Social attention of the top 50 scientific articles on gastric cancer: Bibliometric and altmetric analysis

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Summary

Purpose: *Bibliometric and Altmetric analyse the most influental publications and provide important perspectives regarding article impact. The Altmetric Score (AS) is an automatically calculated metric for monitoring social media attention. The hypothesis is that would citation number correlate positively with AS?*

Methods: *Gastric cancer as a search term was entered into Thomson Reuter's Web of Science database to identify articles in the last decade. The 50 most cited articles were analysed by topic, journal, author, year, and AS.*

Results: *By bibliometric criteria, it was observed that there were 63,154 articles published in the literature on gastric cancer in the last decade. The most cited article was made by Bang et al for the treatment of HER2-positive advanced gastric or gastro-oesophageal junction cancer. The study with*

the highest altmetric score was published by Bass et al and described the molecular evaluation of gastric cancer as part of the cancer genome atlas. The majority of the top 50 most cited article types were original scientific papers (n=39). The highest number of publications was published in the Journal of Clinical Oncology (n=9) and the most contributing country was the United States (n=22). Positive correlation was detected between the number of citations and AS. We revealed a negative correlation between AS and numbers of years since publication of the article.

Conclusion: *The remarkable result of this study is that both the citation and AS of the articles provide important but different viewpoints.*

Key words: *altmetric score, bibliometric analysis, gastric cancer, social media*

Introduction

Gastric cancer is a major cause of morbidity and mortality worldwide. According to GLOBOCAN 2018 data, it is the 5th most common cancer in the world with an estimated 783,000 deaths and it is the third most common cause of cancer-related deaths. More than one million new cases of gastric cancer are detected each year worldwide with males prevailing [1].

The term bibliometry is defined as the application of mathematical and statistical methods to books and other media [2]. In the bibliometric researches, by analyzing the specific features of

the documents or publications, various findings related to scientific communication are obtained, while determining the most productive researchers in any subject, the dimensions of the interaction between them can be revealed. It is claimed that the first bibliometric study was the source called "Theory of the National and International Bibliography" published by Campbell in 1896 [3,4]. Although there are different claims about when the first bibliometric study was conducted, it is a fact that the interest in bibliometric research has increased over time.

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Altmetrics qualitative data that are complementary to traditional citation-based metrics are an alternative to other assessment methods. The most positive feature of the altmetrics, which stands for "Article Level Metrics", is not only the number of citations; peer reviews on Faculty of 1000, citations on Wikipedia and public policy documents, discussions on research blogs, publications in general media, bookmarks of reference managers such as Mendeley, number of views and downloads of articles, impact on social media such as Twitter, Facebook, Google+ are also a measure. This database has made on more than 68 million mentions for more than 9.5 million researches so far. Some of the data collected with the altmetrics may indicate that research has changed a field of study, public health or any other concrete impact on the wider society. Examples include references in public policy documents or comments from experts and practitioners [5].

Previously, several medical specialties have conducted studies evaluating the impact of articles published in their fields on social media: neurology [6], neurosurgery [7], emergency medicine [8] and dentistry [9]. To the best of our knowledge, no studies have been conducted on the extent of gastric cancer, which is an important cause of morbidity and mortality in the world, attracting attention in social media. We reviewed the first 50 most cited articles on gastric cancer in the last decade. Our attempt was to reveal the bibliometric analysis of the most cited articles and compare them with the altmetric scores to determine whether they receive similar attention in social media.

Methods

Web of Science and Altmetric.com were used as search engine to access the data to be interpreted in this study. The search for the Thomson Reuters Web of Science citation indexing database and research platform were completed using the search terms "gastric cancer" or "gastric carcinoma". Because Altmetrics started collecting data only during the second half of 2011, article publication years were limited to 2009 and beyond (last decade) when searching. Two researchers (Goksoy B. and Bozkurt H) read the full text of the first 50 articles in order of citation and reached the Altmetric scores of these articles (Access date: September 15, 2019). This score was developed by Altmetric company and is automatically calculated on the web. It is based on three main factors: volume, sources, and authors. Each color of the Altmetric donut represents a different source of attention (Figure 1). Following that, the journal name, journal impact factor (IF), Q category of journals according to "Scimago Journal and Country Rank", year of publication, article subject, article type, first author, total number of citations and average number of citations per year (ACpY) were determined. Articles not directly related to gastric cancer were excluded.

