Bibliometric Evaluation of Publications (2000-2020) on the Prognosis of Gastric Cancer

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Abstract

Background: Gastric cancer remains a global malignancy. The role of bibliometric analysis is increasingly valued. It is feasible and necessary to perform a bibliometric analysis to regurgitate studies in the prognosis of gastric cancer. **Materials and methods**: Web of Science was selected for the dataset resource. Articles published between 2000 and 2020 within the database of Web of Science Core Collection were included with predefined search terms. CiteSpace version 5.7.R1 and R software program version 4.0.3 were used for bibliometric analysis with parameters extrapolated from included studies. **Results**: A total of 1721 articles were included from 2000 to 2020 with remarkably increasing trends. China (n=1183), Japan (n=218), and South Korea (n=119) showed the most publications. SUN YAT SEN University, FUDAN University, and NANJING MED University were the top institutions with most publications. Keywords with strongest citation bursts between 2000 and 2020 were characterized. Particularly, "statistics", "resistance", "mortality", "lncrna", "diagnosis", "outcome", "migration", "promote," and "regulatory t cell" were the latest rising keywords since 2017, indicating possible study trends ahead. Several articles showed strongest citation bursts, including Jemal A. CA-CANCER J CLIN, Van Cutsem E. LANCET, and Japanese Gastric Cancer Association GASTRIC CANCER. **Conclusion**: This bibliometric analysis provides a thought-provoking, insightful result concerning the trajectory of research development in prognosis of gastric cancer with a future perspective.

Keywords

gastric cancer, bibliometric analysis, prognosis, journal, Web of Science

- What do we already know about this topic

The role of bibliometric analysis is increasingly recognized as a well-established part for research evaluation methodology both in basic and clinical medicine fields.

- How does your research contribute to the field?

Output was increasing during this period as China, Japan, and South Korea remain the top contributing countries, with keywords and references analysis providing unique clue on the future directions of this field.

- What are your research's implications toward theory, practice, or policy?

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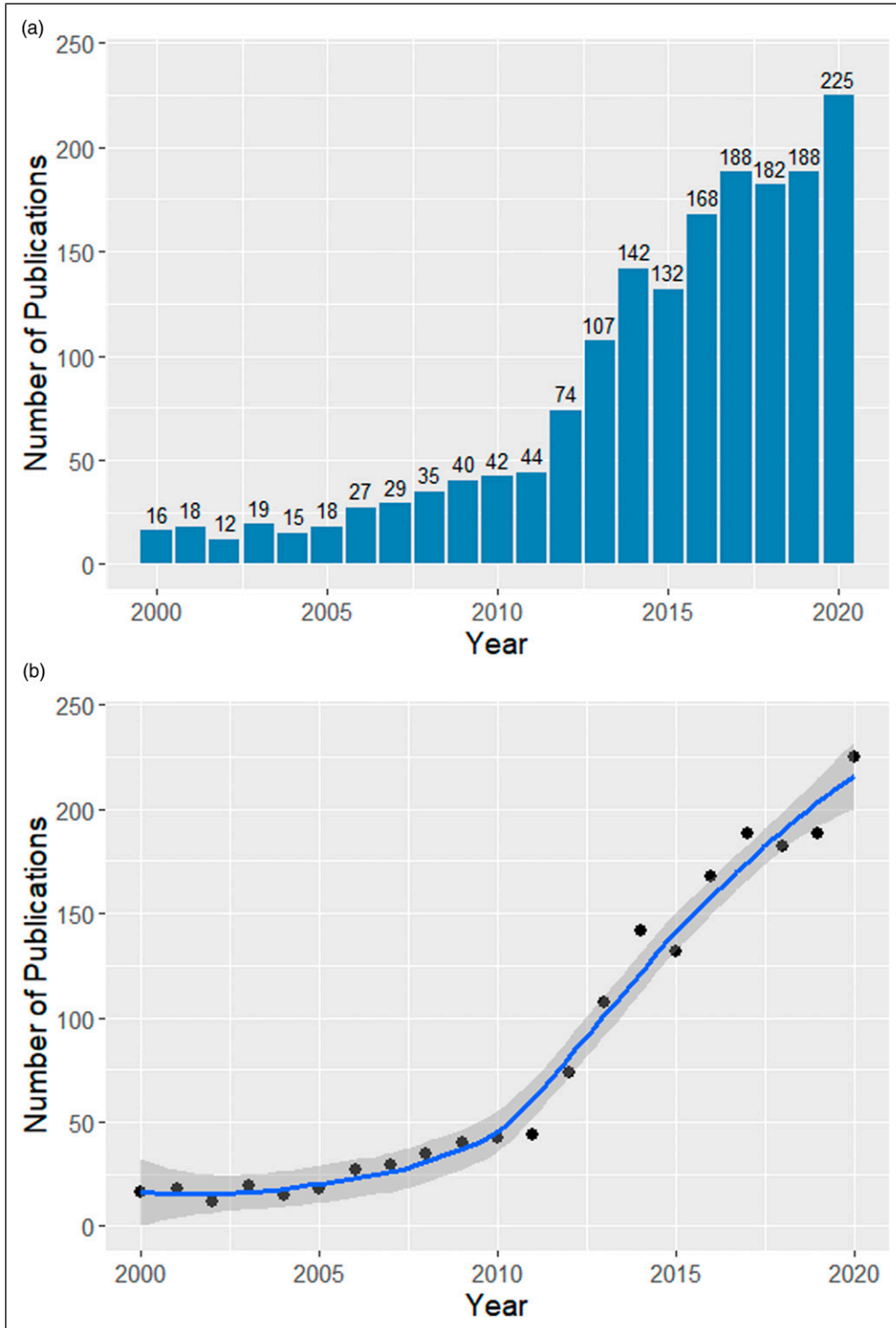Email: chaoran_yu@yeah.net

Figure 1. The curve of annual publications regarding the prognostic studies in gastric cancer. (A) The number of publications in each year from 2000 to 2020; (B) the linear model fitting the time trend of the studies of gastric cancer; the gray zone indicates 95% confidence interval.

Table 1. Top 10 Journals That Published Articles on Gastric Cancer and Prognosis.

