



Global Research Trends in Endometrial Hyperplasia (2002–2021): A Bibliometric Analysis and Visualization Study

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Abstract

Introduction This article quantifies the research contribution related to endometrial hyperplasia (EH).

Materials and Methods We searched the Scopus database in 2002 to 2021.

Results A total of 6,422 were retrieved; 1,906 were open access; 5,602 in English. The number of published papers showed rising productivity over the last 20 years ranging from 261 to 425. There were 5,034 research articles and 1,388 reviews. The most prolific authors were Zullo, F (30), Mirkin, S (28), Archer, DF (27), and Insabato, L (26). The top involved journals were the *Gynecologic Oncology Journal* (144), *European Journal of Gynaecological Oncology* (114), and *International Journal of Gynecological Pathology* (105). The United States was the most dominant country, with 1,592 articles, followed by China (601) and Italy (435). The most actively involved institutions were the University of Texas MD Anderson Cancer Center (77), followed by Fudan University (63) and Harvard Medical School (62). The top funding sponsors were the National Cancer Institute (178), the National Institutes of Health (177), and the National Natural Science Foundation of China (107). The top three most cited articles received 1,182, 746, and 600 citations, respectively.

Conclusion This study defines the prolific researchers, institutions, journals, and countries as a good starting to bridge gaps in research activity.

Keywords

- ▶ bibliometric analysis
- ▶ citation analysis
- ▶ menopause
- ▶ endometrial hyperplasia
- ▶ endometrial cancer
- ▶ research
- ▶ visualization analysis

Introduction

Endometrial hyperplasia (EH), with or without atypia, is a common gynecologic diagnosis and a known precursor of endometrial carcinoma, the most common gynecologic malignancy.¹ The widely used World Health Organization system classifies EH according to four combinations of glandular crowding and nuclear atypia: simple (SH), complex (CH), simple atypical (SAH), or complex atypical hyperplasia

(CAH), although the two forms of atypical hyperplasia (AH) are often collapsed into one category.²

Abnormal uterine bleeding is the most common presenting symptom of EH. It is most often diagnosed in postmenopausal women, although women at any age with unopposed estrogen from any source and conditions associated with intermittent or absent ovulation, in particular, polycystic ovary syndrome (PCOS), are at an increased risk for

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developing EH. Diagnosis could be through specific Pap smear findings, endometrial thickness per ultrasound, and endometrial biopsy.³ Approximately 70% of women with abnormal uterine bleeding are diagnosed with benign findings, and 15% are diagnosed with carcinoma. The remaining 15% receive a diagnosis of EH, which includes a broad range of lesions, from mild, reversible proliferation to the immediate precursors of carcinoma.²

The clinical importance of this pathological entity is the underlying risk of carrying a concomitant genital cancer and the potential risk of progression to endometrial carcinoma during the follow-up.⁴ The choice of treatment for EH depends on the patient's age, the presence of cytologic atypia, the desire for future childbearing, and surgical risk. EH without atypia responds well to progestins. However, women with AH should be treated with a hysterectomy unless other factors preclude surgery.¹

Knowledge of the academics and clinicians who share an interest in this area of clinical practice and research, their academic affiliations, and their expertise and available resources may help foster more collaborations with more confidence and trust.^{5,6} The bibliometric methods have been used in many scientific disciplines to investigate the scientific production and research trends on a given theme, population, or region.⁷⁻⁹ Many such studies helped shed light on issues related to specific ethnic groups, socioeconomic conditions, personal behaviors, or professional practices.¹⁰⁻¹²

While research activities on EH constantly grow, to the best of our knowledge, there needs to be a concise description of the global research architecture on EH. Hence, we aim to analyze and depict the current worldwide scientific output on EH through a bibliometric analysis. The principal objectives were to quantify the research contribution related to EH at the global level and determine its relative growth rate, collaborative measures taken, productivity at the institutional level, and the most prolific journals publishing on the subject.

