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A social attention with altmetric score analysis on the relationship between oxidative stress and cancer

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Abstract

Oxidative stress has a crucial role in the development of various cancers. The aim of our study was to identify and analyze research articles about oxidative stress and cancer that have attracted the highest online attention. Our study is the first one evaluating social media attention to the articles on cancer and oxidative stress published in academic literature. Altmetric Explorer was used to identify research articles about oxidative stress and cancer. We evaluated the top 50 research articles having the highest Altmetric attention scores (AAS), using the Altmetric.com database. The Altmetric Attention Score (AAS) of 50 articles (T50) investigated was between 15 and 445 (mean±SD; 60.66±86.18). The social media platforms where the T50 articles are mentioned from highest to the lowest scores are the Facebook (n=2678) followed by Twitter (n=886) and Google + users (n=214). According to demographic breakdowns in Twitter, tweet counts were similar between scientists (34%) and not scientists (32%). Total citations of the 50 articles ranged from 3 to 3700 (mean ± SE; 203.40±87.07). A weak statistically significant positive correlation was found between the Altmetric score and the Q category (r=0.338: p=0.016). Interestingly, there was no correlation between Altmetric score and number of article citations. The increasing use of online social media platforms makes this area worthy, and the online impact of an article is becoming progressively more convenient for academic and public accessibility. Social media also may give oppurtunity to the researchers for disseminating their studies in scholar and non-scholar platforms.

Keywords: Oxidative stress, cancer, altmetric analyze, social media,twitter

Introduction

Normal human cells generate free radicals, during aerobic respiration in the mitochondria, and incompletely reduced oxygen generates reactive oxygen species (ROS) including superoxide and hydrogen peroxide [1]. It has been shown that isolated mitochondria from tissues produces ROS corresponding to the 2-5% of the total oxygen respired. Oxidative stress due to overproduction of ROS causes damage to DNA, proteins and lipids [2]. Overproduction of free radicals "reactive oxygen/nitrogen/chlorine species" causing oxidative stress is associated with the development of numerous age-related diseases, degeneratif pathologies and cancer development [3].

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Although the term ''oxidative stress'' is used regularly in the 1970s, its conceptual source can be outlined in the mid-1950s as the researchers have discovered toxic effects of molecular oxygen forming free radicals causing oxidative damage to tissues and leading to cancer develepment [4,5]. Oxidative stress can be described as an imbalance between the production of ROS, and their removal by protective mechanisms namely by antioxidants [6,7]. This imbalance stimulates the damage of cell's overall structure and membranes that are mainly composed of DNA, lipids, and proteins, which may promote to cancer development [8].

Every year, hundreds of new publications about cancer are introduced to the literature by researchers, since cancer research is a very active field [9].

Altmetric attention score, is stated as the frequency of sharing scientific articles on social media platforms such as Facebook,

Twitter, LinkedIn, blogs, posts, various social media platforms. Each citation received for a published study further increases the impact value of the published article indicating the publication's contribution to science. Nonetheless, generally there is not a correlation between Altmetric scores and citation times of the publications [10]. Altmetric scores give us an opportunity to evaluate the association between altmetric scores and citation status of the publications. Dimension badges are used in altmetric systems (Figure 1). The Dimension badge platform gives information about grants, patents, scientific outputs, policy documents, and altmetric information of published articles [11].

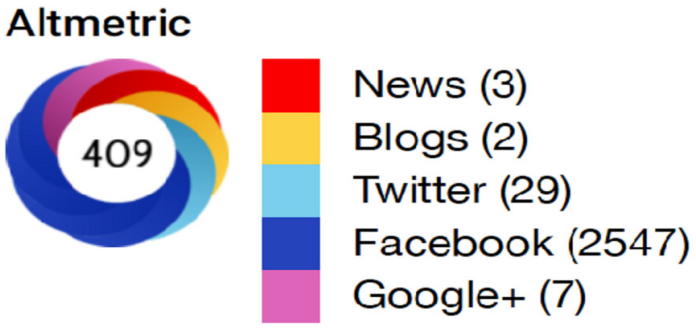

Figure 1. Altmetric donut

The purpose of our study is to draw attention of the scientists and researchers to our study as a reference for future studies by assesing the top 50 research articles with the highest Altmetric attention scores on oxidative stress and cancer giving altmetric, dimension badges, geographical breakdown, mentioned by demographical breakdown and research categories with respect to the data acquired from the site "altmetric.com".

