Comparison of Attention for Cancer Research on Social Media Versus Academia: An Altmetric Score Analysis

Emir CELIK[1], Mehmet DOKUR[2], Betul BORKU UYSAL[3], Nilay SENGUL SAMANCI[1], Fuat Hulusi DEMIRELLI[1]

[1] Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Department of Medical Oncology

[2] Biruni University Faculty of Medicine, Department of Emergency Medicine

[3] Biruni University Faculty of Medicine, Department of Internal Medicine, Istanbul, TURKEY

ABSTRACT

Background: Bibliometric and Altmetric analyses highlight key publications. The role of social media platforms in the promotion, dissemination and display of medical literature has improved greatly over the last few years. The hypothesis is that highly cited cancer articles would correlate positively with Altmetric attention scores (AAS). 'Cancer' as a search term was entered into Thomson Reuter's Web of Science database to identify all articles in the last decade. The 50 most cited articles were analysed by topic, journal, author, year, and AAS. By bibliometric criteria, eligible articles numbered 1,465,400 and the median (range) citation number was 3601.5 (2556-23725). The most cited article in the top 50 list was "Global cancer statistics'' published by Jemal A. et al. in 2011, while the highest AAS was published by Siegel RL.et.al., ''Cancer Statistics'', in 2017. New England Journal of Medicine published most articles (n= 14). Positive correlation was between average citations per year and AAS (r= 0.491 p< 0.01) but no correlation was found between citation number and AAS (r= 0.184 p= 0.2). Bibliometric and Altmetric analysis provide important but different perspectives regarding article impact. Our findings provide useful information on the dissemination of cancer research among the general public.

Keywords: Altmetric, Bibliometric, Cancer, Citation, Social media

ÖZET

Kanser Araştırmalarına Sosyal Medya ve Akademik Dünya İlgilerinin Karşılaştırılması: Altmetrik Skor Analizi

Bibliometrik ve altmetrik çalışmalar önemli yayınları analiz eder. Geçtiğimiz birkaç yılda sosyal medya ile medikal literatürün diseminasyonu, görüntülenmesi daha fazla oldu. Hipotezimiz daha çok atıf alan kanser makaleleri ile altmetrik skorlar arasında pozitif korelasyon olmasıdır. Thomson Reuter's Web of Science data tabanına 'kanser' araştırma terimi girilerek son 10 yılda yayımlanmış tüm makaleler belirlendi. En çok atıf alan 50 makale konu, dergi, yazar, yayımlanma yılı ve altmetrik skoruna göre analiz edildi. Bibliometrik kriterlerle uygun makale sayısı 1,465,400 idi ve median (aralık) atıf sayısı 3601.5 (2556-23725). Top 50 listesinde en çok atıf alan makale Jemal A. ve arkadaşları tarafından 2011'de yayımlanmış "Global cancer statistics" idi. En çok makale New England Journal of Medicine'de (n= 14) yayımlandı. Yıllık ortalama atıf sayısı ile altmetrik skor arasında pozitif korelasyon (r= 0.491 p< 0.01) olmasına rağmen toplam atıf sayısı ile altmetrik skor arasında korelasyon yoktu (r= 0,184 p= 0,2). Bibliometrik ve altmetrik analizler makalenin değeri ile ilgili önemli ama farklı yönde bilgi sağlar. Bulgularımız kanser makalelerinin genel toplumda nasıl ilgi gördüğü konusunda önemli bilgiler sağladı.

Anahtar Kelimeler: Altmetrik, Bibliometric, Kanser, Atıf, Sosyal medya

INTRODUCTION

Cancer is a group of diseases leading to an uncontrolled increase of abnormal cells that have the potential to invade or spread to other parts of the body. This is the second leading cause of death in the United States and a major public health problem worldwide. It is estimated that there are 1,735,350 new cancer cases in the US in 2018 and 609,640 people have died from cancer.[1] Every year, thousands of new articles about cancer, which is a very dynamic field, are added to the literature by researchers. There have been significant developments in recent years, such as immune checkpoint-inhibitors, that have changed standard treatments for cancer treatment.[2-4]

It is important for scientists to reach the most valuable studies not only in the field of cancer, but also in any field. Different indicators are used to measure the quality of scientific articles. Citation of a research article is one of the most important quality indicators. This measurement is precise, powerful and clear. Although we have traditionally measured the quality of the research article by the number of citations, it is not a sufficient indicator of quality in itself.[5] First of all, a certain period of time after the publication of scientific articles is required in order to increase the number of citations.[6] Therefore, the ability to evaluate the quality of scientific papers in real time is limited. The citation-based indicator used to measure the quality of journals is the impact factor (IF). The IF was first mentioned by Eugene Garfield in 1955 to provide a tool for assessing the citation performance of a journal.[7] The IF of a journal is calculated by dividing the number of citations in the current year by the sources published in that journal during the previous two years. IF was accepted as a quantitative indicator[8]; however, some researchers criticized the methods used to calculate IF and suggested that IF should be rejected as a guide to quality.[9] Another indicator used to measure journal quality is the journal H-Index provided by Web of Science (WoS), Scopus, Google Scholar, and Scimago Journal & Country Rank (SJCR).[10-12]