Statistics

Mostly descriptive statistical methods were used in this study. If the data did not show a normal distribution, Spearman test was used to evaluate the correlation between the number of citations and the Altmetric score. All statistical analyses were performed using SPSS package software for Windows® (version: 21.0).

Results

Through the Web of Science, it was observed that there were 63,154 articles published in the literature on gastric cancer in 2009 and beyond. The articles were ranked from the most cited to the least cited. Both researchers conducted the screening independently from each other, and the first 50 most cited articles directly related to gastric cancer were reached in the article 103. Regarding the first 50 articles listed by citation number, article title, first author, year of study, number of citations, average number of citations per year, and altmetric score are shown in Table 1. The most cited article was made by Bang et al (#1 in Table 1). For the treatment of HER2-positive advanced gastric or gastro-oesophageal junction cancer, trastuzumab plus chemotherapy was compared with chemotherapy alone [10]. The study with the highest Altmetric score was published by Bass et al in the Nature (#2) and described the molecular evaluation of gastric cancer as part of the cancer
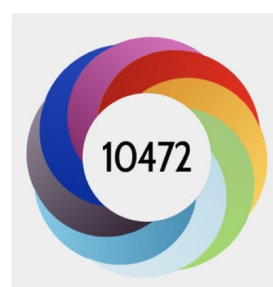

Figure 1. Altmetric donuts.

Table 1. The top 50 cited articles in gastric cancer

Article title	First Authors	Publication Years	Times Cited	Average Citations per Year	Altmetric Score
1. Trastuzumab in combination with chemotherapy versus chemotherapy alone for treatment of HER2-positive advanced gastric or gastro-oesophageal junction cancer (ToGA): a phase 3, open-label, randomised controlled trial.	Bang YJ	2010	2601	260.1	0
2. Comprehensive molecular characterization of gastric adenocarcinoma	Bass AJ	2014	1824	304	211
3. Ramucirumab monotherapy for previously treated advanced gastric or gastro-oesophageal junction adenocarcinoma (REGARD): an international, randomised, multicentre, placebo-controlled, phase 3 trial.	Fuchs CS	2014	950	155	109
4. Surgical treatment of gastric cancer: 15-year follow-up results of the randomised nationwide Dutch D1D2 trial.	Songun I	2010	837	83.7	4
5. Ramucirumab plus paclitaxel versus placebo plus paclitaxel in patients with previously treated advanced gastric or gastro-oesophageal junction adenocarcinoma (RAINBOW): a double-blind, randomised phase 3 trial.	Wilke H	2014	817	136.17	68
6. Perioperative chemotherapy compared with surgery alone for resectable gastroesophageal adenocarcinoma: an FNCLCC and FFCD multicenter phase III trial.	Ychou M	2011	806	89.56	6
7. Adjuvant capecitabine and oxaliplatin for gastric cancer after D2 gastrectomy (CLASSIC): a phase 3 open-label, randomised controlled trial	Bang YJ	2012	687	85.88	8
8. Bevacizumab in combination with chemotherapy as first-line therapy in advanced gastric cancer: a randomized, double-blind, placebo-controlled phase III study	Ohtsu A	2011	661	73.44	17
9. Gastric cancer	Hartgrink HH	2009	637	57.91	0
10. 7th edition of the AJCC cancer staging manual: stomach.	Washington K	2010	624	62.4	3
11. Trastuzumab in combination with chemotherapy versus chemotherapy alone for treatment of HER2-positive advanced gastric or gastro-oesophageal junction cancer (ToGA): a phase 3, open-label, randomised controlled trial	Bang YJ	2010	596	59.6	48
12. Five-year outcomes of a randomized phase III trial comparing adjuvant chemotherapy with S-1 versus surgery alone in stage II or III gastric cancer	Sasako M	2011	592	65.78	21
13. Japanese gastric cancer treatment guidelines 2014 (ver. 4)	J. Gastric Cancer Association	2017	575	191.67	23
14. Identification of gastric cancer stem cells using the cell surface marker CD44	Takaishi S	2009	562	51.09	7
15. Relation between microRNA expression and progression and prognosis of gastric cancer: a microRNA expression analysis.	Ueda T	2010	549	54.9	12
16. Phase III comparison of preoperative chemotherapy compared with chemoradiotherapy in patients with locally advanced adenocarcinoma of the esophagogastric junction	Stahl M	2009	516	46.91	13