Rank	Source	IF, 2016	IF, 2017	IF, 2018	IF, 2019	IF, 2020	Publication
1	ONCOTARGET	5.008	5.168	0	0	0	68
2	ONCOLOGY LETTERS	1.482	1.390	1.664	1.871	2.311	65
3	INTERNATIONAL JOURNAL OF CLINICAL AND EXPERIMENTAL PATHOLOGY	1.581	1.706	1.396	.205	.252	60
4[a]	PLOS ONE	3.057	2.806	2.766	2.776	2.740	48
4[a]	WORLD JOURNAL OF GASTROENTEROLOGY	2.787	3.365	3.300	3.411	3.665	48
5[b]	ANNALS OF SURGICAL ONCOLOGY	3.655	4.041	3.857	3.681	4.061	43
5[b]	TUMOR BIOLOGY	3.650	0	0	0	0	43
6	JOURNAL OF SURGICAL ONCOLOGY	3.151	2.993	2.886	3.114	2.771	39
7	ANTICANCER RESEARCH	1.895	1.937	1.865	1.935	1.994	34
8	ONCOTARGETS AND THERAPY	2.272	2.612	2.656	3.046	3.337	33
9	EUROPEAN REVIEW FOR MEDICAL AND PHARMACOLOGICAL SCIENCES	1.575	1.778	2.387	2.721	3.024	27
10	ONCOLOGY REPORTS	2.486	2.662	2.976	3.041	3.417	26

[a]Indicates a tie for fourth place.
[b]Indicates a tie for fifth place.
IF = impact factor.
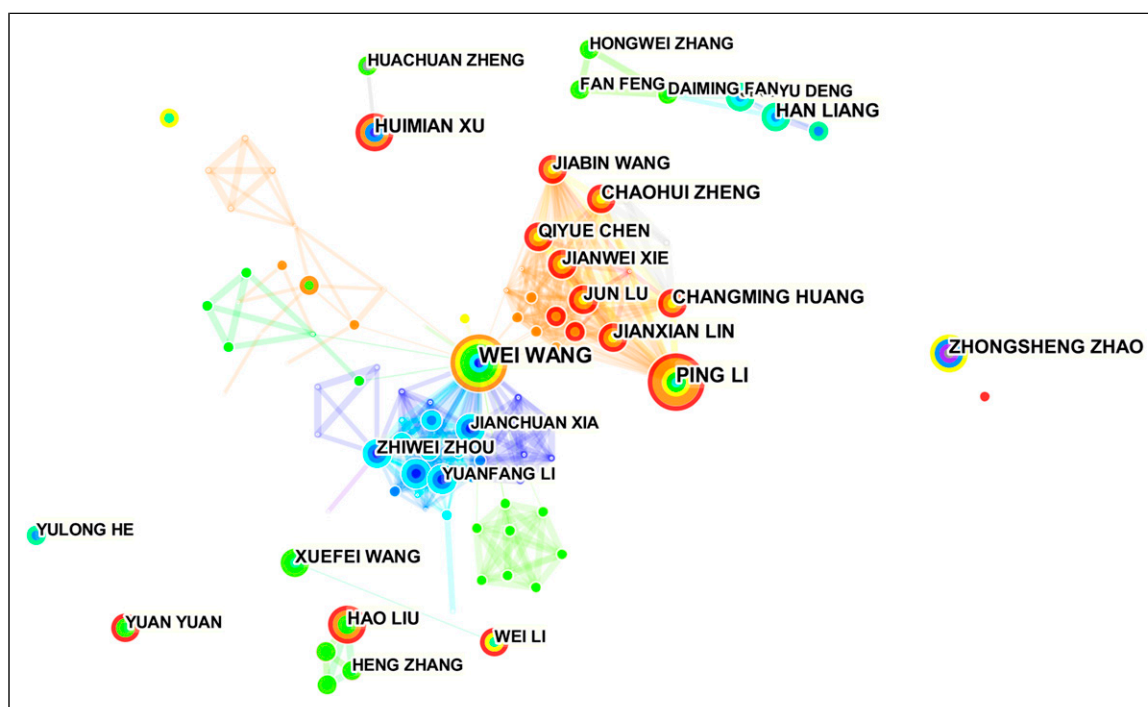
Figure 2. Cooperation relationship of authors contributing to the included studies is displayed in networks. The thickness of connection indicates the cooperation degree; the size of the circle indicates the value of centrality.

Bibliometric analysis provides an insightful result depicting the trajectory of research development with a future perspective.

Introduction

Gastric cancer remains a global malignancy and serves as one of the most common malignancies around the world.[1] It is ranked the third among the causes of cancer death.[1] Around 784 000 deaths are recorded in 2018.[2] East Asia, Eastern Europe, and Central/Southern America are areas of gastric cancer with highest incidence and mortality.[3] Notably, overall gastric cancer incidence rates may be predictively falling in most of countries up to 2035, including both high incidence and low incidence.[4] However, increasing cases of gastric cancer may still occur in young and ageing populations.[1,4]

Table 2. Top 10 Contributing Authors Published Prognostic Articles on Gastric Cancer between 2000 and 2020.

Rank	Author	Publication	H-index[e]
1	Li Y	39	12
2[a]	Li P	36	12
2[a]	Zhang J	36	12
3	Zhang Y	35	15
4	Wang Y	31	9
5	Wang W	28	10
6[b]	Lee JH	25	8
6[b]	Wang L	25	12
7	Liu H	24	8
8[c]	Zhang H	23	7
8[c]	Zhou ZW	23	10
9[d]	Liang H	22	13
9[d]	Lin JX	22	7
9[d]	Wang J	22	8
9[d]	Zhao ZS	22	10
9[d]	Zhang CH	22	7
10	He YL	21	11

[a] Indicates a tie for second place.
[b] Indicates a tie for sixth place.
[c] Indicates a tie for eighth place.
[d] Indicates a tie for ninth place.
[e] The H-index in this table was calculated only based on the gastric cancer and prognosis papers published by the author.

Table 3. The Top 10 Countries Contributed to Publication of Prognostic Articles in Gastric Cancer between 2000 and 2020.

Rank	Country	Publication	Centrality
1	China	1183	.4737
2	Japan	218	.4211
3	Korea	119	.4211
4	Germany	44	.2105
5	Italy	29	.2632
6	USA	22	.4737
7	Turkey	19	0
8	United Kingdom	12	.4211
9	Finland	8	0
9	Brazil	8	0
10	Iran	7	.0526
10	Spain	7	.1053

TC = total citations; AAC = average article citations.

As a clinical heterogeneous disease with molecular characterizations, gastric cancer is mainly treated by endoscopic resection at early stage, or surgery at advanced stage.[5,6] Chemotherapy, including platinum and fluoropyrimidine, is commonly used in advanced gastric cancer for survival benefits.[7] Meanwhile, licensed targeted therapies, including trastuzumab (anti-HER2), ramucirumab (anti-angiogenic), and pembrolizumab (anti-PD1), are gaining increasing attention in prognostic studies.[1,7] Mechanistically, large numbers of prognostic biomarkers have been identified in gastric cancer due to advancement of bioinformatics methods.[8,9] In fact, prognostic studies in gastric cancer have now become fully fledged.

The role of bibliometric analysis is increasingly valued. It has become a well-established part for research evaluation methodology both in basic and clinical medicine fields. It offers reliable and repeatable patterns to study the current status of each research subject as well as enables a possible ranking algorithm.[10] A sufficient number of prognostic studies in gastric cancer have been published. It is feasible and necessary to perform a literature evaluation using bibliometric methodology, in order to provide clues navigating future studies. Up now, such analysis remains largely sparse.