Most researchers use citation analysis (bibliometric analysis) to identify the most valuable publications in their field, such as oncology[13], otolaryngology[14] and neurology.[15] This approach was first applied to scientific journals by Eugene Garfield[16], founder of the Institute of Scientific Information in the 1970s. Citations measure only the impact on the scientific community, not the impact on other key stakeholders such as policy makers, patients and the public. The role of social media platforms in the promotion, dissemination and display of medical literature has improved greatly over the last few years. "Altmetric Attention Scores" (AASs) are metrics and qualitative data that are complementary to traditional, citation-based metrics. It measures the interactions of academics, scholars, and scientists as captured by reference management tools and social media such as Facebook, Twitter, LinkedIn, blogs, etc. In the current literature, there are few altmetric studies related to cancer.[17,18]

To our best knowledge, there is no prior study comparing the associations between traditional bibliometrics of publication recognition including citation count, journal H-index, and IF with AAS across the cancer literature. Our objective in this study was to determine the "key or classic papers" in the cancer literature of the last decade and to make correlation between these metrics in order to evaluate whether the influence and impact of the article are changeable measures. We hypothesize that AAS will have a stronger correlation with citation numbers.

MATERIALS AND METHODS

The term "cancer" was searched on the Thomson Reuters Web of Science citation-indexing database and research platform. Article publication years were filtered from 2009 to 2019 (last decade). The manuscripts, whose language is English and have full text, were sorted by number of citations; a method developed for the first time by Paladugu et al.[19] The 50 most cited articles were identified from numerous manuscripts identified. The dataset was further evaluated by examining titles, first authors, years of publication, study types and topics. The IF of 2018 was recorded for each journal in which the articles were published. AASs were obtained by downloading the ''Altmetric it'' function from the Altmetric.com website (https://www.altmetric.com/products/free-tools/bookmarklet/). The AAS

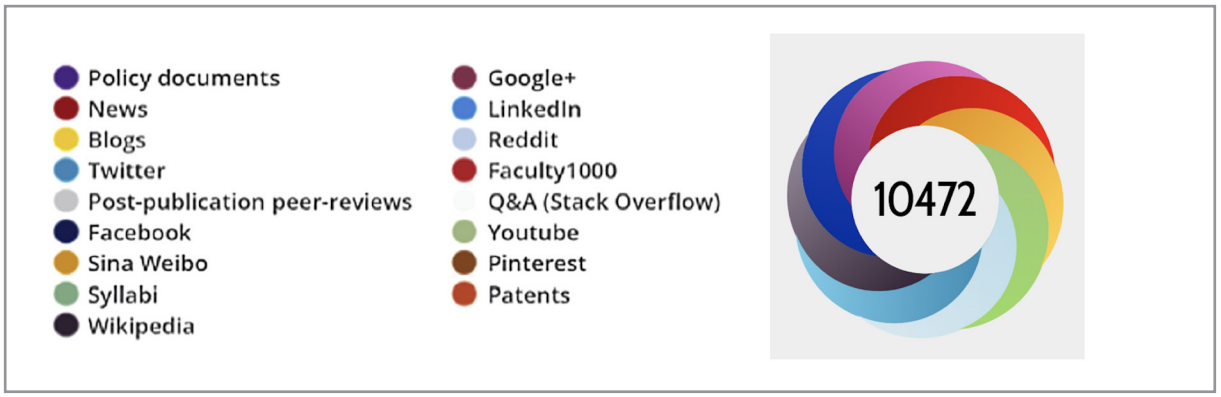


Figure 1. Altmetric donuts

is it is calculated automatically using an algorithm based on the weighted number of all the attention a research output receives. The score indicates the weighted number of the amount of attention Altmetric company has received for a research outcome. The default weight and how the AAS is calculated can be found on the altmetric website.[20] AAS is based on three main factors: volume, sources, and authors. Each color of the Altmetric donut represents a different source of interest (Figure 1).[21] AAS and Almetric donuts are designed to make it easier to determine how much and what kind of attention a particular research outcome has attracted.

Categorical variables were defined using percentages and continuous variables using median and interquartile intervals (IQRs). The data were not normally distributed, so the Kruskal-Wallis test was used to compare 3 or more groups. The Spearman correlation coefficient were used for assessing the correlation between AASs, citations, Average Citations per Year (ACpYs), post-publication year numbers, journal H indexes and IFs. Spearman correlation coefficient was interpreted according to (r) level; (r)< 0.19 very weak, (r)= 0.2-0.39 weak, (r)= 0.4-0.59 moderate, (r)= 0.6-0.79 strong and (r)> 0.8 very strong. p< 0.01 was considered statistically significant. The statistical analysis was performed using SPSS, version 21 (IBM Corporation).