Article title	First Authors	Publication Years	Times Cited	Average Citations per Year	Altmetric Score
17. Chemotherapy for advanced gastric cancer	Wagner AD	2010	506	50.6	4
18. Helicobacter pylori: gastric cancer and beyond.	Polk DB	2010	499	49.9	32
19. Morbidity and mortality of laparoscopic gastrectomy versus open gastrectomy for gastric cancer: an interim report--a phase III multicenter, prospective, randomized Trial (KLASS Trial).	Kim HH	2010	496	49.6	0
20. Helicobacter pylori and gastric cancer: factors that modulate disease risk.	Wroblewski LE	2010	487	48.7	66
21. Capecitabine/cisplatin versus 5-fluorouracil/cisplatin as first-line therapy in patients with advanced gastric cancer: a randomised phase III noninferiority trial.	Kang YK	2009	465	42.27	3
22. Lnc RNA HOTAIR functions as a competing endogenous RNA to regulate HER2 expression by sponging miR-331-5p in gastric cancer	Liu XH	2014	463	77.17	4
23. Whole-genome sequencing and comprehensive molecular profiling identify new driver mutations in gastric cancer	Wang K	2014	457	76.17	45
24. Benefit of adjuvant chemotherapy for resectable gastric cancer: a meta-analysis	Paoletti X	2010	450	45	0
25. Capecitabine and cisplatin with or without cetuximab for patients with previously untreated advanced gastric cancer (EXPAND): a randomised, open-label phase 3 trial	Lordick F	2013	439	62.71	5
26. Circulating microRNAs in plasma of patients with gastric cancers	Tsujiura M	2010	433	43.3	9
27. Molecular analysis of gastric cancer identifies subtypes associated with distinct clinical outcomes	Cristescu R	2015	431	86.2	39
28. Recent patterns in gastric cancer: a global overview	Bertuccio P	2009	431	39.18	11
29. Exome sequencing identifies frequent mutation of ARID1A in molecular subtypes of gastric cancer.	Wang K	2011	415	46.11	21
30. Fluorouracil versus combination of irinotecan plus cisplatin versus S-1 in metastatic gastric cancer: a randomised phase 3 study.	Boku N	2009	403	36.64	3
31. Exome sequencing of gastric adenocarcinoma identifies recurrent somatic mutations in cell adhesion and chromatin remodeling genes	Zang ZJ	2012	402	50.25	19
32. Endoscopic submucosal dissection for early gastric cancer: a large-scale feasibility study	İsomoto H	2009	401	36.45	3
33. Gastric cancer	Van Cutsem E	2016	389	97.25	13
34. Updated analysis of SWOG-directed intergroup study 0116: a phase III trial of adjuvant radiochemotherapy versus observation after curative gastric cancer resection	Smalley SR	2012	387	48.38	10
35. Epirubicin, oxaliplatin, and capecitabine with or without panitumumab for patients with previously untreated advanced oesophagogastric cancer (REAL3): a randomised, open-label phase 3 trial.	Waddell T	2013	378	54	5