Materials and Methods

Study Design: Altmetric score analysis

Level of evidence: Level III (according to SIGN50) [12].

We obtained Altmetric Explorer (accessed January, 2021) utilizing two keywords: "Oxidative stress, cancer". System tracks more than 10 million orginal research articles. We searched 1023 articles and included the top 50 research articles with the highest Altmetric attention scores (T50). Scottish Intercollegiate Guidelines Network (SIGN50, 2019) was utilized for source data on the level of evidence. The datas were assessed by analyzing the titles, first authors, Journal names, publication years, main subjects, dimension badges, SIGN50 (level of evidence), mentioned by twiter demographics, research categories, impact factors (IF), H index and Q category of journals.

Altmetric Score and Statistical Analyses

We used web-based application Altmetric Explorer (Altmetric, London, UK) in our study. Altmetric score analyzes were acquired the from the Altmetric.com website. An altmetric score is calculated utilizing an algorithm depending on the weighted number of all attention on research output gets. The comparisons of altmetric and dimention badge values according to the months were made with the Kruskal Wallis test and the post hoc tests were made with the Dunn test. As descriptive statistics, mean ± standart error, mean±standard deviation for numerical variables, min-max numbers and % values for categorical variables are given. Spearman correlation coefficients calculated and detected linear relationship between numerical variables. Beta coefficients were estimated using univariate linear regression analysis. All statistical analysis were performed using SPSS for windows version 23.0. $P<0.05$ was considered as statistically significant.

Results

We found 1022 articles on ''oxidative stress-cancer'' in our search of Altmetric.com. T50 articles were published between 2006-2020. Table 1 containes the top 50 research articles with the highest Altmetric attention scores (T50 list) about oxidative stress and cancer in the literature; published year, first author, dimensional badge total citations, recent citations and altmetric score.

Total citations of the 50 articles ranged from 3 to 3700 (mean ± SE; 203.40±87.07) and recent citations of the 50 articles ranged from 1 to 745 (mean ± SE;59.42±19). The majority of the articles in the T50 list were published in 2018 (n=9, Table 1).

T50 articles were published in 39 different journals. 5 articles were published in Cancer Cell Journal, which has the highest H index value (316 H index) and 2 articles were published in Cancer Discovery journal with the highest IF of 29.497. 76% of articles (n=38) were published in Q1 journals, followed by Q2 (n=10), Q3 journals (n=1) and Q4 (n=1) Journals (Table 2).

Distribution of main subjects of T50 articles were examined in terms of their level of evidence (SIGN50) (Table 3). As shown in Table 3, 12 articles were not about a specific type of cancer, but they were about generally on ''oxidative stress-cancer'' as the main subject. 5 of the articles on this main subject have Level 2, and 7 of them have Level 4 evidence score. 33 of T50 articles are at Level 2 evidence score and 17 of T50 articles are at Level 4 evidence score.

Figure 2 shows the top three social media platforms where the articles are mentioned. According to Figure 2A,B,C; articles are mentioned most in Facebook (n=2583), followed by Twitter (n=90) and Facebook (n=31) again. The social media platforms where the articles are mentioned mostly is the Facebook (n=2678) followed by Twitter (n=886) and then Google+ User (n=214). (Figure 2D). At least, averagely 70 blogging and social media posts were searched for each article.