Compliance with Ethical Standards

Ethical Statement: All authors declare that the research was conducted in accordance with 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 bibliometric and altmetric analysis of the currently published classical studies.

RESULTS

We found 1,465,400 articles on "cancer" published between 2009-2019 in the search of Web of Science. Table 1 includes the top cited 50 articles (T50 list) in the cancer literature; citation numbers, ACpYs, AASs. Times cited count range from 2556 to 23725. (#50 and #1 in Table 1). The median citation was 3601.5 (IQR 2942,25–8526,5). T50 list AASs ranked between 1709 and 7. (#14, #26). The median AAS was 167,5 (IQR 53,5–420,75). The most cited article in the T50 list (#1) was "Global cancer statistics" published by Jemal A. et al. in 2011, while the highest AAS (#14) was published by Siegel RL et. al, ''Cancer Statistics'', in 2017. Only two of the top 10 articles on the T50 list (#2, #9) were among the top 10 articles with the highest AASs. The median altmetric score of the top 10 AAS was 217 (IQR 61-375), while the median AAS of the top 10 most cited studies was 136 (IQR 31.5-265). According to Table 1, most articles in the T50 list (n= 11) were produced in 2010. T50 articles were published in 15 journals with the number of articles ranging from 1 to 14 per journal (Table 2). Most articles (n= 14) were published in the New England Journal of Medicine. While 13 articles were published in the CA-A

Table 1. Top 50 article by metrics (T50 list)

Rank	Title	Year	First Author	Times Cited	Average citations per year	Altmetric Score
1.	Global cancer statistics	2011	Jemal A.	23725	2636,11	183
2.	Hallmarks of cancer: the next generation	2011	Hanahan D	22687	2520,77	748
3.	Global cancer statistics, 2012	2015	Torre LA	13536	2707,2	165
4.	Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012	2015	Ferlay J	10917	2183,4	274
5.	Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008	2010	Ferlay J	10202	1020,2	101
6.	Cancer statistics, 2010	2010	Jemal A	10122	1012,2	55
7.	Cancer statistics, 2012	2012	Siegel R	10089	1261,12	126
8.	Cancer statistics, 2013	2013	Siegel R	9511	1358,71	205
9.	Cancer statistics, 2016	2016	Siegel RL	9506	862,72	1419
10.	New response evaluation criteria in solid tumours: revised RECIST guideline (version 1.1)	2009	Eisenhauer EA	9490	862,72	81
11.	Cancer statistics, 2014	2014	Siegel R	8819	1469,83	773
12.	Cancer statistics, 2015	2015	Siegel RL	8690	1738	338
13.	Cancer statistics, 2009	2009	Jemal A	8472	770,18	18
14.	Cancer Statistics, 2017	2017	Siegel RL	7057	2352,33	1709
15.	Safety, activity, and immune correlates of anti-PD-1 antibody in cancer	2012	Topalian SL	5653	706,62	257
16.	Cancer statistics in China, 2015	2016	Chen W	5238	1309,5	1380
17.	Understanding the Warburg effect: the metabolic re quirements of cell proliferation	2009	Vander Heiden MG	5064	460,36	273
18.	Comprehensive molecular portraits of human breast tumours	2012	Koboldt DC	4927	615,87	313
19.	Gefitinib or carboplatin-paclitaxel in pulmonary adenocarcinoma	2009	Mok TS	4900	445,45	48
20.	Immunity, inflammation, and cancer	2010	Grivennikov SI	4302	430,2	134
21.	The blockade of immune checkpoints in cancer immunotherapy	2012	Pardoll DM	4231	528,87	170
22.	Intratumor heterogeneity and branched evolution revealed by multiregion sequencing	2012	Gerlinger M	3827	478,37	370
23.	Revised American Thyroid Association management guidelines for patients with thyroid nodules and differentiated thyroid cancer.	2009	Cooper DS	3795	345	58
24.	The cBio cancer genomics portal: an open platform for exploring multidimensional cancer genomics data.	2012	Cerami E	3737	467,12	34
25.	Safety and activity of anti-PD-L1 antibody in patients with advanced cancer	2012	Brahmer JR	3631	453,87	155
26.	The American Joint Committee on Cancer: the 7th edition of the AJCC cancer staging manual and the future of TNM	2010	Edge SB	3572	357,2	7
27.	Reduced lung-cancer mortality with low-dose computed tomographic screening	2011	Aberle DR	3525	391,66	1501
28.	Effects of radiotherapy with concomitant and adjuvant temozolomide versus radiotherapy alone on survival in glioblastoma in a randomised phase III study: 5-year analysis of the EORTC-NCIC trial	2009	Stupp R	3428	311,63	87
29.	Comprehensive molecular characterization of human colon and rectal cancer.	2012	Muzny DM	3387	423,37	178
30.	Integrative analysis of complex cancer genomics and clinical profiles using the cBioPortal	2013	Gao J	3267	466,71	35
31.	Cancer statistics, 2018	2018	Siegel RL	3168	1584	1576
32.	Cancer genome landscapes	2013	Vogelstein B	3125	446,42	250
33.	Gefitinib or chemotherapy for non-small-cell lung cancer with mutated EGFR	2010	Maemondo M	3073	307,3	32

