. pylori* describes a scenario in which knowledge is being generated for a greater understanding of the problem of *H. pylori*.



Legend: Elaborated with the Biblioshiny and Bibliometrix packages in the R language environment using original articles retrieved from the Scopus database.

Figure 4. Terms co-occurrence analysis of titles and abstracts and their temporal evolution for Peruvian scientific production on *Helicobacter pylori* in the Scopus database.

In recent years, a boost has been given to research from the Council of Science (CONCYTEC) of the Government of Peru, including training in research for professionals in national territory and abroad, including those in science and health, as well as financing for the development of research through competitive funds with the participation of public institutions and international institutional collaboration^(17,18). These government measures could help sustain the growing Peruvian scientific production of *H. pylori* over time, useful for the study of this high-frequency pathogen in the Peruvian population.

In relation to institutional affiliations, it was found that the most frequent institution publishing original articles about *H. pylori* was the Universidad Peruana Cayetano Heredia. This institution is one of those that lead the scientific production in Peru, and, specifically, it occupies the first position in scientific production in the area of health⁽¹⁹⁾. Other educational institutions such as the Universidad Peruana de Ciencias Aplicadas and the Universidad Mayor de San Marcos, which occupy the first places in the scientific production in health in Peru, occupied leading positions in the scientific production in *H. Pylori* of Peruvian institutions. Likewise, other institutions stood out, such as the Hospital Nacional Cayetano Heredia, Policlínico Peruano Japonés, Clínica Ricardo Palma, Hospital Nacional Edgardo Rebagliati Martins e Instituto Nacional de Enfermedades Neoplásicas. Since most of the scientific production on *H. pylori* is related to the association of this pathogen with gastric cancer, hospitals and private clinics in research on *H. pylori* could be explained from this point of view. On the other hand, it was found that the largest collaborative work among Peruvian institutions that have published original articles on *H. pylori* occurred with institutions in the United States, such as Johns Hopkins University and Washington University. This country is the one with the highest scientific production globally, and previous bibliometric studies also describe that the institutions of this country present the highest number of publications in the area of gastroenterology and, specifically, in *H. pylori*^(3,4). Likewise, other institutions found in collaboration with Peruvian institutions for scientific production on *H. pylori* were from Europe. Like the US, institutions in this region occupy the first places in scientific production, including on the specific topic of *H. pylori*^(3,4). Collaborative work is an important opportunity for the development of Peruvian scientific production since this work in a network allows to have the material and human resources required for the development of research for an important health problem in Peru.

Regarding the analysis of co-occurrence of terms, by mid-2000, terms related to gastric cancer and the molecular study of *H.pylori* were highlighted, which highlights an interest in the study of pathological and

molecular anatomy of *H. pylori* and its relation to gastric cancer. In more recent years, terms regarding *H. pylori* treatment and water have been described in original *H. pylori* articles. This would indicate that, in recent years, the emphasis is being given to the treatment of patients with *H. pylori*^(20,21), as well as the study of *H. pylori* and its transmission from water reservoirs^(22,23). These results could be explained from the growing study of *H. pylori* eradication therapies to reduce the incidence of gastric cancer globally⁽²⁴⁾ as well as a global scenario that promotes access to clean and safe water as part of the targets of the United Nations Sustainable Development Goals⁽²⁵⁾ to reduce its potential transmission from water reservoirs. Finally, it should be noted that the terms related to gastric cancer have been, in general, those of a sustainable presence during the years studied on scientific production in *H. pylori*. This highlights the importance that researchers find in the study of the association between *H. pylori* and gastric cancer, which has been reflected in the same way in other bibliometric studies in gastroenterology and *H. pylori*.

Most of the Peruvian scientific production on original articles were published in the Revista de Gastroenterología del Perú, an official publication of the Sociedad de Gastroenterología del Perú⁽²⁶⁾. The number of Peruvian scientific journals indexed in bibliographic databases is low. The Revista de Gastroenterología del Perú is a journal indexed in Medline and retrievable from Scopus, being the only journal in the country in the gastroenterology subject indexed in that database, in addition to being one of the few journals to publish in Spanish and English languages indexed in these global databases that are included in the gastroenterology subject (for example, in Scopus, only four journals whose main topic is gastroenterology are indexed to this database)⁽²⁷⁾. The foregoing would indicate that this journal would be an important space for the scientific communication of research results in the area of gastroenterology for researchers, including those with Peruvian institutional affiliation, who seek greater visibility of the results of their research.

Regarding the limitations of the study, it should be specified that the performance of bibliometric analysis depends on the availability of data on the articles retrieved with the search strategies. Given that no documents were included that did not have the *H. pylori* study as their main topic, or that the measurement of data on *H. pylori* was not identified in the title or abstracts, it is possible that some documents that did not include this information in the title or abstract could have been excluded despite the use of specific search strategies for each database aimed at identifying the greatest number of useful documents for the purpose of the study, which could underestimate the Peruvian production on *H. pylori*. Despite the above, we consider that the study of Peruvian production in original articles

published on *H. pylori* serves as a starting point to learn how knowledge about *H. pylori* is being generated by Peruvian institutions and their collaboration networks.

In conclusion, an increase in Peruvian scientific production was found in the number of original articles on *H. pylori*, with greater institutional collaboration with US institutions. The original articles of the most recent publication describe terms in relation to eradication of *H. pylori* and its transmission from water sources which indicates that researchers have been studying these topics in recent years.

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Conflict of interest: the authors have nothing to declare.

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