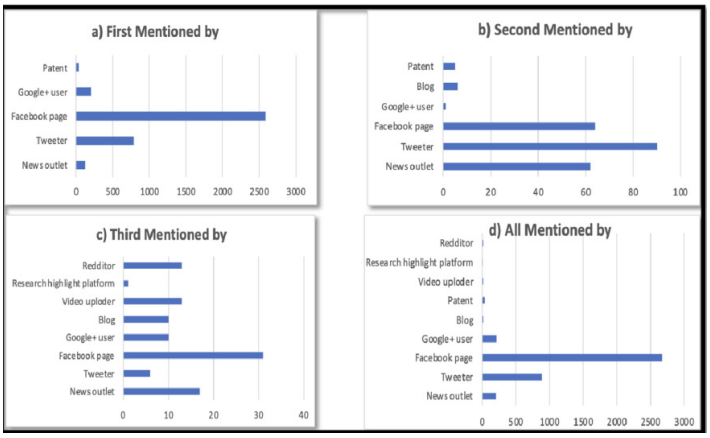

Figure 2. Social media platforms where the T50 articles are mentioned

Figure 3 A,B,C,D shows the top three (first, second, third) and all research categories for each article. According to Figure 3A, the first research category of articles is ‘’Medical and Health Science’’, the second research category of articles is ‘’Oncology and Carcinogenesis’’ and the third one is ‘’Biochemistry and Cell Biology’’. The research categories of 40 articles was ‘’Medical and Health Science’’.

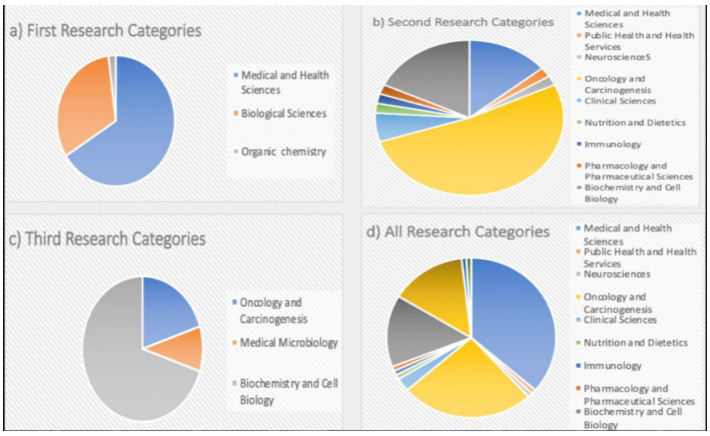

Figure 3. Research categories of the T50 articles

In Figure 4 and Figure 5, Twitter geographical breakdown and Twitter demographical breakdown are shown. The datas were collected from the profiles of Twitters who shared these articles. Twitter demographic and Twitter geographical breakdown of the articles were categorized as the first, second and third according to the number of shares on Twitter. According to Figure 4A, the first Twitter demographic breakdown shows that member of public tweets more than scientists and practitioners, but then second Twitter demographic breakdown shows that tweeting is made mostly by scientists (Figure 4B), the third group is mostly practitioners (doctors and other healthcare professionals) (Figure 4C). The first Twitter geographical breakdown as shown in Figure 5A, demonstrates that United States is the country where most of social media posts have been done in the World. The second Twitter geographical breakdown tweets are written mostly from United Kingdom (n=179), similar to all Twitter geographical breakdowns (Figure 4B,D).