Table 1. Top 50 article by metrics (T50 list) (*Continued*)

Rank	Title	Year	First Author	Times Cited	Average citations per year	Altmetric Score
34.	Integrated genomic analyses of ovarian carcinoma	2011	Bell D	3072	341,33	75
35.	Integrated genomic analysis identifies clinically relevant subtypes of glioblastoma characterized by abnormalities in PDGFRA, IDH1, EGFR, and NF1.	2010	Verhaak RG	3044	304,4	48
36.	Early palliative care for patients with metastatic non-small-cell lung cancer	2010	Temel JS	3039	303,9	1310
37.	Cancer statistics, 2011: the impact of eliminating socio-economic and racial disparities on premature cancer deaths	2011	Siegel R	3012	334,66	65
38.	Nivolumab versus Docetaxel in Advanced Squamous-Cell Non-Small-Cell Lung Cancer	2015	Brahmer J	2954	738,5	399
39.	Anaplastic lymphoma kinase inhibition in non-small-cell lung cancer	2010	Kwak EL	2907	290,7	78
40.	Nivolumab versus Docetaxel in Advanced Nonsquamous Non-Small-Cell Lung Cancer	2015	Borghaei H	2892	578,4	513
41.	Sipuleucel-T immunotherapy for castration-resistant prostate cancer	2010	Kantoff PW	2854	285,4	146
42.	Signatures of mutational processes in human cancer	2013	Alexandrov LB	2849	407	526
43.	Erlotinib versus standard chemotherapy as first-line treatment for European patients with advanced EGFR mutation-positive non-small-cell lung cancer (EURTAC): a multicentre, open-label, randomised phase 3 trial	2012	Rosell R	2802	350,25	30
44.	Efficacy and safety of sorafenib in patients in the Asia-Pacific region with advanced hepatocellular carcinoma: a phase III randomised, double-blind, placebo-controlled trial	2009	Cheng AL	2781	252,81	28
45.	Long non-coding RNA HOTAIR reprograms chromatin state to promote cancer metastasis	2010	Gupta RA	2779	277,9	25
46.	Human papillomavirus and survival of patients with oropharyngeal cancer	2010	Ang KK	2769	276,9	49
47.	Cancer incidence and mortality patterns in Europe: estimates for 40 countries in 2012	2013	Ferlay J	2754	393,42	486
48.	FOLFIRINOX versus gemcitabine for metastatic pancreatic cancer	2011	Conroy T	2752	305,77	229
49.	Final version of 2009 AJCC melanoma staging and classification	2009	Balch CM	2723	247,54	32
50.	PD-1 Blockade in Tumors with Mismatch-Repair Deficiency	2015	Le DT	2556	511,2	815

Cancer Journal with the highest IF, we found that 5 articles were published in Nature, with the highest H-index. The Scimago Journal and Country Rank category of all journals was Q1. The publication language was English for all articles.

Approximately half of the articles in the T50 list (n= 23) were original article, while 21 articles were review (Table 3). There are 11 articles in the randomized controlled clinical (RCT) trial category, which has the highest level of evidence. Of the 11 RCTs, three were studies investigating Tyrosine Kinase Inhibitor (TKI) efficacy in Non-Small Cell Lung Cancer (NSCLC), two were investigating the efficacy of Nivolumab (anti PD-1) in NSCLC and one was investigating the effect of early palliative treatment on the quality of life in diagnosis of NSCLC. Other RCTs were studies comparing temozolomide addition to radiotherapy in glioblastoma, the efficacy of Sipuleucel-T vaccine in prostate cancer, the role of sorafenib in the treatment of hepatocellular cancer, comparing gemcitabine

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

Journal name	Number of articles	IF*	Q category**	H Index**
New England Journal of Medicine	14	70,67	Q1	933
CA-A Cancer Journal for Clinicians	13	223,67	Q1	144
Nature	5	43,07	Q1	1096
Lancet Oncology	3	35,38	Q1	274
Cell	2	36,21	Q1	705
European Journal of Cancer	2	6,68	Q1	193
International Journal of Cancer	2	4,98	Q1	212
Science	2	41,03	Q1	1058
Annals of Surgical Oncology	1	3,68	Q1	155
Cancer Cell	1	23,91	Q1	295
Cancer Discovery	1	26,37	Q1	119
Journal of Clinical Oncology	1	28,24	Q1	494
Nature Reviews Cancer	1	51,84	Q1	396
Science Signaling	1	6,48	Q1	134
Thyroid	1	7,78	Q1	126

* IF: Impact Factor, 2018 Journal Citation Reports, Web of Science Group, 2019
** 2019 Scimago Journal and Country Rank

and FOLFIRINOX in the treatment of metastatic pancreatic cancer. An editorial type (#26) and a retrospective analysis (#46) were also in the T50 list. We found that the number of median AASs and citations was 155 (IQR 48-399) and 3428 (IQR 2907-4900) for original articles, 170 (IQR 51-649) and 4927 (IQR 3098-9797) for reviews, and 165 (IQR 57-357) and 2769 (IQR 2753-8274) for guidelines and advisory documents, respectively. Neither AASs (p = 0.933) nor citation numbers (p= 0.112) showed statistically significant difference to study types.