Materials and Methods

Design and Search Strategy

This is a descriptive bibliometric analysis study with elaborated citation analysis and visualization study. Data were obtained from the Scopus database (Elsevier) with time window between 2002 and 2021. Research tendency was investigated by analyzing the distribution of languages, countries, journals, authors, keywords, authorship patterns, and co-authorship relations. Scientific output was assessed based on a methodology used in several previously published theme-based bibliometric studies⁹⁻¹¹. The term "endometrial hyperplasia OR endometrium hyperplasia" were used in the search since they are universally accepted. All concepts and data retrieved by this search were included in the analysis. The scope of the research went from January 1, 2002, to December 31, 2021, reflecting most of the contemporary research work and clinical practice of relevance. Older research would

only have historical value not relevant to the current study.

Bibliometric and Citation Analysis

The collected data were used to create the following measurements: growth rate collaborative measures productivity at the institutional level, the most productive authors, the most prolific countries with citation patterns, and the most prolific journals. These measurements were ranked according to the order that is now popularly called standard competition ranking, as in similar bibliometric studies. The quality of publications related to EH was measured using the h-index established by Jorge Hirsch in 2005, where index h is defined as the number of papers with a citation number more than or equal to h.¹² Furthermore, the quality of the journals was assessed by two indicators: the impact factor using the Journal Citation Report (JCR; Web of Knowledge) 2017 or 2018 and the SCImago Journal Rank (SJR) (<https://www.scimagojr.com/journalrank.php>).

Data Management and Statistical Analysis

The online Scopus tools were used to make various calculations. Besides, data were entered in a Microsoft Excel sheet for any further data management and analyses to create the tables. Data are presented as absolute (numbers) or relative (percentages) frequencies or mean \pm standard deviation. VOSviewer for Mac OS, version 1.6.10 (Centre for Science and Technology Studies, Leiden University, The Netherlands) was used to construct commonly used bibliometric diagrams¹⁴.

Results

Article Type and Productivity Trend

A total of 6,422 publications on "EH" published between 2002 and 2021 were retrieved from the Scopus online database. The article types and languages are shown in ►**Table 1**. Data-based articles (original research and surveys) were 78%, and opinion-based articles (reviews and editorials) represented 22%. Most of the articles were in English (87.23%). The annual rates of published articles and their citation analyses over the past 20 years are in reverse chronological order in ►**Table 2**. The steadily increasing productivity over the past 20 years is shown in ►**Fig. 1**. Over half (3,492; 54.4%) of the articles were published in the last 10 years, and 1,820 (28.35%) in the last 5 years.

Authorship Contribution

The most prolific authors publishing on EH are shown in ►**Table 3**. Their authorship contribution to EH is expressed in authorship frequency and a percentage of their contribution to global literature on EH. The proportion of their EH research to total research production. Also, the authors' h-index and country of affiliation are shown. However, on an individual basis, a single author (Zullo, F) co-authored the highest number of articles on the topic of the study (30), followed by Mirkin, S (28), Archer, DF (27),

Table 1 Types of retrieved documents and their primary language of all publications on EH over two decades (2002–2021) ($N = 6,422$)

Type of document ^a			Primary language ^b		
Type	Number	Percentage	Language	Number	Percentage
Article	4,984	77	English	5,602	87.23
Review	1,279	20	Chinese	184	2.87
Short survey	50	1	Russian	155	2.41
Editorial	109	2	Spanish	99	1.54
Conference paper ^a	278	–	German	86	1.34
Letter ^a	230	–	French	72	1.12
Note ^a	174	–	Polish	66	1.03
Book chapter ^a	110	–	Other languages	191	2.97

Abbreviation: EH, endometrial hyperplasia.

^aExcluded from further analysis.

^bOther languages in decreasing order of count: Turkish (38), Portuguese (21), Japanese (19), Bulgarian (18), Italian (18), Czech (13), Romanian (13), Moldavian (12), Dutch (11), Croatian (10), Ukrainian (10), Persian (8), and Korean (5).