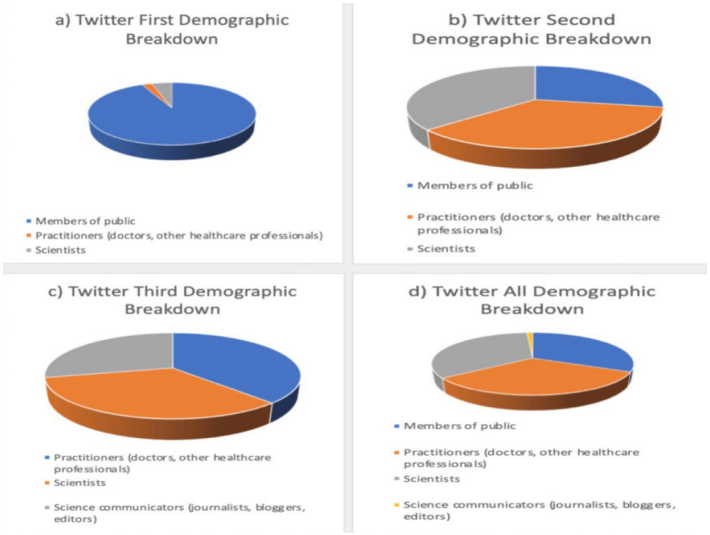

Figure 4. Twitter demographical breakdowns of the T50 articles

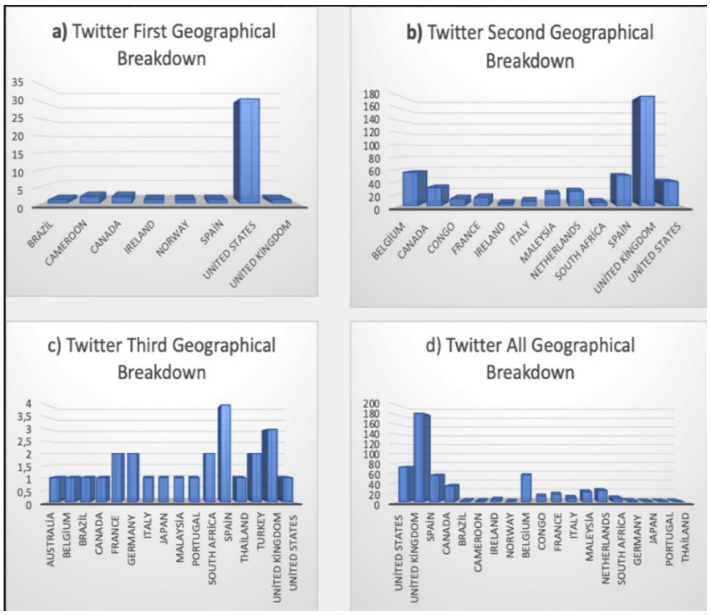

Figure 5. Twitter geographical breakdowns of the T50 articles

A very strong statistically significant positive correlation was found between total citations and recent citations (r=0.932: p=0.001) (Figure 6). According to univariate linear regression analysis, 87% of variation in total citations score was explained by Recent citations. 1 unit increase in recent citations resulted in 4.27 increase in total citations score. Total citations score was estimated using the formula.

$$Y_{\text{Total Citations Score}} = -50.4+4.27*X_{\text{Recent Citations Score}}$$

A weak statistically significant positive correlation was found between the Altmetric score and the Q category (r=0.338: p=0.016). It was unexpected that there was no correlation between Altmetric score and number of citations. There was statistically significant moderate positive correlation between impact factor (IF) and H index (r=0.567, p=0.001), but a strong negative correlation between IF and Q category was found (r=-0.714, p=0.001). A moderate negative correlation was observed between the H index and the Q category (p<0.05).