Sixteen articles in the T50 list were epidemiological studies examining the statistical data of cancer. The median citation number of these epidemiological studies was 9162 (IQR 5693-10182), while the median AAS was 239 (IQR 107-1228). 4 of the top 5 articles with the highest number of citations, and 4 of the top 5 articles with the highest AAS were studies of statistics on cancer (Table 1). The most common subjects were ''treatment'' (n= 16) and ''cancer statistics'' (n= 16) followed by ''cancer genomics'' (n= 8) (Table 4). According to the article topics, when citation numbers were compared within the group, while it was determined that

Table 3. Study types

Type-Subtype	Number of articles	AAS, median (IQR)	p value	Citations, median (IQR)	p value
All article	50	167 (53–421)		3601 (2942–8526)	
Original scientific paper	23	155 (48-399)		3428 (2907-4900)	
Randomised controlled clinical trial	11				
Basic science research	7				
Non-randomised clinical trial	4		p = 0.933		p = 0.112
Case-control study	1				
Review	21	170 (51-649)		4927 (3098-9797)	
Guidelines and advisory documents	5	165 (57-357)		2769 (2753-8274)	
Editorial	1	273 (NA)		5064 (NA)	

Abbreviations: AAS, Altmetric Attention Score; NA, not applicable; IQR; interquartile range.

Table 4. Top-50 cited articles according to subject categories

Article Topic	Number of articles	AAS, median (IQR)	p value	Citations, median (IQR)	p value
All articles	**50**	167 (53–421)		3601 (2942–8526)	
Treatment	**16**	150 (50-363)		2996 (2815-3754)	
Immune Check-point Inhibitors	6				
Anti PD-1	4				
Anti PD-L1	1				
Anti-CTLA4, Anti PD-L1 and Anti PD-1	1		p= 0.052		p= 0.002
Tyrosine Kinase Inhibitor (NSCLC)	4				
Gefitinib	2				
Erlotinib	1				
Crizotinib	1				
Tyhroid nodules and cancer	1				
Temozolomide (glioblastom)	1				
Sipuleucel-T (prostate cancer)	1				
Sorafenib (HCC)	1				
Chemotherapy (pancreatic cancer)	1				
Palliative care (NSCLC)	1				
Cancer statics	**16**	239 (107-1228)		9162 (5693-10182)	
Cancer genomics	**8**	61 (34-297)		3098 (2898-3619)	
The cBio Cancer Genomics Portal	2				
Somatic mutations in breast cancer	1				
Cancer Genome Landscapes	1				
Ovarian cancer	1				
Glioblastoma (GBM)	1				
Mutational processes underlying the development of cancer	1				
HOTAIR expression and cancer metastasis	1				
Molecular oncology	**5**	273 (156-559)		4302 (3607-13875)	
Complex biology of cancer	1				
Aerobic glycolsis (The Warburg Effect)	1				
Effects of inflammation and immunity on tumor development	1				
Intratumor heterogeneity	1				
Molecular characterization of colorectal cancer	1				
Cancer staging	**3**	32 (7-NA)		3572 (2723-3572)	
TNM	2				
RECIST	1				
HPV effects on oropharyngeal cancer prognosis	**1**	49 (NA)		2769 (NA)	
Lung cancer screening	**1**	1501 (NA)		3525 (NA)	

Abbreviations: AAS= Altmetric Attention Score; IQR= interquartile range; NSCLC= Non-Small Cell Lung Cancer; HCC= Hepatocellular Cancer; TNM= Tumor, Node, Metastasis; RECIST= Response Evaluation Criteria In Solid Tumors; NA= not applicable.

the articles in the ''cancer statistics'' category received significantly more citations than those in the ''treatment'' category (p= 0.002), there was no significant difference in the other group comparisons. AAS did not show a significant difference between the groups according to article topics (p= 0.052).

The correlation between AAS, citation parameters, IF and H-index is shown in Table 5. We found that the correlation between AAS and citation, which we considered as the primary objective before the study, was not significant (r= 0.184 p= 0.200), but there was a moderate positively correlation between AAS and ACpY (r= 0.491 p< 0.001) (Figure 2). While AAS correlated poorly with IF, a strong negative correlation was found between AAS and number of years since publication (r= -0.667, p<