Table 2 Numbers of published articles and their citations over the past 20 years^a in reverse chronological order

Year	Articles per year		Citations			Articles with citations [N (%)]	
	Number	Percentage	Total	Per article	Per year	Yes	No
2021	425	6.6	943	2.2	943	250 (58.8)	175 (41.2)
2020	387	6.0	1,852	4.8	926	266 (68.7)	121 (31.3)
2019	373	5.8	3,707	9.9	1235.7	290 (77.7)	83 (22.3)
2018	341	5.3	3,205	9.4	801.25	281 (82.4)	60 (17.6)
2017	294	4.6	4,320	14.7	864	239 (81.3)	55 (18.7)
2016	360	5.6	4,946	13.7	824.3	297 (82.5)	63 (17.5)
2015	339	5.3	6,295	18.6	899.28	301 (88.8)	38 (11.2)
2014	314	4.9	6,305	20.1	788.13	274 (87.3)	40 (12.7)
2013	344	5.4	8,630	25.1	958.89	308 (89.5)	36 (10.5)
2012	315	4.9	8,250	26.2	825	271 (86.0)	44 (14.0)
2011	317	4.9	8,526	26.9	775.09	270 (85.2)	47 (14.8)
2010	288	4.5	8,091	28.1	674.25	242 (84.0)	46 (16.0)
2009	305	4.6	8,641	28.3	664.69	268 (87.9)	37 (12.1)
2008	296	4.6	8,548	28.9	610.57	264 (89.2)	32 (10.8)
2007	322	5.0	9,723	30.2	648.2	267 (82.9)	55 (17.1)
2006	291	4.5	10,103	34.7	631.44	249 (85.6)	42 (14.4)
2005	282	4.4	7,374	26.6	433.76	241 (85.5)	41 (14.5)
2004	261	4.1	8,858	33.9	492.11	229 (87.7)	32 (12.3)
2003	280	4.4	9,060	32.4	476.84	250 (89.3)	30 (10.7)
2002	288	4.5	8,263	28.7	413.15	236 (81.9)	52 (18.1)

^aSeveral citations per article are calculated by dividing the total number of citations retrieved for each year by the total number of publications in that year.

and Insabato, L (26). Three authors published 25 articles (Aoki, D, Palacios, S, and Raffone, A), 20 articles (Banno, K, Mollo, A, and Orbo, A), and 18 articles (Goldstein, SR, Gupta, JK, and Konishi, I) and two authors published 24 articles

(Broadus, RR and Travaglina, A). Furthermore, single authors published 23, 22, 21, 19, and 17 articles. Collaborations between various research groups are depicted in ► **Fig. 2**.

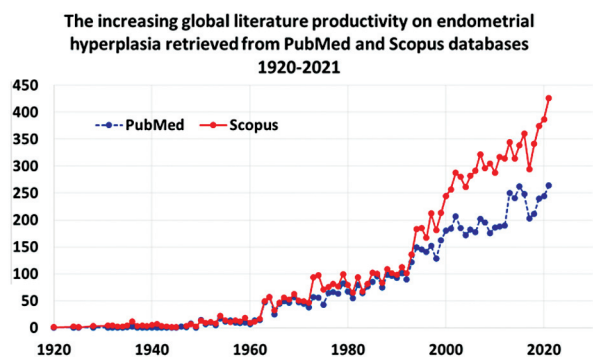


Fig. 1 The increasing global scholarly productivity on endometrial hyperplasia over a century (1920–2021) is depicted in PubMed and Scopus databases.