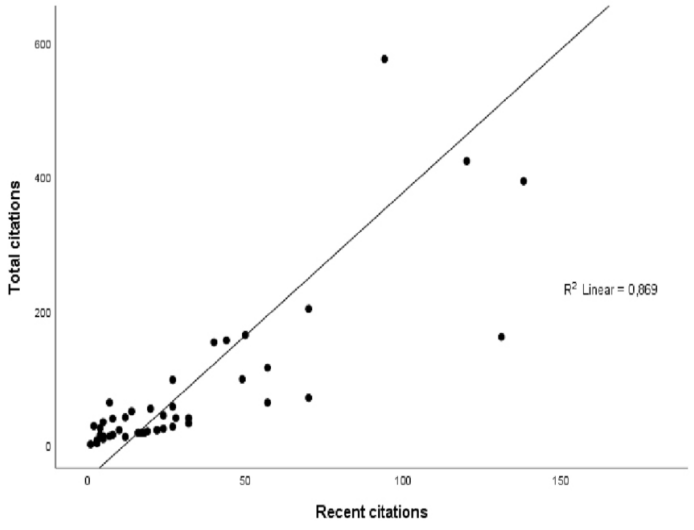

Figure 6. Total citations Score & Recent citations score scater plot

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

Rank	Title	Year	First Author	Total Citation	Recent Citation	Altmetric Score
1	Grape seed extract targets mitochondrial electron transport chain complex III and induces oxidative and metabolic stress leading to cytoprotective autophagy and apoptotic death in human head and neck cancer cells	2014	Sangeeta Shrotriya	13	7	445
2	Induction of Apoptosis by the Medium-Chain Length Fatty Acid Lauric Acid in Colon Cancer Cells due to Induction of Oxidative Stress	2013	J.K. Fauser	54	20	409
3	2.45-Gz wireless devices induce oxidative stress and proliferation through cytosolic Ca 2+ influx in human leukemia cancer cells	2012	Mustafa Nazıroğlu	28	2	220
4	Oxidative stress, inflammation, and cancer: How are they linked?	2010	Simone Reuter	2400	745	150
5	Ionizing radiation-induced metabolic oxidative stress and prolonged cell injury	2012	Edouard I. Azzam	562	234	144
6	Chronic Inflammation and Oxidative Stress as a Major Cause of Age- Related Diseases and Cancer	2009	Nemat Khansari	423	120	120
7	Cancer Cells Co-opt the Neuronal Redox-Sensing Channel TRPA1 to Promote Oxidative-Stress Tolerance	2018	Nobuaki Takahashi	63	57	118
8	Targeting Oxidative Stress in Embryonal Rhabdomyosarcoma	2013	Xiang Chen	156	44	77
9	Intestinal Bacteria Modify Lymphoma Incidence and Latency by Affecting Systemic Inflammatory State, Oxidative Stress, and Leukocyte Genotoxicity	2013	Mitsuko L. Yamamoto	41	12	77
10	Cannabis sativa L. and Nonpsychoactive Cannabinoids: Their Chemistry and Role against Oxidative Stress, Inflammation, and Cancer	2018	Federica Pellati	70	70	74
11	Activation of Oxidative Stress Response in Cancer Generates a Druggable Dependency on Exogenous Non-essential Amino Acids	2020	Sarah E. LeBoeuf	27	27	68
12	Multi-stage Differentiation Defines Melanoma Subtypes with Di!erential Vulnerability to Drug- Induced Iron-Dependent Oxidative Stress	2018	Jennifer Tsoi	164	50	66
13	Adverse outcome pathways for ionizing radiation and breast cancer involve direct and indirect DNA damage, oxidative stress, inflammation, genomic instability, and interaction with hormonal regulation of the breast	2020	Jessica S. Helm	3	3	60
14	IL-6 controls resistance to radiation by suppressing oxidative stress via the Nrf2-antioxidant pathway in oral squamous cell carcinoma	2016	Yuichiro Matsuoka	40	28	57
15	Endostatin inhibits androgen-independent prostate cancer growth by suppressing nuclear receptor-mediated oxidative stress	2017	Joo Hy-oung Lee	9	5	56
16	Nutrition Education Intervention for Women With Breast Cancer: Elect on Nutritional Factors and Oxidative Stress	2015	Cecilia C. Schiavon	15	4	55
17	Skeletal muscle atrophy and dysfunction in breast cancer patients: role for chemotherapy-derived oxidant stress	2018	Blas A. Guigni	22	22	50
18	Oxidative Stress and Skin Diseases: Possible Role of Physical Activity	2014	Joanna Kruk	57	27	45
19	Exercise training reverses cancer-induced oxidative stress and decrease in muscle COPS2/TRIP15/ALIEN	2020	Christiano R.R. Alves	3	3	35
20	Dietary polyunsaturated fatty acids and heme iron induce oxidative stress biomarkers and a cancer promoting environment in the colon of rats	2015	Françoise Guéraud	3	3	35
21	Effects of Broccoli Intake on Markers Related to Oxidative Stress and Cancer Risk in Healthy Smokers and Nonsmokers	2009	Patrizia Riso	39	8	35
22	Effects of Lactobacillus strains on cancer cell proliferation and oxidative stress in vitro	2006	S.S. Choi,	153	40	33
23	Ketogenic Diets Enhance Oxidative Stress and Radio-Chemo-Therapy Responses in Lung Cancer Xenografts	2013	Bryan G. Allen	97	27	33
24	Free radicals, metals and antioxidants in oxidative stress-induced cancer	2006	M. Valko	3200	598	33