Table 5. Correlation analysis

		Citation number	Number of years since publication	Average citations per year	Impact factor	H-index
Altmetric score	r	0,184	-0,667**	0,491**	0,376**	0,089
	p	0,200	< 0,001	< 0,001	0,007	0,538
Citation number	r	-	-0,124	0,805**	0,248	-0,466**
	p	-	0,392	< 0,001	0,082	0,001
Number of years since publication	r	-	-	-0,582**	-0,372**	0,174
	p	-	-	< 0,001	0,008	0,228
Average citations per year	r	-	-	-	0,390**	-0,465**
	p	-	-	-	0,005	0,001
Impact factor	r	-	-	-	-	-0,186
	p	-	-	-	-	0,196

** Correlation is significant at the 0.01 level

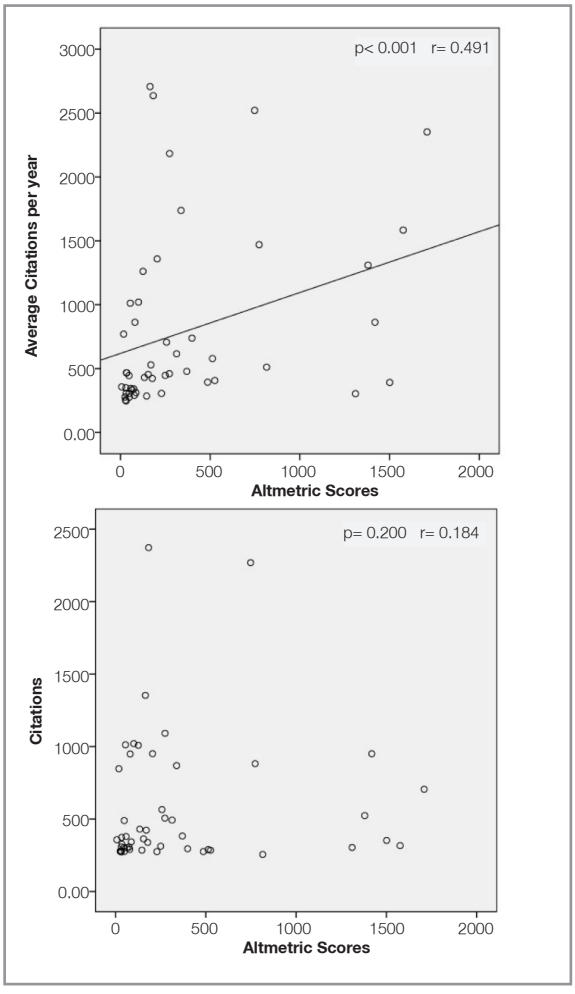


Figure 2. The relationship between Altmetric score and number of citations or average citations per year

0.001). One of the unexpected findings worth mentioning in the correlation analysis is that the journal H-index shows a statistically significant negative correlation with both the citation number and ACpY. There was no correlation between citation number and IF, while weak positive correlation was found between citation number and ACpY. There was no correlation between IFs and H-indexes of the journals in which the trend articles (T50 list) of the recent cancer literature were published.

DISCUSSION

According to WHO data, cancer is the second leading cause of death globally and is responsible for an estimated 9.6 million deaths in 2018. Worldwide, approximately 1 in 6 deaths is caused by cancer. Awareness and early diagnosis are crucial for the fight against cancer. Significant advances have been made in the diagnosis and treatment of cancer in recent years and thousands of new articles on cancer are added to the literature every year. Therefore, it has become important to measure the value and impact of these researches and to identify more valuable topics (trend topics). Due to the greater use of online social media by scientists, the general public, scientific journals and academic research institutes, Altmetric, which measures the online impact of an article, is becoming more increasingly more precious.[22,23] Contrary to the hy-

pothesis when designing the study, it is surprising that the top 50 articles in the cancer literature are not parallel to the interest in social media and the interest in the scientific community. In contrast to other citation classic articles in the field.[24-26], this analysis considers both traditional citation metrics and AASs to capture the impact of cancer-related research on the realm of social and traditional news media. To our best knowledge, this is the first study to provide an in-depth statistical analysis of the relationship between Altmetrics and traditional bibliometrics of this scale in the cancer literature.

The previous study by Barbic and colleagues analyzed the top 50 cited emergency medicine articles with the highest Altmetric scores without any publication year restrictions.[27] AAS was found between 25-0 in this study. A similar study was conducted by Powell et al. using keyword surgery, and the first 50 articles with the highest AASs were 53-0.[28] In our study, AAS ranged between 1709-7 and we found that there was no correlation between the number of citations and AASs. The range of AAS is wide, this is because the T50 list does not receive similarly high interest in social media. However, in the last decade, some articles in the cancer literature have received similarly high interest both in the academic world and in the general public. According to the results of our study, epidemiological studies investigating the prevalence of cancer and the cause of death have received high interest both in the academic community and social media. Since Altmetric.com has been collecting data for the last 8 years, it is expected that articles published in earlier years will have a relatively lower AAS.