Continued on the next page

Article title	First Authors	Publication Years	Times Cited	Average Citations per Year	Altmetric Score
36. Multicenter phase III comparison of cisplatin/S-1 with cisplatin/infusional fluorouracil in advanced gastric or gastroesophageal adenocarcinoma study: the FLAGS trial.	Ajani JA	2010	366	36.6	2
37. A comprehensive survey of genomic alterations in gastric cancer reveals systematic patterns of molecular exclusivity and co-occurrence among distinct therapeutic targets.	Deng N	2012	365	45.63	5
38. Differential expression of microRNA species in human gastric cancer versus non-tumorous tissues	Guo J	2009	364	33.09	9
39. Salvage chemotherapy for pretreated gastric cancer: a randomized phase III trial comparing chemotherapy plus best supportive care with best supportive care alone	Kang JH	2012	360	45	33
40. Japanese gastric cancer treatment guidelines 2010 (ver. 3).	J. Gastric Cancer Association	2011	358	39.78	1
41. Phase III trial comparing capecitabine plus cisplatin versus capecitabine plus cisplatin with concurrent capecitabine radiotherapy in completely resected gastric cancer with D2 lymph node dissection: the ARTIST trial.	Lee J	2012	351	43.88	10
42. Therapeutic outcomes in 1000 cases of endoscopic submucosal dissection for early gastric neoplasms: Korean ESD Study Group multicenter study	Chung IK	2009	344	31.27	0
43. Let-7 microRNA family is selectively secreted into the extracellular environment via exosomes in a metastatic gastric cancer cell line	Ohshima K	2010	342	34.2	2
44. Gastric cancer: descriptive epidemiology, risk factors, screening, and prevention	Karimi P	2014	340	56.67	1
45. Using circular RNA as a novel type of biomarker in the screening of gastric cancer.	Li P	2015	339	67.8	0
46. Functional links between clustered microRNAs: suppression of cell-cycle inhibitors by microRNAclusters in gastric cancer	Kim YK	2009	337	30.64	3
47. Pembrolizumab for patients with PD-L1-positive advanced gastric cancer (KEYNOTE-012): a multicentre, open-label, phase 1b trial	Muro K	2016	331	82.75	41
48. Neoadjuvant chemotherapy compared with surgery alone for locally advanced cancer of the stomach and cardia: European Organisation for Research and Treatment of Cancer randomized trial 40954	Schuhmacher C	2010	319	31.9	16
49. A shared susceptibility locus in PLCE1 at 10q23 for gastric adenocarcinoma and esophageal squamous cell carcinoma.	Abnet CC	2010	318	31.8	3
50. MiR-218 inhibits invasion and metastasis of gastric cancer by targeting the Robo1 receptor.	Tie J	2010	314	31.4	0

Table 2. Journals with top-50 articles, ranked according to the citations

Journal Name	Number of articles	Number of total citations	Number of total Altmetric Score	Average citations per year	Impact factor*	Q category**
Journal of Clinical Oncology	9	4351	128	481.1	28.2	Q1
The Lancet Oncology	7	3754	138	510.7	35.3	Q1
The Lancet	6	5840	178	715.5	59.1	Q1
Nature Genetics	4	1592	88	204.2	25.4	Q1
Gastric cancer	2	933	24	231.3	5.5	Q1
Gut	2	766	8	82	17.9	Q1
Nature	1	1824	211	304	43	Q1
Annals of Surgical Oncology	1	624	3	62.4	3.6	Q1
Stem Cells	1	562	7	51	5.6	Q1
Cochrane Database of Systematic Reviews	1	506	4	50.6	7.7	Q1
Nature Reviews Cancer	1	499	32	49.9	51.8	Q1
Annals of Surgery	1	496	0	49.6	9.4	Q1
Clinical Microbiology Reviews	1	487	66	48.7	17.7	Q1
Annals of Oncology	1	465	3	42.2	14.1	Q1
Molecular Cancer	1	463	4	77.1	10.6	Q1
JAMA	1	450	0	45	47.6	Q1
British Journal of Cancer	1	433	9	43.3	5.4	Q1
Nature Medicine	1	431	39	86.2	30.6	Q1
International Journal of Cancer	1	431	11	39.1	4.9	Q1
Journal of Gastroenterology and Hepatology	1	364	9	33	3.6	Q1
Gastrointestinal Endoscopy	1	344	0	31.2	7.2	Q1
PLOS One	1	342	2	34.2	2.7	Q1
Cancer Epidemiology	1	340	1	56.6	2.6	Q1
Clinica Chimica ACTA	1	339	0	67.8	2.7	Q1
Nucleic Acids Research	1	337	3	30.6	11.1	Q1
PLoS Genetics	1	314	0	31.4	5.2	Q1