detailed. Although *Gynecologic Oncology Journal* had the highest number of articles (144), citations (5,166), and h-index, the *American Journal of Obstetrics and Gynecology* had the highest SJR number (► **Table 4**). Institution-wise analysis revealed that the University of Texas MD Anderson Cancer Center and the Fudan University were the leading institutions/organizations, with 77 and 63 publications, respectively. They were followed closely by Harvard Medical School (62) and Massachusetts General Hospital (55) (► **Table 5**). The top 10 funders were the National Cancer Institute (178), National Institutes of Health (177), National Natural Science Foundation of China (107), Eunice Kennedy Shriver National Institute of Child Health and Human Development (92), U.S. Department of Health and Human Services (66), Japan Society for the Promotion of Science (61), Ministry of Education, Culture, Sports, Science and Technology

Table 3 Top most prolific authors publishing on EH over the last two decades (2002–2021) and their authorship contribution to EH expressed in authorship frequency and a percentage of their contribution to global literature on EH and as a proportion of their research production in addition to the authors' h-index and country of affiliation

SCR	Author	Authorship frequency		Contribution to global literature (%) (6,422)	The proportion of own research production (%)	h-index	Country
		EH (n)	All authorship (n)				
1st	Zullo, F	30	310	0.47	9.7	54	Italy
2nd	Mirkin, S	28	188	0.44	14.9	28	USA
3rd	Archer, DF	27	205	0.42	13.9	58	USA
4th	Insabato, L	26	179	0.40	14.5	35	Italy
5th	Aoki, D	25	548	0.39	4.6	46	Brazil
5th	Palacios, S	25	304	0.39	8.2	45	Spain
5th	Raffone, A	25	165	0.39	15.2	28	Italy
8th	Broaddus, RR	24	187	0.37	12.8	89	USA
8th	Travaglino, A	24	125	0.37	19.2	27	Italy
10th	McCluggage, WG	23	478	0.36	4.8	72	U.K.
11th	Mutter, GL	22	63	0.34	33.3	55	USA
12th	Pickar, JH	21	76	0.33	27.6	35	Thailand
13th	Banno, K	20	239	0.31	8.4	31	Japan
13th	Mollo, A	20	157	0.31	12.7	33	Italy
13th	Ørbo, A	20	38	0.31	52.6	20	Norway
16th	Saccone, G	19	347	0.30	5.5	41	Italy
17th	Goldstein, SR	18	105	0.28	17.4	77	USA
17th	Gupta, JK	18	143	0.28	12.6	47	U.K.
17th	Konishi, I	18	382	0.28	4.7	69	Japan
20th	Hickey, M	17	763	0.26	2.2	52	Australia

Abbreviations: EH, endometrial hyperplasia; SCR, standard competition ranking.

Note: Equal authors were given the same ranking number, and a gap was left in the numbers.

Journals, Institutions, and Sponsors

The top 20 journals published on EH over the last two decades, the frequency of the article, citations, and average citation/article ratios, together with the SJR and h-index, are

(44), National Institute of Environmental Health Sciences (39), Pfizer (39), and Medical Research Council (26). Charitable, academic, and government institutions funded a small number of publications.

