

# Bibliometric analysis of research relating to gonorrhoea reported over the period 1980–2020

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## Research Article

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# Abstract

**Objective and Design:** Gonorrhoea is an important sexually transmitted disease that threatens public health in the 21st century. Aim of this study was to reveal the current status of literature data about gonorrhoea.

**Methods:** A scan of literature was performed on the Web of Science (WoS) database on 17 Aug 2021 to retrieve bibliometric data. The literature search was applied using the search term “gonorrhoea” in article titles for the period January 1980–December 2020.

**Results:** After applying all inclusion and exclusion criteria, 1068 articles remained for final evaluation. The number of articles published by year tended first to decrease and then to increase. According to the number of articles, the first three countries were the USA (n=660; 61.80%), England (n=107; 10.02%), and Canada (n=52; 4.87%). The journal with the highest number of articles were the Journal of Sexually Transmitted Diseases and Sexually Transmitted Infections. The Centers for Disease Control and Prevention organization in the United States produced the largest number of articles on gonorrhoea during this specified time period.

**Conclusions:** This holistic data evaluation of analysis of the findings, knowing the trend topics, understanding which topics are cited more, will be of benefit for authors conducting future research.

## Introduction

Gonorrhoea, caused by the *Neisseria gonorrhoeae* bacterium, is the second most common sexually transmitted disease in the world and continues to be an important public health problem in developed and developing countries [1,2]. Uncomplicated gonococcal infection in the lower urogenital system, may also become ascending infection with sequelae complications such as pelvic inflammatory disease in women, chronic pelvic pain, ectopic pregnancy, epididymitis in men, and infertility in both sexes, which can cause more problems later on. Gonococemia, although relatively rare, can be seen in the course of gonorrhoea with the cardiovascular system, joint, skin, and mucosal involvement (oral, anal, conjunctival). However, many cases of gonorrhoea may be asymptomatic. Furthermore, effective antibiotics for gonorrhoea have started to become unusable with the unavoidable increase in antimicrobial resistance. The diagnosis, treatment, and control of gonorrhoea are made more difficult by these current conditions [3-5].

Bibliometric studies are one of the most important research analyses that are frequently used to evaluate global academic productivity with qualitative and quantitative analyses in a specific field [6-8]. These studies provide a detailed insight about a topic beyond journals [9]. Within a specific time period, research trends can be observed with the use of parameters such as author, country, journal, and number of citations, and the deficiencies in academic productivity can be identified. Moreover, these studies reduce the time researchers spend searching for information [10-12]. Bibliometric studies are beneficial in revealing and mapping large volumes of cumulative scientific data [13].

To the best of our knowledge, there has been no previous bibliometric study about gonorrhoea. Therefore, the aim of this study was to reveal the current status of literature data about gonorrhoea using the Web of Science (WoS) database and bibliometric analysis. It is hoped that this will be of use for researchers and a guide for further studies.

## Methods

The methodology used is in parallel with other bibliometric studies used in specific disciplines [9,10,14]. A scan of literature was performed on the Web of Science (WoS) database on 17 Aug 2021 to retrieve bibliometric data. The WoS is a reliable scientific database and is commonly used to scan scientific articles. Previous bibliometric studies in many fields have used WoS and similar databases [15].

The literature search was applied using the search term “gonorrhoea” in article titles for the period January 1980–December 2020. The only document types included were articles and reviews. Meeting abstract, letter, editorial materials, and other document types were excluded from the study. Only articles in the English language were included in the study. The articles which fulfilled the criteria were registered as a folder and were analyzed.

Bibliometric web visualizations were made using the VOSviewer (version 1.6.17), in which a visualization map is created for each article by combining country, journal names, citations and keywords. Clusters are created between these components and lines between the components demonstrate connections. The thickness of the lines represents the strength of the connection, and the width of the circles represents data redundancy [16].

Data were analyzed statistically using the Statistical Package for Social Sciences, Version 15 software (SPSS; SPSS Inc., Chicago, IL, USA). Categorical data were stated as number (n) and percentage (%).

The data used in this study are in the public domain. Ethical approval was not required for this study.

## Results

In the first stage, 1963 articles were listed as the result of the WoS search. After applying all inclusion and exclusion criteria, 1068 articles remained for final evaluation, ranging from 46 articles in 1980 to 6 articles in 2000 and 56 articles in 2020. The number of articles published by year tended first to decrease and then to increase (Figure 1a).

The authors of the five most cited articles on gonorrhoea were Ohnishi M et al. (cited=449), Kent CK et al. (cited= 344), Cohen D et al. (cited=322), Golden MR et al. (cited=300), and Fortenberry D et al. (cited=281) (Table 1). A co-authorship network visualization map was created to show collaborations between authors. When the minimum number of documents for authors was selected as 3, the map was formed for 243 authors (Figure 1b).