Table 3. Numbers of top-50 cited articles according to article types

Subgroup	Number of articles
Original scientific papers	39
Systematic reviews and meta-analyses	3
Guidelines and advisory documents	3
Reviews	5

genome atlas [11]. This study also ranked among the top three in terms of number of citations, number of citations per year and Altmetric score. The first 50 most cited studies were published in 26 journals (Table 2). Looking at these studies, the highest number of publications was published in the Journal of Clinical Oncology (4351 total citation) with 9 studies, followed by The Lancet Oncology (3754 total citation) with 7 studies. All journals are in the Q1 category, with The Lancet having the highest impact factor of 591.

When the article types were evaluated, it was seen that the majority of the articles were original scientific papers (n=39) and reviews were on the second place (n=5) (Table 3). When evaluated according to subjects, 25 studies were in treatment and management, 16 studies were in molecular and genetics, 6 studies were in risk factors, classification, diagnosis, incidence and epidemiology and 3 guideline were published (Table 4). In the field of treatment and management, most studies were conducted in the field of chemotherapy drugs (20 studies) followed by surgical treatments (11

Table 4. Numbers of top 50 cited articles according to subject categories

Subject category	Number of articles
Treatment and Management	25
Only Chemotherapy	(3)
Only Surgery	(4)
Only Immunotherapy	(1)
Chemotherapy + surgery	(7)
Chemotherapy + immunotherapy	(7)
Chemotherapy + radiotherapy	(3)
Molecular and Genetics	16
Micro RNA	(8)
Molecular characterization and analysis	(7)
Stem cells	(1)
Risk factors, classification, diagnosis, incidence, epidemiology	6
Helicobacter Pylori	(2)
Others	(4)
Guideline	3
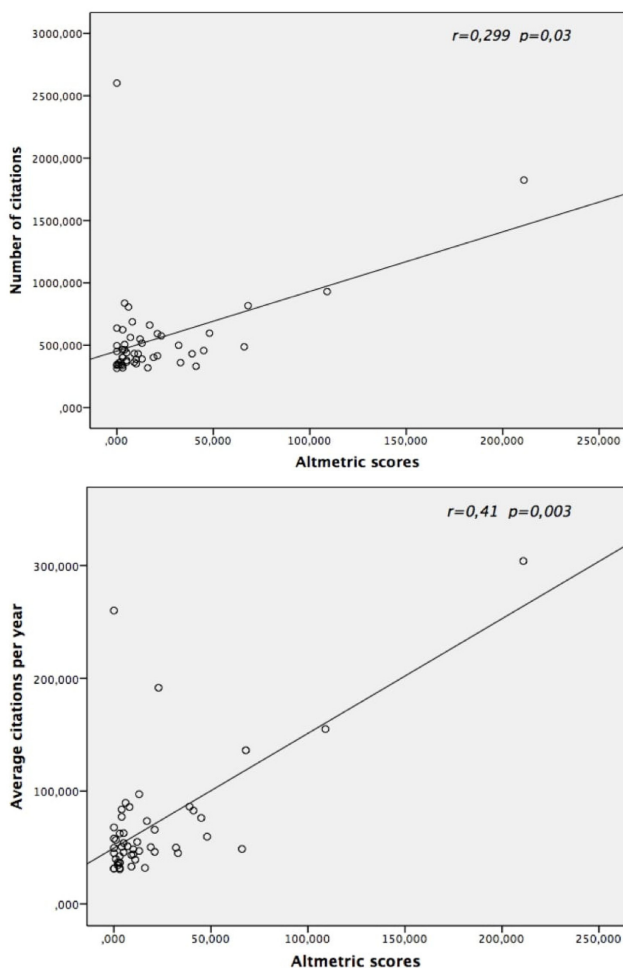
Figure 2. Correlations analysis.