Of note, Powell et al studied the 100 most cited papers in gastric cancer in 2015 and highlighted the 3 most ubiquitous topics: the pathology, etiology, and basic science of gastric cancer.[11] However, bibliometric analysis regarding the prognosis and gastric cancer is not specified. Hereby, we focused on the studies concerning the prognosis and gastric cancer via bibliometric analysis with literature resources retrieved from Web of Science from 2000 to 2020. This study is aimed to identity nations, universities, references, keywords, and authors with most contributions in the field during the last 20 years.

Materials and Methods

Web of Science, a comprehensive database for science citation index, was selected for the resource of bibliometric analysis in this study.[10,12] Search terms were as the following: TI = (*stomach* OR *gastric*)AND (*neoplasm* OR *cancer* OR *carcinoma*) AND (prognosis). Articles published between 2000 and 2020 within the database of Web of Science Core Collection were included. Letter, comments, and meeting abstracts were excluded from this collection process. The language was not restricted. All literatures were searched in January 2021.

CiteSpace version 5.7.R1[13] and R software program version 4.0.3[14] were selected for bibliometric analysis. Parameters including authors, journals, affiliations, countries, publication number, H-index, impact factor, centrality, and citation bursts were recorded accordingly. Local polynomial regression was used for the determination of changing outputs of publications. P value<.05 was considered as statistical significant.

H-index, also named as Hirsch index or Hirsch number, is an author-specific metric to measure the publications of a certain scholar both in productivity and citation.[15] It was originally proposed by Jorge Hirsch to quantify the academic contribution of individual theoretical physicists' relative quality.[16] Now, it has been widely used across the scientific community. Impact factor (IF), another impactful parameter reflecting the yearly scientometric index, was initially devised
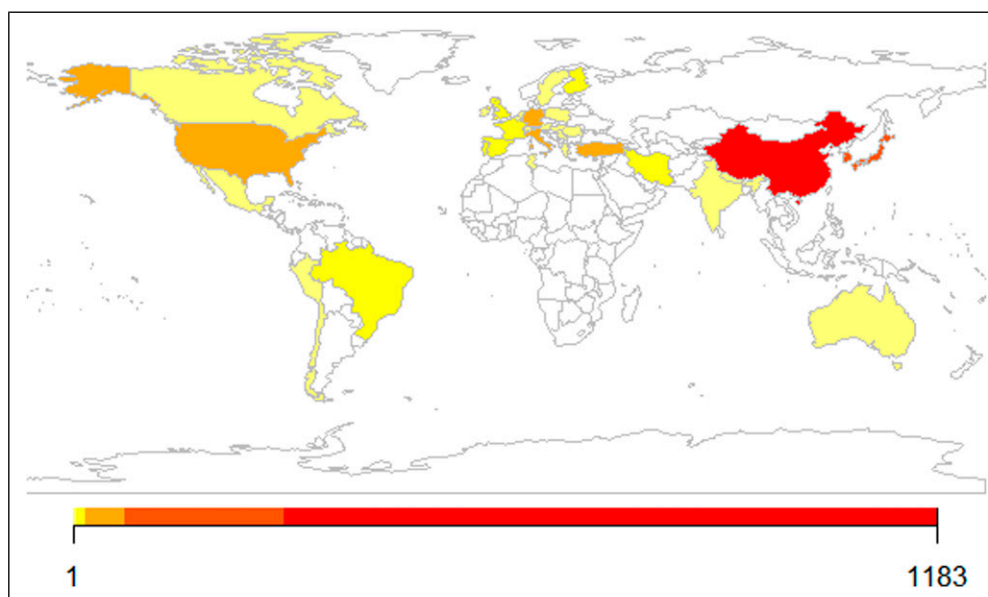
Figure 3. Countries contributing to the prognostic studies of gastric cancer across the world with marked color indicating the number of publications. Yellow indicates low number of publication while red indicates high.

by the Institute for Scientific Information from 1975.[17] IF has been currently used in many fields across the globe. It serves as a reliable bibliometric indicator to evaluate the quality of research, journal, and institution.[17] Centrality is used to measure the importance of a given node in a network with comparable high value indicating a pivotal status.[18] In this study, centrality helped the identification of scholars and institutions with high academic performance as well as corresponding relationships with fellows. Citation bursts indicate a reference or keyword frequently used in a period. These parameters facilitated the identification of research focus and distribution of increasing attention in a period.[13]

Results

A total of 1721 articles were included from 2000 to 2020 (Figure 1A). A Locally Weighted Scatterplot Smoothing (LOWESS) fit was used in the correlation between the number of publication and year of publication (Figure 1B). Apparently, the number of publication was remarkably increased from 16 in 2000 to 225 in 2020.

The top 10 journals that published the prognostic studies of gastric cancer included ONCOTARGET (n = 68), ON-COLOGY LETTERS (n = 65), INTERNATIONAL JOURNAL OF CLINICAL AND EXPERIMENTAL PATHOLOGY (n = 60), PLOS ONE (n = 48), WORLD JOURNAL OF GASTROENTEROLOGY (n = 48), ANNALS OF SURGICAL ONCOLOGY (n = 43), TUMOR BIOLOGY (n = 43), JOURNAL OF SURGICAL ONCOLOGY (n = 39), ANTI-CANCER RESEARCH (n=34), ONCOTARGETS AND THERAPY (n = 33), EUROPEAN REVIEW FOR MEDICAL AND PHARMACOLOGICAL SCIENCES (n = 27), and

ONCOLOGY REPORTS (n = 26) (Table 1). Of note, ON-COTARGET and TUMOR BIOLOGY, with the number of publications accounting for 6.4% of all publications, were removed from the MEDLINE index without new IF between 2017 and 2018.

The most cited authors and in-between cooperation networks as well as the top 10 names with published studies were displayed (Figure 2, Table 2).

The national distribution of studies indicated that China (n = 1183, centrality = .4737), Japan (n = 218, centrality = .4211), and South Korea (n = 119, centrality = .4211) showed the most significant impact across the field of prognostic studies in gastric cancer (Table 3, Figure 3). Cooperation networks of each nation were also displayed (Figure 4). Meanwhile, top 10 universities published the most studies were summarized (Table 4, Figure 5). SUN YAT SEN UNIVERSITY (n = 228), FUDAN UNIVERSITY (n = 175), and NANJING MED UNIVERSITY (n = 172) were the top 3 universities. In fact, all top 10 universities are all from China.

The top 52 keywords with the strongest citation bursts between 2000 and 2020 were displayed (Figure 6). The citation bursts showed a dynamic change over a period of time. Notably, "statistics", "resistance", "mortality", "lncrna", "diagnosis", "outcome", "migration", "promote," and "regulatory t cell" were the rising latest keywords since 2017 (Figure 6).