The top 10 countries with the most articles are listed in Table 2. The articles produced from these countries accounted for 92.2% of all articles. According to the number of articles, the first three countries were the USA (n=660; 61.80%), England (n=107; 10.02%), and Canada (n=52; 4.87%). For countries with a minimum of two documents, a country co-authorship visualization map was created in the VOS viewer application. A visualization map with 62 countries that meet the criteria is presented in Figure 1c. The size of the circle on the map is in proportion to the number of articles.

The three most common keywords in the articles were gonorrhoea (n=156; 14.607%), *Neisseria Gonorrhoeae* (n=58; 5.431%) and chlamydia (n=57; 5.337%) (Table3). A network visualization map and overlay visualization map for these frequently used keywords are shown in Figures 2a and 2b.

The 10 most active journals are presented in Table 3. The journal with the highest number of articles was the Journal of Sexually Transmitted Diseases (n=276; 25.8%), and this is represented by the largest circle on the bibliographic coupling of journals network visualization map (Figure 2c).

A bibliographic coupling of institutions network visualization map was created for the 82 institutions with a minimum of five documents (Figure 2d). The Centers for Disease Control and Prevention organization in the United States produced the largest number of articles on gonorrhoea during this specified time period.

## Discussion

Bibliometric studies have gained more importance in recent years in terms of summarizing publications, presenting visual data and showing trends in a specific field. In this study, 1068 articles were examined following the implementation of the inclusion and exclusion criteria. The study was conducted with a systematic and comprehensive

methodology, using many parameters such as the country of origin, year, author, institution, keywords, citation, and journal.

There was a decrease in the number of articles published by year between 1990 and 2010, and then the number of articles increased by the year. The most cited article was a study by Ornishi et al. (2011) on ceftriaxone drug resistance, followed by the study by Kent CK et al. (2005) on the prevalence of the disease. The increase in the prevalence of the disease due to the development of resistance to simple antibiotics and the weakening in disease control in recent years may explain the increase in the number of articles in the last decade. The number of articles published by year and the distribution of articles by country are presented as a table in this study. The activity of countries to produce articles can be affected by the socioeconomic development level, the support they give to scientific studies, the presence of many scientific institutions, the prevalence of the disease and many other factors. When the number of articles was evaluated by country, it was seen that the USA produced the most articles on gonorrhea, accounting for more than half of all the articles. In addition to producing the most articles, the USA was also the country with the highest number of total citations. As the United States is known to be the most productive country in many respects, these data were not surprising [17,18].

The most productive institution in the USA was seen to be the Centers for Disease Control and Prevention. The long-standing success of USA institutions in implementing research and population-based public health programs is a major driver of article productivity. The USA can also support scientific studies due to the advantages of its economic development [19]. The USA and England, which are the leading countries in terms of article production, also had the most citations, although articles originating from Sweden, which had relatively few articles, were highly cited. Considering the increase in article productivity in Australia, South Africa and China in the last 10 years, it can be predicted that these countries will dominate more in the coming years.

The journal Sexually Transmitted Diseases made the largest contribution to the literature, with the publication of a quarter of all articles. Therefore, researchers should focus on this journal for high impact. The journals with the greatest impact should be followed when planning research and deciding where to publish.

Network visualization analysis using keywords is frequently used to see research points and predict research trends [20]. It was an expected result that gonorrhea and Neisseria Gonorrhoeae were among the top 10 most used keywords in this study. "Sexually Transmitted Diseases" and diseases such as "chlamydia", "syphilis" and "HIV" in this group were among the most frequently used keywords. This demonstrated that gonorrhea is often studied together with these other sexually transmitted diseases. The overlay visualization map shown in Figure 2b demonstrates the predicted research trend according to the keywords in the study.

One limitation of this study was that it only used the WoS database. Although the WoS database has limited content compared to databases such as Google Scholar, PubMed and Scopus, it is more reliable than other databases because it indexes journals with high impact factor. Therefore, the WoS database is mostly used in bibliometric studies. Another limitation in this study was that only English-language articles were included. However, the date range examined was broad (1980–2020), and the evaluation of articles published in 2020 showed that current data were presented.

This study determined the number of articles published by journals and the most cited articles on the subject of gonorrhea, and demonstrated the trend in the number of articles published on gonorrhea by year. This holistic data evaluation of analysis of the findings, knowing the trend topics, and understanding which topics are cited more, will be of benefit for authors conducting future research.

## Declarations

**Ethics approval:** Not required

**Consent to participate, Research involving Human Participants and/or Animals and/or plants:** This research does not involve Human Participants and/or Animals and/or plants.