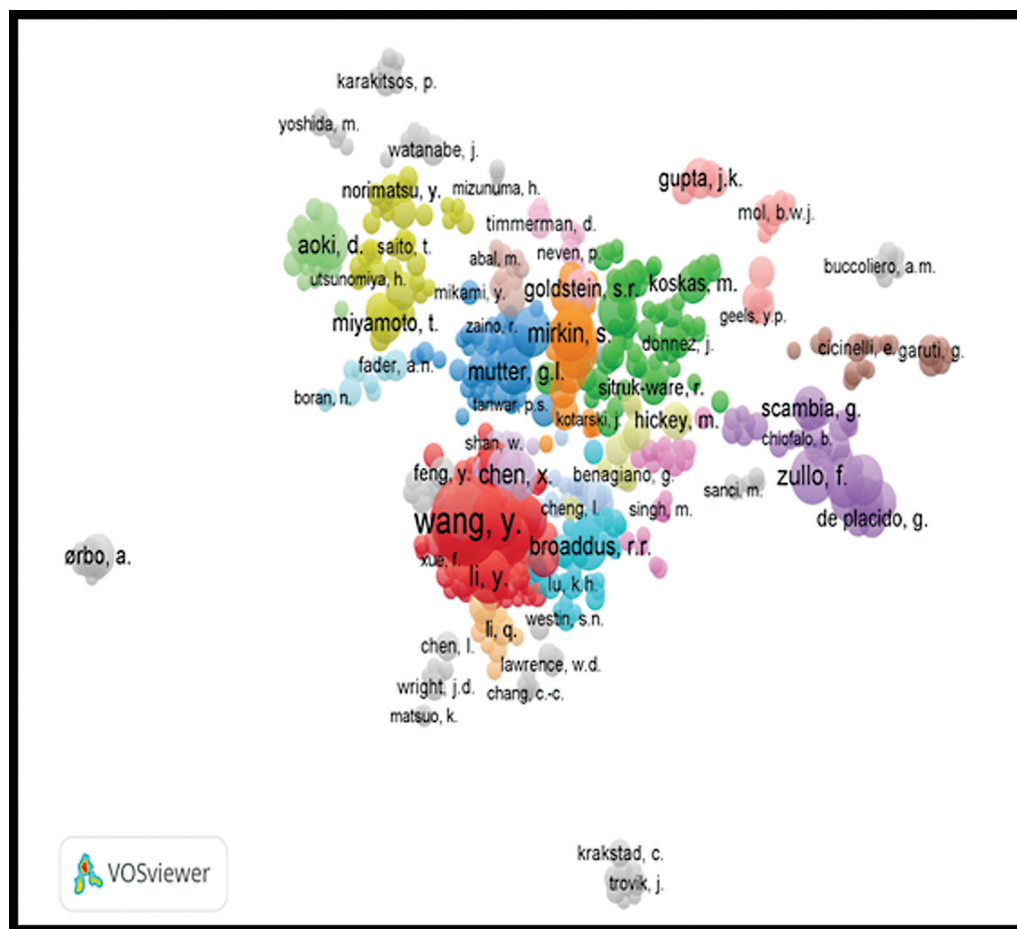


Fig. 2 Co-authorship network diagram in endometrial hyperplasia. Of 21,383 authors, 574 had 5 articles identified in 30 clusters. The size reflects the authorship volume, and the proximity of individual authors and clusters reflects the extent of collaboration.

Regional Productivity

Authors from 105 countries or regions contributed to the published articles (►Table 6). The United States had the most published articles (1,592) and consequently the most significant number of citations (53,399 citations), followed by China with 601 and 6,385 citations. Equal contribution in the third position was by Italy and the United Kingdom with 435 articles each and 12,803 and 16,353 citations, respectively. Japan (368 articles), Turkey (361 articles), India (255 articles), Germany (239 articles), Spain (189 articles), and Canada (180 articles) occupied the following position with decreased order of the top 10 most active publishing countries. The citation-to-article ratio varied between 7.64 and 43.77. ►Fig. 3 presents the country collaborations co-occurrence analysis network diagram in EH. The size reflects the number of articles, and the proximity and thickness of the connecting lines reflect the extent of collaboration.

Citation and Impact Analysis

The top 10 most cited articles on EH over the past two decades, including the article, journal, country of origin, access type, and the number of citations, are shown in ►Table 7. The top 10 most cited articles included articles

(7) and reviews (3). The top three most cited articles received 1,182, 746, and 600 citations, respectively. The three articles with the highest number of citations were “Bisphenol A and human health: A review of the literature” (1,182), followed by “Survival and safety of exemestane versus tamoxifen after 2-3 years’ tamoxifen treatment (Intergroup Exemestane Study): a randomized controlled trial” (746) and the “The 2017 hormone therapy position statement of the North American Menopause Society” (600).