Both Barbic et al. and Powell et al. did not set a time limit in their altmetric scoring studies. Therefore, the median AAS of the articles in their lists was considerably lower than in our study. Therefore, although we know that there are articles in the cancer literature that have been published in the early years and have received high citation, we have compared the citation and AAS based on the last decade of cancer literature. This allowed us to compare the AAS in our study and obtain a more accurate result. Moreover, although we only analyzed the last decade, we found a strong negative correlation between the "AAS" of the T50 article and "the number of years since publication". This means that articles published in the cancer literature in the last few years have received more attention in social media. The increase in the number of social media users all over the world in recent years may explain this situation.

Half of the articles in the T50 list in our study were published in non-oncology journals. This shows that general medical journals are also very interested in articles about cancer. The IF of the journal in Table 2 is in the range of 3.68-223.67 and 86% of the T50 list was published in IF 23.91 and above. The first two journals with the highest IF, "CA-A Cancer Journal for Clinicians" and "New England Journal of Medicine", published 27 articles. As a result, it can be said that the trend topic articles about cancer have been published in prestigious and frequently read medical journals. Looking at the study types (Table 3), we found that more than half of the articles in the T50 list had the lowest level of evidence according to the SIGN 50 criteria.[29] Although epidemiological review studies involving cancer statistics are of low level of evidence, they are frequently cited in the academic community, and in the last decade, statistical studies in cancer literature have become a trend topic. This is actually expected, as there are epidemiological data on cancer in the introduction of almost every article. In addition, cancer news and how deadly it is an interesting issue in the community and is receiving high interest in social media.

We identified 16 articles on the T50 list that examined cancer treatment. In particular, clinical trials investigating immune check-point inhibitors (ICPI) and the efficacy of tyrosine kinase inhibitor in NSCLC were the prominent studies. James P. Allison and Tasuku Honjo were awarded the Nobel Prize in Medicine for their research into immune check-point blockade. ICPI can be considered as an immunotherapy modality that has begun a new era in cancer treatment and this is a new trend.[30-32] The T50 list includes 13 articles on cancer genomics and molecular oncology. These basic science studies, which are very important in understanding carcinogenesis and determining effective treatment targets, have received high interest in academia and general society. "The Warburg Effect" (#17), described by Otto Warburg in the early 20th century, explains how cancer cells use aerobic glycolysis as

a source of their energy rather than oxidative phosphorylation, a more effective process of cellular respiration.[33] He won the Nobel Prize for this work in 1931. The identification of this phenomenon has led to the development of the positron emission tomography (PET) scan, which is nowadays widely used in the evaluation of diagnosis, staging and treatment response in cancer patients.[34]

Since the "times cited" term used to determine article quality needs a long time to reach its true value, indicators are needed to measure article quality in a shorter period of time. This latent time is not required for the formation of AASs. However, ''AAS'' and ''times cited'' are not interchangeable parameters. AAS is useful when looking at several outputs together to quickly determine the level of online activity that surrounds a particular research output, so it is not a measure of the quality of the research or researcher. Altmetric.com recommends to click on the donut to view the details page, and all of the original mentions because attention can be both positive and negative. The mentions considering the score should be completely transparent and completely visible on the Altmetric details page. The use of AAS, as well as the existing traditional measures, will provide a different understanding of how far the research has spread. Therefore, it is necessary to use and interpret AAS carefully. To provide a more rounded picture of the impact of the article, AAS should be used in conjunction with IF, H-index, number of downloads, and citations. Altmetric.com is still relatively new in the scientific field, so it is difficult to assess the real impact. Further research is needed to determine the real impact of AAS on citations and whether AAS can actually predict citations over time.

CONCLUSION

This study provides a detailed list of 50 most cited cancer articles and social media interest using the Altmetric.com database. Our findings provide useful information on the dissemination of cancer research among the general public.

REFERENCES

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2018. CA Cancer J Clin 68: 7-30, 2018.
2. Pham T, Roth S, Kong J, et al. An update on Immunotherapy for Solid Tumors: A Review. Ann Surg Oncol 25: 3404-3412, 2018.
3. Lee JK, Priceman SJ. Precision Medicine-Enabled Cancer Immunotherapy. Cancer Treat Res 178: 189-205, 2019.
4. Velcheti V, Schalper K. Basic Overview of Current Immunotherapy Approaches in Cancer. Am Soc Clin Oncol Educ Book 35: 298-308, 2016.
5. William G. Social signals reflect academic impact: What it means when a scholar adds a paper to mendeley. Inf Stand Q 25: 33-39, 2013.
6. Priem J, Piwowar HA, Hemminger BM. Altmetrics in the wild: Using social media to explore scholarly impact. Ar Xiv 1203: 4745, 2012
7. Garfield E. Citation indexes for science; a new dimension in documentation through association of ideas. Science 122: 108-111, 1955.
8. Garfield E. Journal impact factor: a brief review. CMAJ 161: 979-980, 1999.
9. Hansson S. Impact factor as a misleading tool in evaluation of medical journals [published correction appears in Lancet 1995 Oct 28; 346 (8983): 1172. Lancet 346: 906, 1995.
10. Tibor B, Wolfgang G, András S. A Hirsch-type index for journals. Scientometrics 69: 169-173, 2006.
11. Anne-Wil H, Ron Van DW. A Google Scholar h-index for journals: An alternative metric to measure journal impact in economics and business. J Am Soc Inf Sci and Technol 60: 41-46, 2009.
12. H-Index Portals. SCImago, (n.d.). SJR– SCImago Journal & Country Rank [Portal]. Retrieved November 8, 2019, from http://www.scimagojr.com
13. Wrafter PF, Connelly TM, Khan J, et al. The 100 most influential manuscripts in colorectal cancer: A bibliometric analysis. Surgeon 14: 327-336, 2016.
14. Saunders TFC, Rymer BC, McNamara KJ. A global bibliometric analysis of otolaryngology: Head and neck surgery literature. Clin Otolaryngol 42: 1338-1342, 2017.
15. Kim Y, Yoon DY, Kim JE, et al. Citation Classics in Stroke: The Top-100 Cited Articles on Hemorrhagic Stroke. Eur Neurol 78: 210-216, 2017.
16. Garfield E. Citation indexing for studying science. Nature 227: 669-671, 1970.
17. Hassona Y, Qutachi T, Dardas L, et al. The online attention to oral cancer research: An Altmetric analysis. Oral Dis 25:1502-1510, 2019.