Reference analysis is one of the commonly used methods in bibliometric analysis. The top 62 references with the strongest citation bursts between 2000 and 2020 were displayed (Figure 7). The strongest citation burst was achieved by Jemal A. CA-CANCER J CLIN in 2011 (strength=45.28).[19] There were 2 articles showed rising strength since 2018, Van
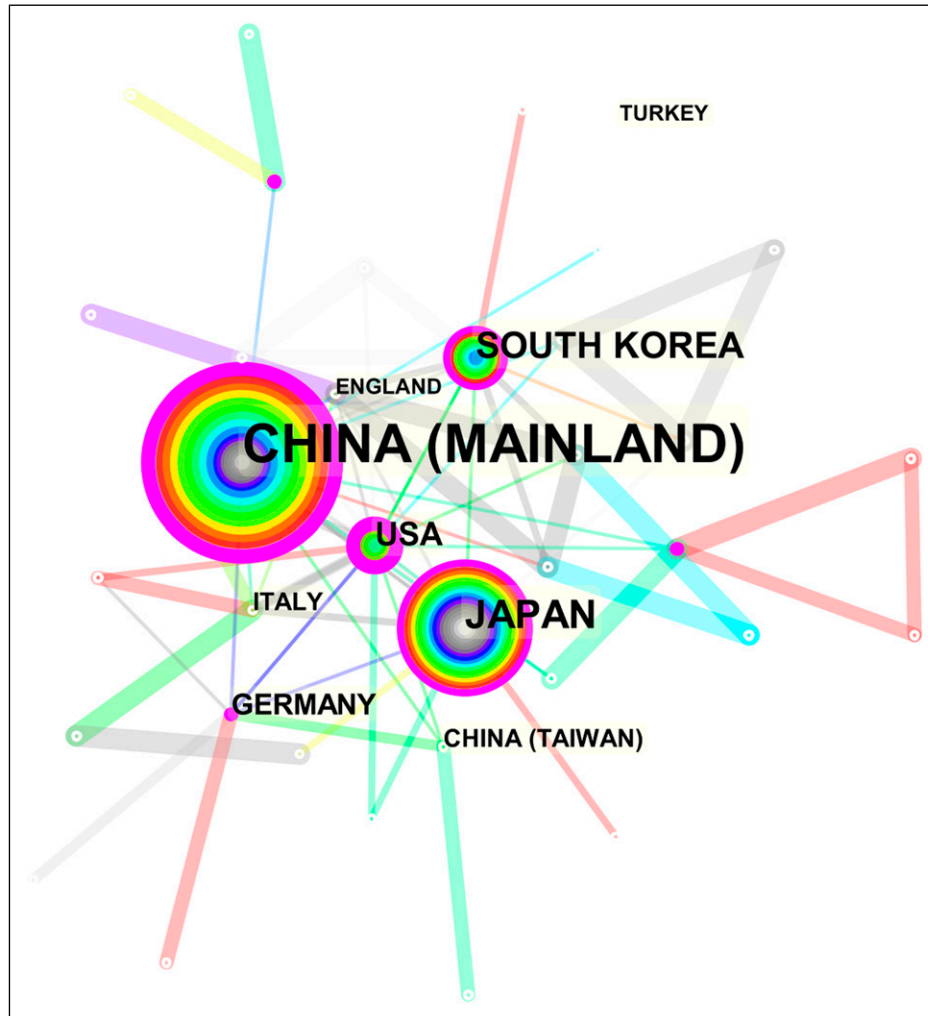
Figure 4. Cooperation relationship of countries contributing to the studies is displayed in networks. USA: United States of America. The thickness of connection indicates the cooperation degree; the size of the circle indicates the value of centrality.

Cutsem E. LANCET[20] and Japanese Gastric Cancer Association. GASTRIC CANCER.[21]

Table 4. The Top 10 Universities Published Prognostic Articles On Gastric Cancer Between 2000 and 2020.

Rank	Institution	Publication	Country
1	SUN YAT SEN UNIV	228	China
2	FUDAN UNIV	175	China
3	NANJING MED UNIV	172	China
4	CHINA MED UNIV	163	China
5	SHANGHAI JIAO TONG UNIV	112	China
6	FUJIAN MED UNIV	101	China
7	NANTONG UNIV	89	China
8	PEKING UNIV	87	China
9	SHANDONG UNIV	70	China
10	ZHEJIANG UNIV	61	China

Discussion

This study performed a bibliometric analysis on the prognostic studies in gastric cancer between 2000 and 2020. Output was increasing during this period. Top 10 journals and authors were identified mostly contributing to the field. China, Japan, and South Korea remain the top contributing countries. Keywords and references analysis provided unique clue on the future directions of this field.

Previously, Powell et al have conducted a landscape bibliometric analysis in gastric cancer and presented insightful clues on the most cited 100 papers across the world.[11] This study is more specific in citations–authors–institutions analysis. Interestingly, it also highlighted the most referred topics, including pathology (57%), etiology (47%), science (44%), genetics (31%), and prognosis (30%). Hereby, we found out the published number of papers in prognosis have been significantly increased during the last 5 years (Figure 1A). For citation comparison, we reported a list of top 62
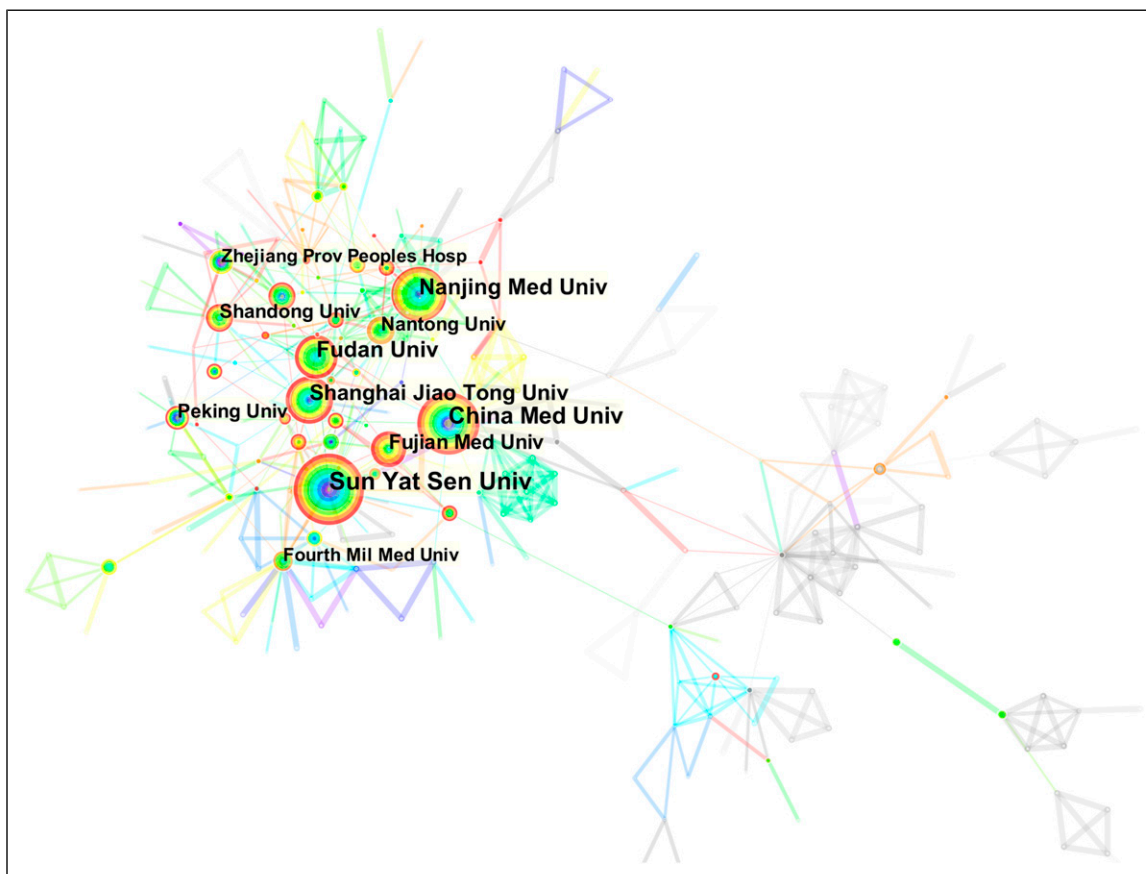
Figure 5. Cooperation relationship of institutions contributing to the studies is displayed in networks; Univ: University; Prov: Province; Hosp: Hospital; Mil: Military. The thickness of connection indicates the cooperation degree; the size of the circle indicates the value of centrality.