studies) in second place. Seven studies included chemotherapy and surgery, 7 studies included chemotherapy and immunotherapy, and 3 studies included chemotherapy and radiotherapy. There were 4 studies examining only surgical procedures in the treatment of gastric cancer (#4, #19, #32, #42). The first three studies with the highest Asltmetric score were in the field of immunotherapy (#1, #3, #5).

The most cited study in the field of molecular and genetics has been the molecular evaluation of gastric cancer by Bass et al. This study also stands out as the study with the highest Altmetric score (#2). Eight studies were concentrated on microRNA (#15, #22, #26, #38, #43, #45, #46, #50). The most cited study on microRNA is a microRNA expression analysis that investigated the relationship between microRNA expression and the progression and prognosis of gastric cancer conducted by Ueda et al and it is stated that the Unique microRNAs are associated with the progression and prognosis of gastric cancer [12]. Two review studies on helicobacter pylori, an important risk factor in gastric cancer, have been published (#18, #20). These studies, ranked 18th and 20th in terms of the number of citations, are among the top 10 studies with the highest Altmetric score.

The most contributing countries to the 50 most cited articles are the United States with 22 articles, followed by South Korea with 17 publications and Japan with 16 publications. Van Cutsem (n=7) contributed to the highest number of articles and also Bang (n=4). Bang was also the first author in 3 studies. There is weak positive correlation between the number of citations and Altmetric scores (r=0.299 p=0.03) and also ACpY and Altmetric score (r=0.41 p=0.003) have positive correlation (Figure 2). We revealed a negative correlation between altmetric scores and numbers of years since publication (r=-0.419 p=0,02) of the article.

Discussion

Unlike our hypothesis we found that there was no strong positive correlation between citation parameters and Altmetric scores. Consequently, the high number of citations of scientific articles may not lead to the consideration that they will receive much interest in social media. There is no doubt that the number of citations of articles is widely used to measure the impact of journals and to assess the quality of authors' contributions. While the number of citations of articles may increase over the years, its popularity in social media may decrease in time. Researchers share their data, presentations and other scientific activities online more than ever.

There are remarkable aspects of this study. A period of time needs to pass to reach the number of citations that are frequently used to evaluate the quality of articles. One of the most interesting findings is that there is a negative correlation between the time elapsed after the publication of the article and the Altmetric score. This means that long periods are not required for the Altmetric score of the articles. Therefore, Altmetric scores may lead to the prominence of important articles in social media in a shorter period of time. Thanks to this, the effect of time-dependent bias can be reduced. One of the other findings was that only 11 of the top 20 cited articles are among the top 20 articles of most interest on social media (#2, #3, #5, #8, #11, #12, #13, #15, #16, #18, #20). Interestingly, the study conducted by Bang et al, having the highest ranking of citation, was ranked lower in terms of Altmetric score. Another finding was that articles published in journals with the highest IF received more attention than articles published in journals with lower IF in social media. Regarding two exceptional studies that attracted attention although the IF was lower, the study of "Japanese gastric cancer treatment guidelines 2014 (ver. 4)" conducted by the Japanese Gastric Cancer Association in the Gastric Cancer Journal evidently attracted more attention than that of "Benefit of adjuvant chemotherapy for resectable gastric cancer: a meta-analysis" published in JAMA conducted by "GASTRIC (Global Advanced/Adjuvant Stomach Tumor Research International Collaboration) Group's from a meta-analysis study" in the social media (#13, #24).