Content Analysis

The top three subject areas were dominated by medicine (5,603), followed in decreasing order by biochemistry, genetics, and molecular biology (1,301) and pharmacology, toxicology, and pharmaceuticals (303). The most frequently used subject-based themes (reflected in keywords) in addition to EH were endometrial neoplasms (1,725), endometrium carcinoma, cancer, or tumor (1,585, 1,498, 974), endometrium biopsy (966), endometrium polyp (874), and breast cancer (766). ►Fig. 4 represents a keyword co-occurrence analysis network diagram. The size reflects frequency, the proximity and thickness of the connecting lines reflect relationships between the used keywords (2002–2021). The time overlay links the use of the keywords with dates. The

Table 4 Top 20 journals publishing on the subject of EH in the last two decades (2002–2021)

SCR ^a	Journal	Frequency		Citations	C/A	SJR	h-Index
		N	%				
1st	<i>Gynecologic Oncology</i>	144	2.24	5,166	35.88	1.49	42
2nd	<i>European Journal Of Gynaecological Oncology</i>	114	1.78	865	7.59	0.15	16
3rd	<i>International Journal Of Gynecological Pathology</i>	105	1.64	1,842	17.54	0.65	25
4th	<i>International Journal Of Gynecological Cancer</i>	101	1.57	1,874	18.55	0.85	25
5th	<i>Menopause</i>	96	1.49	3,920	40.83	0.98	34
6th	<i>Archives Of Gynecology And Obstetrics</i>	92	1.43	1,417	15.40	0.63	24
6th	<i>European Journal Of Obstetrics And Gynecology And Reproductive Biology</i>	92	1.43	2,021	21.97	0.53	29
8th	<i>Journal Of Minimally Invasive Gynecology</i>	84	1.31	1,591	18.94	0.63	24
9th	<i>Climacteric</i>	82	1.28	2,376	28.98	0.79	27
10th	<i>Maturitas</i>	72	1.12	1,970	27.36	1.17	26
11th	<i>Obstetrics And Gynecology</i>	70	1.09	3,694	52.77	2.02	33
12th	<i>Gynecological Endocrinology</i>	62	0.97	787	12.69	0.56	16
13th	<i>American Journal Of Obstetrics and Gynecology</i>	59	0.92	2,633	44.63	2.95	32
14th	<i>International Journal Of Gynecology and Obstetrics</i>	54	0.84	1,510	27.96	0.96	18
15th	<i>Fertility and Sterility</i>	52	0.81	2,900	55.77	1.90	29
15th	<i>Journal of Obstetrics And Gynecology Research</i>	52	0.81	499	9.60	0.64	14
17th	<i>Gynecologic and Obstetric Investigation</i>	47	0.73	464	9.87	0.69	13
18th	<i>Journal Of Obstetrics and Gynecology</i>	46	0.72	419	9.11	0.36	11
19th	<i>Acta Obstetricia Et Gynecologica Scandinavica</i>	43	0.67	1,358	31.58	1.23	23
20th	<i>Journal of Gynecologic Surgery</i>	37	0.58	38	1.03	0.15	4

Abbreviations: C/A ratio, average number of citations per article calculated by dividing the total citation by the number of articles for each journal; EH, endometrial hyperplasia; IF impact factor; SCR, standard competition ranking; SJR, SCImago Journal Rank.

^aEqual countries were given the same ranking number, and a gap was left in the numbers.