references with the strongest citation burst, specified with citation burst period (Figure 7). It opened up another perspective on how to compare and analyze the most cited papers.

The strongest citation burst article identified by this bibliometric analysis is by Jemal A. et al published in CA-CANCER J CLIN in 2011.[19] The most frequently cited period was 2012 to 2016. This article reported an overview of global cancer statistics, demonstrating the estimated results of cancer cases and deaths in 2008 as well as region-specific incidence and mortality rates.[19] Meanwhile, Jemal A. et al highlighted and commented preventive measures that target possible patterns for incidence and mortality across several malignancies. This article indeed shared a global perspective over cancer epidemiology and policies.

The studies of Van Cutsem E. and Japanese Gastric Cancer Association showed remarkable increasing impact, separately.[20,21] Van Cutsem E. et al systematically updated the current knowledge of the causes, classification, diagnosis, and treatment of gastric cancer.[20] The study published by Japanese Gastric Cancer Association was an English version of the treatment guideline in Japan.[21] It compiled several therapeutic topics, including surgery and lymphadenectomy, postoperative follow-up, risk calculation prior to surgery, and others.[21] These contents made the 2 studies the most popular references among others.

Among the top 10 countries, China, Japan, and South Korea are the countries with the most publications. They are also the hotspots with the highest incidence and mortality rates of gastric cancer. However, both Japan and Korea develop national screening program for gastric cancer to improve the early diagnosis and therapeutic intervention.[22,23] Overdose of salt in diet leads to potential gastritis.[24] Regional cultures, such as China and Japan, are close to pickled and salty foods.[24] Environmental and diet shift of Japanese immigrants into the United States substantially contributes to reducing rate of gastric cancer.[25]

Clearly, top keywords with burst citations kept changing dynamically over this period, reflecting a redistribution of research interests and resources. Particularly, the keyword "regulatory t cell" became increasingly cited by new studies and signified as a future direction. Regulatory T cells are essential to the tumor microenvironment regulation and immune homeostasis as well as tumor immune escape.[26,27] Li

Top 52 Keywords with the Strongest Citation Bursts

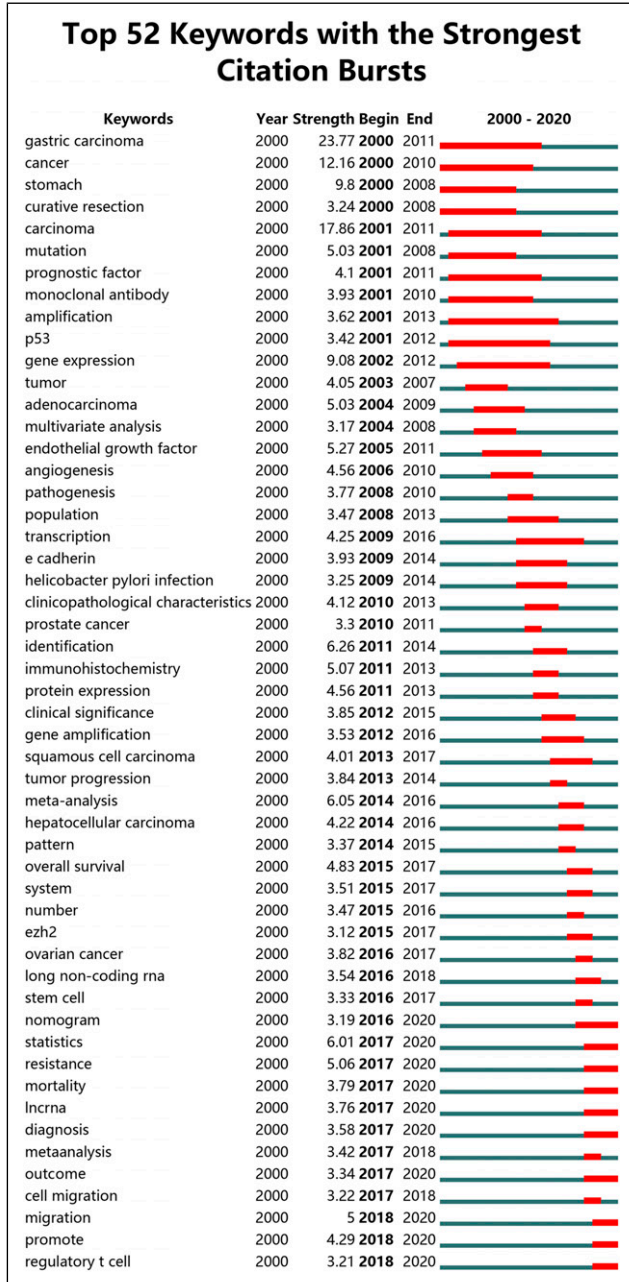| Keywords	Year	Strength	Begin	End	2000 - 2020
gastric carcinoma	2000	23.77	2000	2011	
cancer	2000	12.16	2000	2010	
stomach	2000	9.8	2000	2008	
curative resection	2000	3.24	2000	2008	
carcinoma	2000	17.86	2001	2011	
mutation	2000	5.03	2001	2008	
prognostic factor	2000	4.1	2001	2011	
monoclonal antibody	2000	3.93	2001	2010	
amplification	2000	3.62	2001	2013	
p53	2000	3.42	2001	2012	
gene expression	2000	9.08	2002	2012	
tumor	2000	4.05	2003	2007	
adenocarcinoma	2000	5.03	2004	2009	
multivariate analysis	2000	3.17	2004	2008	
endothelial growth factor	2000	5.27	2005	2011	
angiogenesis	2000	4.56	2006	2010	
pathogenesis	2000	3.77	2008	2010	
population	2000	3.47	2008	2013	
transcription	2000	4.25	2009	2016	
e cadherin	2000	3.93	2009	2014	
helicobacter pylori infection	2000	3.25	2009	2014	
clinicopathological characteristics	2000	4.12	2010	2013	
prostate cancer	2000	3.3	2010	2011	
identification	2000	6.26	2011	2014	
immunohistochemistry	2000	5.07	2011	2013	
protein expression	2000	4.56	2011	2013	
clinical significance	2000	3.85	2012	2015	
gene amplification	2000	3.53	2012	2016	
squamous cell carcinoma	2000	4.01	2013	2017	
tumor progression	2000	3.84	2013	2014	
meta-analysis	2000	6.05	2014	2016	
hepatocellular carcinoma	2000	4.22	2014	2016	
pattern	2000	3.37	2014	2015	
overall survival	2000	4.83	2015	2017	
system	2000	3.51	2015	2017	
number	2000	3.47	2015	2016	
ezh2	2000	3.12	2015	2017	
ovarian cancer	2000	3.82	2016	2017	
long non-coding rna	2000	3.54	2016	2018	
stem cell	2000	3.33	2016	2017	
nomogram	2000	3.19	2016	2020	
statistics	2000	6.01	2017	2020	
resistance	2000	5.06	2017	2020	
mortality	2000	3.79	2017	2020	
lncrna	2000	3.76	2017	2020	
diagnosis	2000	3.58	2017	2020	
metaanalysis	2000	3.42	2017	2018	
outcome	2000	3.34	2017	2020	
cell migration	2000	3.22	2017	2018	
migration	2000	5	2018	2020	
promote	2000	4.29	2018	2020	
regulatory t cell	2000	3.21	2018	2020	