**Availability of data and materials:** Not applicable

**Competing interests:** None of the authors have any conflicts of interest to declare

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## Tables

**Table 1. Top-10 most commonly-cited articles related to gonorrhea.**

Rank	Article Title	Authors	Institution	Journal	Year	TC	CPY	JIFS
1	Is Neisseria Gonorrhoeae initiating a future era of untreatable gonorrhea?:Detailed characterization of the first strain with high-level resistance to ceftriaxon	Ohnishi Makoto et al.	Tokyo Medical University	Antimicrobial Agents and Chemotherapy	2011	449	40,82	4,715
2	Prevalence of rectal, urethral, and pharyngeal chlamydia and gonorrhea detected in 2 clinical settings among men who have sex with men: San Francisco, California, 2003	Kent CK et al.	Centers for Disease Control &Prevention	Clinical Infectious Diseases	2005	344	20,24	9,055
3	Broken windows and the risk of gonorrhea	Cohen D et al.	Louisiana State University	American Journal of Public Health	2001	322	14,64	5,381
4	Effect of expedited treatment of sex partners on recurrent or persistent gonorrhea or chlamydial infection	Golden MR et al.	University of Washington	New England Journal of Medicine	2005	300	17,65	70,670
5	Relationships of stigma and shame to gonorrhea and HIV screening	Fortenberry D et al.	Indiana University	American Journal of Public Health	2002	281	14,05	5,381
6	Emergence of multidrug-resistant, extensively drug-resistant and untreatable gonorrhea	UnemoMagnus et al.	Orebro University	Future Microbiology	2012	276	27,6	2,746
7	Rectal gonorrhea and chlamydia reinfection is associated with increased risk of HIV seroconversion	Bernstein Kyle T et al.	Centers for Disease Control & Prevention	Jaids-Journal of Acquired Immune Deficiency Syndromes	2010	216	18	3,863
8	Confidential HIV testing and condom promotion in africa - impact on HIV and gonorrhea rates	Allen S et al.	University of California San Francisco	Jama-Journal of the American Medical Association	1992	199	6,63	51,273
9	The role of sexual partnership networks in the epidemiology of gonorrhea	Ghani AC et al.	Imperial College London	Sexually Transmitted Diseases	1997	191	7,64	2,27

10	Repeat infection with chlamydia and gonorrhea among females: A systematic review of the literature	Hosenfeld Christina B et al.	US Department of Veterans Affairs	Sexually Transmitted Diseases	2009	188	14,46	2,270
JIFS: Journal impact factor score 2018. TC: Total citations CPY: Citations per year								

**Table 2. Top 10 most productive countries for gonorrhea articles.**

Rank	Country	Number and percentage of articles				TN	TC	CPA	H-index
		1980-90	1991-00	2001-10	2011-20				
1	USA	187	91	127	255	660	15760	23,88	60
2	ENGLAND	60	20	4	23	107	1988	18,58	23
3	CANADA	11	4	8	29	52	733	14,1	16
4	AUSTRALIA	3	9	2	24	38	728	19,16	15
5	SWEDEN	13	3	3	11	30	1435	47,83	16
6	NETHERLANDS	16	4	2	6	28	539	19,25	12
7	CHINA	0	1	2	23	26	194	7,46	7
8	THAILAND	12	1	2	3	18	304	16,89	8
9	SINGAPORE	10	1	1	1	13	156	12	8
10	SOUTH AFRICA	2	1	0	10	13	428	32,92	9
TN: Total number of articles, TC: Total citations, CPA: Citations per articles									

**Table 3. Top 10 high-frequency keywords and journals of research on gonorrhea.**

Rank	Keyword	Frequency	%
1	Gonorrhea	156	14,607
2	Neisseria gonorrhoeae	58	5,431
3	Chlamydia	57	5,337
4	Sexually transmitted disease	55	5,150
5	Sexually transmitted infection	32	2,996
6	Chlamydia trachomatis	19	1,779
7	Adolescent	16	1,498
8	Epidemiology	15	1,404
9	Syphilis	14	1,311
10	Hiv	14	1,311
<b>Journals</b>			
1	<i>Sexually Transmitted Diseases</i>	276	25.843
2	<i>Sexually Transmitted Infections*</i>	82	7,678
3	<i>Clinical Infectious Diseases</i>	29	2,715
4	<i>Antimicrobial Agents and Chemotherapy</i>	26	2,434
5	<i>American Journal of Public Health</i>	21	1,966
6	<i>Journal of Infectious Diseases</i>	16	1,498
7	<i>Journal of Clinical Microbiology</i>	15	1,404
8	<i>International Journal of StdAids</i>	13	1,217
9	<i>Journal of Adolescent Health</i>	13	1,217
10	<i>Journal of the American Medical Association</i>	11	1,030
*Previously named as Genitourinary medicine and The british journal of venereal disease			

## Figures

### Figure 1

- Number of published documents according to years, n
- Co-authorship authors network visualization map.
- Co-authorship country network visualization map
- Author keywords co-occurrence network visualization map.