Table 5 The top 10 most productive institutions in publications on EH in the last two decades (2002–2021)

SCR	Institution	Articles		Country	TC	TC/A
		Number	Percentage			
1st	University of Texas MD Anderson Cancer Center	77	1.20	USA	3,599	46.74
2nd	Fudan University	63	0.98	China	858	13.62
3rd	Harvard Medical School	62	0.97	USA	2,295	37.02
4th	Massachusetts General Hospital	55	0.86	USA	2,018	36.69
5th	Brigham and Women's Hospital	53	0.83	USA	2,074	39.13
6th	University of California, San Francisco	50	0.78	USA	3,224	64.48
7th	Pfizer Inc.	49	0.76	USA	2,773	56.59
8th	Università degli Studi di Napoli Federico II	46	0.72	Italy	1,204	26.17
9th	Mayo Clinic	43	0.67	USA	1,264	29.40
10th	Ministry of Health of Russian Federation	41	0.64	Russia	48	1.17

Abbreviations: C/A ratio, citation-to-articles ratio; EH, endometrial hyperplasia; SCR, standard competition ranking; TC, total citations.

Note: National Health Services was removed as it is too generic to be meaningful of any specific affiliation. Equal countries were given the same ranking number, and a gap is left in the numbers. The 10th position was empirically truncated to the first provided by the system.

Table 6 Selected country-wise bibliometric analysis on the top ten most active countries in publishing on the subject of EH in the last two decades (2002–2021)^a

SCR ^b	Country	Articles, N (%)	Citations	C/A ratio
1st	United States	1,592 (24.79)	53,399	33.54
2nd	China	601 (9.36)	6,385	10.62
3rd	Italy	435 (6.77)	12,803	29.43
3rd	United Kingdom	435 (6.77)	16,353	37.59
5th	Japan	368 (5.73)	7,632	20.74
6th	Turkey	361 (5.62)	3,298	9.14
7th	India	255 (3.97)	1,947	7.64
8th	Germany	239 (3.72)	7,497	31.37
9th	Spain	189 (2.94)	5,846	30.93
10th	Canada	180 (2.80)	7,878	43.77

Abbreviations: C/A ratio, citation-to-articles ratio; EH, endometrial hyperplasia; SCR, standard competition ranking.

^aProduction and impact are presented as the number of articles and percent contribution to the total, the number of citations.

^bEqual countries were given the same ranking number, and then a gap is left in the ranking number.

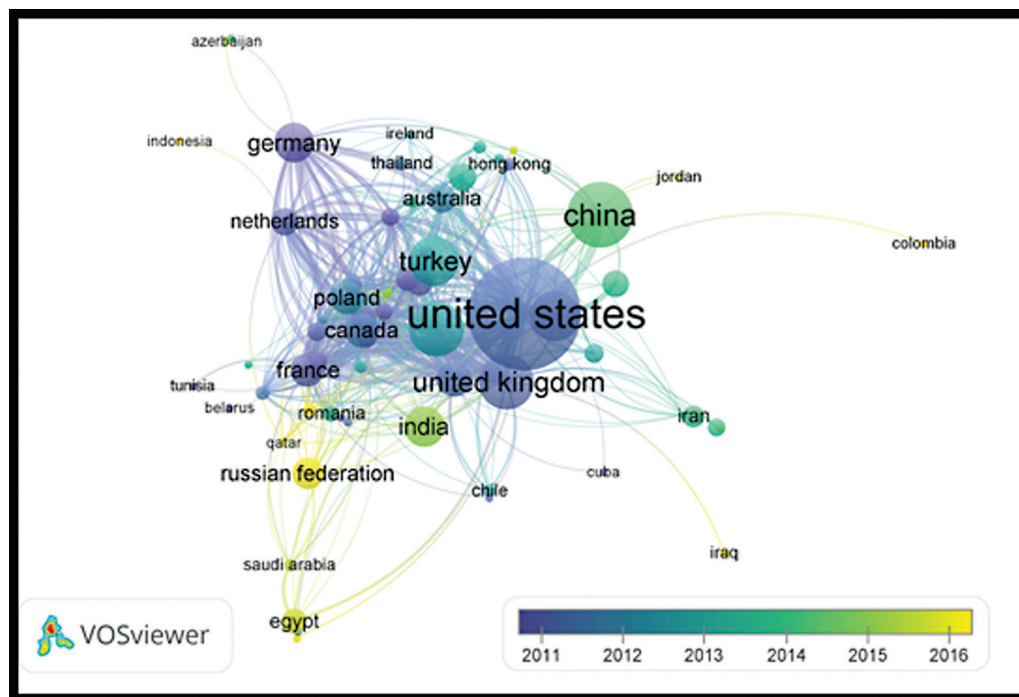


Fig. 3 Country collaborations cooccurrence analysis network diagram in endometrial hyperplasia. The size reflects the number of articles, and the proximity and thickness of the connecting lines reflect the extent of collaboration. The time overlay links the use of the country collaborations with dates.