Figure 6. Top keywords with the strongest citation bursts between 2000 and 2020. Green bar indicates the period of citation bursts.

et al reported that regulatory T cells interacted with other immunocompetent cells to confer a complex immune community with significant prognostic impact in gastric cancer.[28] High expression of tumor-infiltrating Foxp3+ regulatory T cells was significantly correlated with poor overall survival.[28] Another pilot study by Liu et al indicated that inducible costimulator+ Foxp3+ regulatory T cells both in peripheral blood and tumor tissue predict poor outcome in gastric cancer.[29] Interestingly, regulatory T cells modulate the TGF-beta1 signaling pathway and promote the expression of

Top 62 References with the Strongest Citation Bursts

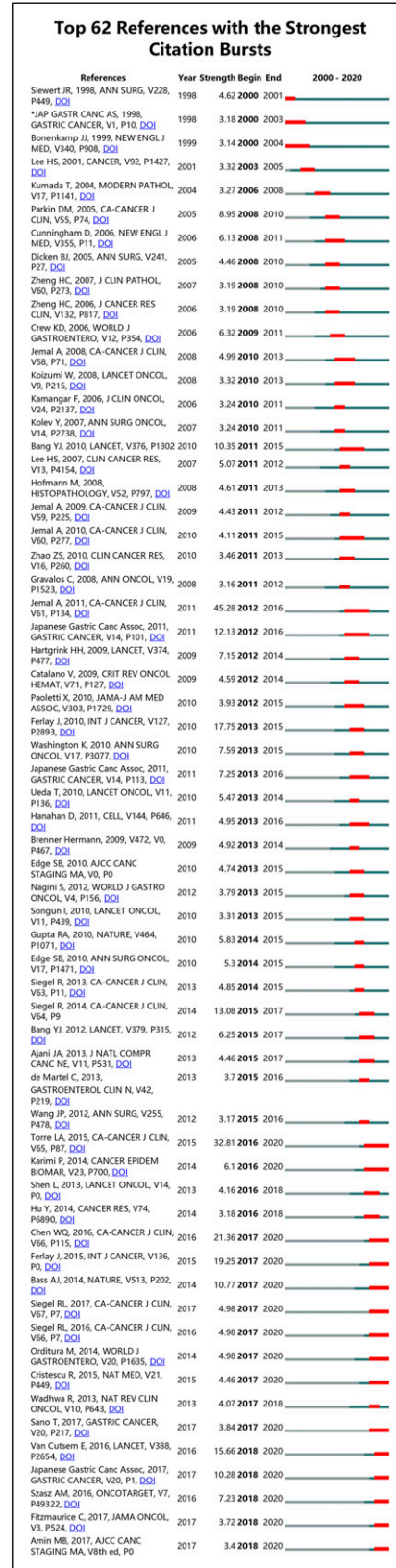| References	Year	Strength	Begin	End	2000 - 2020
Siewert JR, 1998, ANN SURG, V228, P449, DOI	1998	4.62	2000	2001	
*JAP GASTR CANC AS, 1998, GASTRIC CANCER, V1, P10, DOI	1998	3.18	2000	2003	
Bonenkamp JJ, 1999, NEW ENGL J MED, V340, P908, DOI	1999	3.14	2000	2004	
Lee HS, 2001, CANCER, V92, P1427, DOI	2001	3.32	2003	2005	
Kumada T, 2004, MODERN PATHOL, V17, P1141, DOI	2004	3.27	2006	2008	
Parkin DM, 2005, CA-CANCER J CLIN, V55, P74, DOI	2005	8.95	2008	2010	
Cunningham D, 2006, NEW ENGL J MED, V355, P11, DOI	2006	6.13	2008	2011	
Dicken BJ, 2005, ANN SURG, V241, P27, DOI	2005	4.46	2008	2010	
Zheng HC, 2007, J CLIN PATHOL, V60, P273, DOI	2007	3.19	2008	2010	
Zheng HC, 2006, J CANCER RES CLIN, V132, P817, DOI	2006	3.19	2008	2010	
Crew KD, 2006, WORLD J GASTROENTERO, V12, P354, DOI	2006	6.32	2009	2011	
Jemal A, 2008, CA-CANCER J CLIN, V58, P71, DOI	2008	4.99	2010	2013	
Koizumi W, 2008, LANCET ONCOL, V9, P215, DOI	2008	3.32	2010	2013	
Kamangar F, 2006, J CLIN ONCOL, V24, P2137, DOI	2006	3.24	2010	2011	
Kolev Y, 2007, ANN SURG ONCOL, V14, P2738, DOI	2007	3.24	2010	2011	
Bang YJ, 2010, LANCET, V376, P1302	2010	10.35	2011	2015	
Lee HS, 2007, CLIN CANCER RES, V13, P4154, DOI	2007	5.07	2011	2012	
Hofmann M, 2008, HISTOPATHOLOGY, V52, P797, DOI	2008	4.61	2011	2013	
Jemal A, 2009, CA-CANCER J CLIN, V59, P225, DOI	2009	4.43	2011	2012	
Jemal A, 2010, CA-CANCER J CLIN, V60, P277, DOI	2010	4.11	2011	2015	
Zhao ZS, 2010, CLIN CANCER RES, V16, P260, DOI	2010	3.46	2011	2013	
Gravalos C, 2008, ANN ONCOL, V19, P1523, DOI	2008	3.16	2011	2012	
Jemal A, 2011, CA-CANCER J CLIN, V61, P134, DOI	2011	45.28	2012	2016	
Japanese Gastric Canc Assoc, 2011, GASTRIC CANCER, V14, P101, DOI	2011	12.13	2012	2016	
Hartgrink HH, 2009, LANCET, V374, P477, DOI	2009	7.15	2012	2014	
Catalano V, 2009, CRIT REV ONCOL HEMAT, V71, P127, DOI	2009	4.59	2012	2014	
Paoletti X, 2010, JAMA-J AM MED ASSOC, V303, P1729, DOI	2010	3.93	2012	2015	
Ferlay J, 2010, INT J CANCER, V127, P2893, DOI	2010	17.75	2013	2015	
Washington K, 2010, ANN SURG ONCOL, V17, P3077, DOI	2010	7.59	2013	2015	
Japanese Gastric Canc Assoc, 2011, GASTRIC CANCER, V14, P113, DOI	2011	7.25	2013	2016	
Ueda T, 2010, LANCET ONCOL, V11, P136, DOI	2010	5.47	2013	2014	
Hanahan D, 2011, CELL, V144, P646, DOI	2011	4.95	2013	2016	
Brenner Hermann, 2009, V472, V0, P467, DOI	2009	4.92	2013	2014	
Edge SB, 2010, AJCC CANC STAGING MA, V0, P0	2010	4.74	2013	2015	
Nagini S, 2012, WORLD J GASTRO ONCOL, V4, P156, DOI	2012	3.79	2013	2015	
Songun I, 2010, LANCET ONCOL, V11, P439, DOI	2010	3.31	2013	2015	
Gupta RA, 2010, NATURE, V464, P1071, DOI	2010	5.83	2014	2015	
Edge SB, 2010, ANN SURG ONCOL, V17, P1471, DOI	2010	5.3	2014	2015	
Siegel R, 2013, CA-CANCER J CLIN, V63, P11, DOI	2013	4.85	2014	2015	
Siegel R, 2014, CA-CANCER J CLIN, V64, P9	2014	13.08	2015	2017	
Bang YJ, 2012, LANCET, V379, P315, DOI	2012	6.25	2015	2017	
Ajani JA, 2013, J NATL COMPR CANC NE, V11, P531, DOI	2013	4.46	2015	2017	
de Martel C, 2013, GASTROENTEROL CLIN N, V42, P219, DOI	2013	3.7	2015	2016	