Laparoscopic approach in gastric cancer surgery has become popular in recent years. As a matter of fact, when the 2 guidelines published by the Japanese Gastric Cancer Association in 2011 and 2017 were examined, the advantages of laparoscopic method were mentioned in 2011 and it was stated that it was started to be applied. In the last guideline published in 2017, distal gastrectomy with laparoscopic approach was recommended for stage I gastric cancer. However, it is emphasized that data on long-term results are not yet available and studies are continuing [13,14]. The majority of studies have focused on chemotherapy regimens in advanced gastric cancers, and only 6 studies have investigated chemotherapy in operable gastric cancer, 3 studies of neo-adjuvant chemotherapy (#6, #16, #48) and 3 studies of adjuvant chemotherapy (#12, #24, #34). There have been three studies in the field of radiotherapy, all of which have been published in the Journal of Clinical Oncology, and are not in the top 10 list of citation or social media interest (#16, #34, #41). In the top 10 list of Altmetrics, 5 studies were in the field of chemotherapy and immunotherapy, 3 were related to molecular and genetic studies, and 2 were related to helicobacter pylori. Helicobacter pylori infection can lead to gastric ulcer and persistent gastric cancer [15] and is therefore considered one of the most important risk factors for gastric cancer [16]. With this feature, gastric cancer has become the most popular risk factor in social media.

Interestingly, although the only curative treatment of gastric cancer is surgery, only 4 of the 50 most cited articles are investigating the effectiveness of surgical intervention. Two of these studies were related to endoscopic submucosal dissection (ESD) and were published in 2009. They demonstrated that ESD is an effective and safe method in experienced centers for selected early stage gastric cancer [17,18]. These studies conducted only in the field of surgery have not received sufficient attention on social media. This shows us that in the last decade, there have been few new developments in terms of surgical technique, so that interest is focused more on non-surgical treatments. In the last decade, most studies in the field of molecular research and genetics have been conducted in the field of microRNA, with the majority (6 out of a total of 8 studies) conducted between 2009 and 2010. At the same time, these studies did not receive sufficient attention in social media. There may be a reason for the popularity of social media to coincide with the end of the 2000s when it was just beginning. Yet only 2 of the top 10 articles with the highest Altmetric score are from 2010 and older.

Limitations and strengths

This article has some limitations. In our study, we found the first 50 most frequently cited articles on gastric cancer and only examined the Altmetric

scores of these articles. The most popular publications on gastric cancer in social media have not been researched. Consequently, there may be studies that do not fall into this top 50 cited list but have received more attention in social media. Disproportional citations may consist of institutional or language bias, self-citation or strong human bias. We used only Altmetric.com data for social media interest. Altmetric company started collecting data since November 2011. Therefore, this may lead to misinterpretations, which means that older articles may have fewer Altmetric scores.

The addition of Altmetric scores and correlation analyses are one of strengths of this study. Furthermore, this trend topic study makes it possible to evaluate the classic articles with a novel point of view. We also minimized time bias by using ACpY.

Conclusion

In this study, bibliometric characteristics and social media attention of articles published in the field of gastric cancer were evaluated. It is relatively new for academic articles to gain interest in social media. To develop a more comprehensive approach to assessing research impact, Altmetrics should be combined with citation metrics. To the best of our knowledge this is the first study measuring online interest to the studies of gastric cancer using Altmetrics data and the times cited. The remarkable result of this study is that both the citation and Altmetrics scores of the articles provide important but different perspectives. Researchers should use social media more effectively in order to transmit valuable articles to the society and to raise awareness.

Authors' contributions

Both authors have made substantial contributions to the conception and design, acquisition, analysis and interpretation of the data in this study. Both have also been involved in drafting the manuscript or revising it critically for important intellectual content and have given final approval of the version to be published.

Ethical statement

Both authors declare that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects." This study did not need to be approved by an ethics committee because it performed a bibliometric analysis or citation analysis of existing published classical studies.

Conflict of interests

The authors declare no conflict of interests.

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