most commonly used words in the titles of the top cited 100 articles are represented in a word cloud style (→ Fig. 5).

Discussion

Novak's first paper on EH under the title "Relation of hyperplasia of the endometrium to so-called functional uterine bleeding" appeared over a century ago and related EH to uterine bleeding.¹⁴ For several decades, only a few articles were published on EH. From 1960 onwards, the interest of authors on the subject increased, and mass publications

were observed. To date, more than 11,000 articles have been published. More than half of these were published in the past 20 years (→ Fig. 1).

In the present study, we made some observations regarding the research productivity on EH over the past two decades. This is the first bibliometric study of EH. → Fig. 1 provides an extended presentation of data over a long period from the database's inception to portray the complete picture. → Table 2 and → Fig. 1 demonstrate the progressive rise in research work. The relatively high opinion-based articles reflect the dynamic scholarly environment with

Table 7 The top 10 most cited articles on EH over the last two decades (2002–2021) by type of article, journal, country of origin, access type, and the number of citations

SCR	Reference	Title/Theme	Type	Journal	Country	Access	Citation
1st	Rochester, JR, 2013	Bisphenol A and human health: A review of the literature	Review	<i>Reproductive Toxicology</i>	U.S.	Open access	1,182
2nd	Coombes, R, 2007	Survival and safety of exemestane versus tamoxifen after 2–3 years' tamoxifen treatment (Intergroup Exemestane Study): a randomized controlled trial	Article	<i>Lancet</i>	U.K. and Belgium	Open access	746
3rd	Pinkerton, JV, 2017	The 2017 hormone therapy position statement of the North American Menopause Society	Review	<i>Menopause</i>	U.S.	-	600
3rd	Martino, S, 2004	Continuing outcomes relevant to Evista: Breast cancer incidence in postmenopausal osteoporotic women in a randomized trial of raloxifene	Article	<i>Journal of the National Cancer Institute</i>	U.S.	Open access	600
5th	Donnez, J, 2012	Ulipristal acetate versus placebo for fibroid treatment before surgery	Article	<i>New England Journal of Medicine</i>	Belgium and Ukraine	Open access	522
6th	Vogel, VG, 2010	Update of the national surgical adjuvant breast and bowel project Study of Tamoxifen and Raloxifene (STAR) P-2 trial: Preventing breast cancer	Article	<i>Cancer Prevention Research</i>	U.S.	Open access	520
7th	Konikoff, MR, 2006	An RDBPCT of Fluticasone Propionate for Pediatric Eosinophilic Esophagitis	Article	<i>Gastroenterology</i>	U.S.	Open access	511
8th	Else, T, 2014	Adrenocortical carcinoma	Review	<i>Endocrine Reviews</i>	U.S.	Open access	482
9th	Donnez, J, 2012	Ulipristal acetate versus leuprolide acetate for uterine fibroids	Article	<i>New England Journal of Medicine</i>	Belgium and Poland	Open access	476
10th	Munro, MG, 2011	FIGO classification system (PALM-COEIN) for causes of abnormal uterine bleeding in nongravid women of reproductive age	Article	<i>International Journal of Gynecology and Obstetrics</i>	U.S. and U.K.	Open access	474

Abbreviations: EH, endometrial hyperplasia; RDBPCT, randomized, double-blind, placebo-controlled; SCR, standard competition ranking.

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