Wang JP, 2012, ANN SURG, V255, P478, DOI	2012	3.17	2015	2016	
Torre LA, 2015, CA-CANCER J CLIN, V65, P87, DOI	2015	32.81	2016	2020	
Karimi P, 2014, CANCER EPIDEM BIOMAR, V23, P700, DOI	2014	6.1	2016	2020	
Shen L, 2013, LANCET ONCOL, V14, P0, DOI	2013	4.16	2016	2018	
Hu Y, 2014, CANCER RES, V74, P6890, DOI	2014	3.18	2016	2018	
Chen WQ, 2016, CA-CANCER J CLIN, V66, P115, DOI	2016	21.36	2017	2020	
Ferlay J, 2015, INT J CANCER, V136, P0, DOI	2015	19.25	2017	2020	
Bass AJ, 2014, NATURE, V513, P202, DOI	2014	10.77	2017	2020	
Siegel RL, 2017, CA-CANCER J CLIN, V67, P7, DOI	2017	4.98	2017	2020	
Siegel RL, 2016, CA-CANCER J CLIN, V66, P7, DOI	2016	4.98	2017	2020	
Orditura M, 2014, WORLD J GASTROENTERO, V20, P1635, DOI	2014	4.98	2017	2020	
Cristescu R, 2015, NAT MED, V21, P449, DOI	2015	4.46	2017	2020	
Wadhwa R, 2013, NAT REV CLIN ONCOL, V10, P643, DOI	2013	4.07	2017	2018	
Sano T, 2017, GASTRIC CANCER, V20, P217, DOI	2017	3.84	2017	2020	
Van Cutsem E, 2016, LANCET, V388, P2654, DOI	2016	15.66	2018	2020	
Japanese Gastric Canc Assoc, 2017, GASTRIC CANCER, V20, P1, DOI	2017	10.28	2018	2020	
Szasz AM, 2016, ONCOTARGET, V7, P49322, DOI	2016	7.23	2018	2020	
Fitzmaurice C, 2017, JAMA ONCOL, V3, P524, DOI	2017	3.72	2018	2020	
Amin MB, 2017, AJCC CANC STAGING MA, V8th ed, P0	2017	3.4	2018	2020	

Figure 7. Top references with the strongest citation bursts between 2000 and 2020. Green bar indicates the period of citation bursts.

leucine-rich repeat containing G protein-coupled receptor 5 (Lgr5), a biomarker commonly overexpressed in tumors.[30]

Of note, ONCOTARGET and TUMOR BIOLOGY, with the number of publications accounting for 6.4% of all publications, were removed from the MEDLINE index without new IF since 2017. Specifically, TUMOR BIOLOGY was deselected from July 2017 by Web of Science while ONCOTARGET was removed from MEDLINE since volume 8 in 2017. These conducts had exerted negative impact on the capability of these 2 journals to receive more research results since then. Therefore, it is reasonable to presume that significant amount of subsequent prognostic studies of gastric cancer chose other journals.

Also, there is another disputable topic: Quality versus quantity debate. Based on the results from this study, the references with burst citations, such as the studies by Jemal A. et al, Van Cutsem E. et al, and Japanese Gastric Cancer Association, were not from China, the country with the most publications in this field. Similar results were also found in the top journal list. We believe that it depends on the situations in which direction is better. If the aim is to provide a policy-changing study or a full picture for decision-maker, it is better to take a high quality study.

Limitations remain in this study. Notably, due to the pronunciation of Chinese name and in abbreviation writing style, in some rare cases, an English name may reflect several Chinese

authors if other specific information, such as institution or publication year, is not disclosed. Perhaps not all prognostic studies were strictly included even with predefined criteria. It is possible some mechanistic or bioinformatics studies also contain essential prognostic parts. Meanwhile, possibility exists that some non-English studies also provide insightful clues, such as original Japanese, Chinese, and Korean studies. Limitations in synonyms may potentially contribute to the outcome. For example, possible synonyms for "neoplasm OR cancer OR carcinoma" also include "tumor" and "tumour." Noteworthy, there are inherent limitations of bibliometric analysis, such as disproportionate citation, self-citation, powerful person bias, and older journal bias, that should be paid attention to. Moreover, co-authors may also show important connections, which have not been included for bibliometric analysis.