18. Haneef R, Ravaud P, Baron G, et al. Factors associated with online media attention to research: a cohort study of articles evaluating cancer treatments. Res Integr Peer Rev 2: 9, 2017.

19. Paladugu R, Schein M, Gardezi S, Wise L. One hundred citation classics in general surgical journals. World J Surg 260: 1099-1105, 2002.

20. AAS Calculation on altmetric website. https://help.altmetric.com/support/solutions/articles/6000060969-how-is-the-altmetric-attention-score-calculated (Access date: 08/11/2019)

21. Altmetric donut colors. https://www.altmetric.com/about-our-data/the-donut-and-score/ (Access date: 08/11/2019)

22. Elmore SA. The Altmetric Attention Score: What does it mean and Why should I care?. Toxicol Pathol 46: 252–255, 2018.

23. Kim Y, Kim JE, Kim YH, et al. Social attention and scientific articles on stroke: Altmetric analysis of top-50 articles. Clin Neurol Neurosurg 183: 105386, 2019.

24. Zhang Y, Quan L, Du L. The 100 top-cited studies in cancer immunotherapy. Artif Cells Nanomed Biotechnol 47: 2282-2292, 2019.

25. Wrafter PF, Connelly TM, Khan J, et al. The 100 most influential manuscripts in colorectal cancer: A bibliometric analysis. Surgeon 14: 327-336, 2016.

26. Jin B, Wu XA, Du SD. Top 100 most frequently cited papers in liver cancer: a bibliometric analysis. ANZ J Surg 90: 21-26, 2020.

27. Barbic D, Tubman M, Lam H, Barbic S. An Analysis of Altmetrics in Emergency Medicine. Acad Emerg Med 23: 251-268, 2016.

28. Powell AGMT, Bevan V, Brown C, Lewis WG. Altmetric Versus Bibliometric Perspective Regarding Publication Impact and Force. World J Surg 42: 2745-2756, 2018.

29. Scottish Intercollegiate Guidelines Network; SIGN 50 (in: A Guideline developer's handbook Re, November 2011), Healthcare Improvement Scotland. Healthcare Improvement Scotland. Available from https://www.sign.ac.uk/assets/sign50_2011.pdf (Access date: April 19, 2019).

30. Philips GK, Atkins M. Therapeutic uses of anti-PD-1 and anti-PD-L1 antibodies. Int Immunol 27: 39-46, 2015.

31. Suzuki S, Ishida T, Yoshikawa K, Ueda R. Current status of immunotherapy. Jpn J Clin Oncol 46: 191-203, 2016.

32. Singh S, Hassan D, Aldawsari HM, et al. Immune checkpoint inhibitors: a promising anticancer therapy. Drug Discov Today 25: 223-229, 2020.

33. Warburg O. On the origin of cancer cells. Science 123: 309-314, 1956.

34. Mankoff DA, Bellon JR. Positron-emission tomographic imaging of cancer: glucose metabolism and beyond. Semin Radiat Oncol 11: 16-27, 2001.

Correspondence:

Dr. Emir CELIK
Istanbul Universitesi-Cerrahpasa
Cerrahpasa Tip Fakultesi Yerleskesi
Kocamustafapasa Cd. No: 53
Cerrahpasa 34098 Fatih
ISTANBUL / TURKEY

Tel: (+90-212) 414 30 00
(+90-505) 557 70 42
Fax: (+90-212) 633 29 37
e-mail: emircelikk@gmail.com

ORCIDs:

Emir CELIK:	*0000-0001-8440-3082*
Mehmet DOKUR:	*0000-0003-2119-3801*
Betul Borku UYSAL:	*0000-0001-9192-5024*
Nilay Sengul SAMANCI:	*0000-0003-4966-3561*
Fuat Hulusi DEMIRELLI:	*0000-0002-3096-4308*