Conclusion

China, Japan, and Korea are the top 3 nations with most contribution in the prognostic studies of gastric cancer. Top used keywords and references are changing dynamically. This bibliometric analysis provided a thought-provoking, insightful result concerning the trajectory of research development in prognosis of gastric cancer with a future perspective.

Appendix

Abbreviations

IF   Impact factor
LOESS   Locally Weighted Scatterplot Smoothing

Author's Note

CY and YZ carried out data analysis; CY and YZ drafted the manuscript; and CY and YZ participated in study design, data collection, and analysis; All authors read and approved the final manuscript.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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References

1. Smyth EC, Nilsson M, Grabsch HI, van Grieken NC, Lordick F. Gastric cancer. *Lancet*. 2020;396(10251):635-648. doi:10.1016/S0140-6736(20)31288-5.

2. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A, Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries [published correction appears in CA Cancer J Clin. 2020Jul;70(4):313]. *CA A Cancer J Clin*, 2018;68(6): 394-424. doi:10.3322/caac.21492.4

3. Brenner H, Rothenbacher D, Arndt V. Epidemiology of stomach cancer. *Methods Mol Biol*. 2009;472:467-477. doi:10.1007/978-1-60327-492-0_23.

4. Arnold M, Park JY, Camargo MC, Lunet N, Forman D, Soerjomataram I. Is gastric cancer becoming a rare disease? A global assessment of predicted incidence trends to 2035. *Gut*. 2020;69(5):823-829. doi:10.1136/gutjnl-2019-320234.

5. Chia N-Y, Tan P. Molecular classification of gastric cancer. *Ann Oncol*. 2016;27(5):763-769. doi:10.1093/annonc/mdw040.

6. Johnston FM, Beckman M. Updates on management of gastric cancer. *Curr Oncol Rep*. 2019;21(8):67. doi:10.1007/s11912-019-0820-4. Published June 24, 2019.

7. Tomita Y, Moldovan M, Chang Lee R, Hsieh AH, Townsend A, Price T. Salvage systemic therapy for advanced gastric and

oesophago-gastric junction adenocarcinoma. *Cochrane Database Syst Rev*. 2020;2020(11):CD012078. doi:10.1002/14651858. CD012078.pub2. Published November 19, 2020.

8. Zeng D, Li M, Zhou R, et al. Tumor Microenvironment Characterization in Gastric Cancer Identifies Prognostic and Immunotherapeutically Relevant Gene Signatures. *Cancer Immunology Research*. 2019;7(5):737-750. doi:10.1158/2326-6066.CIR-18-0436.

9. Zeng D, Zhou R, Yu Y, et al. Gene expression profiles for a prognostic immunoscore in gastric cancer. *Br J Surg*. 2018; 105(10):1338-1348. doi:10.1002/bjs.10871.

10. Analytics C. *Web of science[J]. Trust the Difference. Web of Science Fact Book*; 2017. http://images.info.science.thomsonreuters.biz/Web/ThomsonReutersScience/%7Bd6b7faae-3cc2-4186-8985-a6ecc8cce1ee%7D_Crv_WoS_Upsell_Factbook_A4_FA_LR_edits.pdf. Accessed October 10, 2017.

11. Powell AG, Hughes DL, Wheat JR, Lewis WG. The 100 most influential manuscripts in gastric cancer: A bibliometric analysis. *Int J Surg*. 2016;28:83-90.

12. Ellegaard O, Wallin JA. The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics*. 2015; 105(3):1809-1831. doi:10.1007/s11192-015-1645-z.

13. Chen C. CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *J Am Soc Inf Sci Technol*. 2006;57(3):359-377.

14. Chambers J. *Software for Data Analysis: Programming with R[M]*. Berlin, Germany: Springer Science & Business Media; 2008.

15. Bornmann L, Daniel H-D. What do we know about theh index? *J Am Soc Inf Sci Technol*. 2007;58(9):1381-1385.

16. Hirsch JE. An index to quantify an individual's scientific research output. *Proc Natl Acad Sci Unit States Am*. 2005; 102(46):16569-16572. doi:10.1073/pnas.0507655102.

17. Garfield E. The meaning of the impact factor. *Int J Clin Health Psychol*. 2003;3(2):363-369.

18. Brandes U. A faster algorithm for betweenness centrality*. *J Math Sociol*. 2001;25(2):163-177.

19. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA A Cancer J Clin*. 2011;61(2):69-90. doi:10.3322/caac.20107.

20. Van Cutsem E, Sagaert X, Topal B, Haustermans K, Prenen H. Gastric cancer. *Lancet*. 2016;388(10060):2654-2664. doi:10.1016/S0140-6736(16)30354-3.

21. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2014 (ver. 4). *Gastric Cancer : Official Journal of the International Gastric Cancer Association and the Japanese Gastric Cancer Association*. 2017;20(1):1-19. doi:10.1007/s10120-016-0622-4.

22. Rawla P, Barsouk A. Epidemiology of gastric cancer: global trends, risk factors and prevention. *Gastroenterol Rev*. 2019; 14(1):26-38. doi:10.5114/pg.2018.80001.

23. Tsugane S, Sasazuki S. Diet and the risk of gastric cancer: review of epidemiological evidence. *Gastric Cancer*. 2007; 10(2):75-83. doi:10.1007/s10120-007-0420-0.

24. Hamashima C. Update version of the Japanese guidelines for gastric cancer screening. *Jpn J Clin Oncol*. 2018;48(7):673-683. doi:10.1093/jjco/hyy077.

25. Lin JT. Screening of gastric cancer: who, when, and how. *Clin Gastroenterol Hepatol*. 2014;12(1):135-138. doi:10.1016/j.cgh.2013.09.064.

26. Chaudhary B, Elkord E. Regulatory T cells in the tumor microenvironment and cancer progression: Role and therapeutic targeting. *Vaccines*. 2016;4(3):28. doi:10.3390/vaccines4030028.

27. Facciabene A, Motz GT, Coukos G. T-Regulatory cells: Key players in tumor immune escape and angiogenesis: Figure 1. *Cancer Res*. 2012;72(9):2162-2171. doi:10.1158/0008-5472.CAN-11-3687.

28. Li F, Sun Y, Huang J, Xu W, Liu J, Yuan Z. CD4/CD8 + T cells, DC subsets, Foxp3, and IDO expression are predictive indictors of gastric cancer prognosis. *Cancer Medicine*. 2019;8(17): 7330-7344. doi:10.1002/cam4.2596.

29. Liu X, Yu H, Yan C, et al. Plasmacytoid dendritic cells and ICOS+ regulatory T cells predict poor prognosis in gastric cancer: A pilot study. *J Cancer*. 2019;10(26):6711-6715. doi:10.7150/jca.34826. Published October 22, 2019.

30. Liu X-S, Lin X-K, Mei Y, et al. Regulatory T cells promote overexpression of lgr5 on gastric cancer cells via TGF-beta1 and confer poor prognosis in Gastric Cancer. *Front Immunol*. 2019;10: 1741. doi:10.3389/fimmu.2019.01741. Published July 30, 2019.