25	PGC1α Expression Defines a Subset of Human Melanoma Tumors with Increased Mitochondrial Capacity and Resistance to Oxidative Stress	2013	Francisca Vazquez	393	138	31
26	Targeting the Metabolic Response to Statin-Mediated Oxidative Stress Produces a Synergistic Antitumor Response	2019	Grace H. McGregor	18	18	31
27	LIPG-promoted lipid storage mediates adaptation to oxidative stress in breast cancer	2019	Cristina Cadenas	12	12	29
28	Oxidative Stress in Cancer	2020	John D. Hayes	24	24	29
29	Oxidative stress and dietary phytochemicals: Role in cancer chemoprevention and treatment	2018	Shireen Chikara	161	131	28
30	Comparative E!ects of Two Di!erent Forms of Selenium on Oxidative Stress Biomarkers in Healthy Men: A Randomized Clinical Trial	2014	John P. Richie	34	5	27
31	Molecular Analysis of BRCA1 in Human Breast Cancer Cells Under Oxidative Stress	2017	Brian L. Gilmore	7	3	27
32	Serum deprivation initiates adaptation and survival to oxidative stress in prostate cancer cells	2020	ElShaddai Z. White	1	1	24
33	Mitochondrial control of apoptosis through modulation of cardiolipin oxidation in hepatocellular carcinoma: A novel link between oxidative stress and cancer	2017	Huiqin Zhong	44	24	23
34	Autophagy-independent induction of LC3B through oxidative stress reveals its non-canonical role in anoikis of ovarian cancer cells	2018	Eswara Murali Satyavarapu	18	17	20
35	Colorectal Tumors Require NUAK1 for Protection from Oxidative Stress	2018	Jennifer Port	18	16	20
36	Polyphenols as Modulator of Oxidative Stress in Cancer Disease: New Therapeutic Strategies	2016	Anna Maria Mileo	115	57	20
37	Pectin Oligosaccharides Ameliorate Colon Cancer by Regulating Oxidative Stress- and Inflammation-Activated Signaling Pathways	2018	Haidong Tan	22	22	19
38	Grape seed proanthocyanidines and skin cancer prevention: Inhibition of oxidative stress and protection of immune system	2008	Santosh K. Katiyar	63	7	19
39	Levothyroxine and lung cancer in females: the importance of oxidative stress	2013	Umberto Cornelli	5	3	18
40	Chronic inflammation and oxidative stress in human carcinogenesis	2007	Alessandro Federico	575	94	17
41	Transketolase counteracts oxidative stress to drive cancer development	2016	Iris Ming-Jing Xu	98	49	16
42	Nicotine and oxidative stress induced exomic variations are concordant and overrepresented in cancer-associated genes	2014	Jasmin H. Bavarva	25	4	16
43	Molecular Mechanisms Involved in the Antitumor Activity of Cannabinoids on Gliomas: Role for Oxidative Stress	2010	Paola Massi	15	8	16
44	Effects of a multimodal rehabilitation programme on inflammation and oxidative stress in oesophageal cancer survivors: the ReStOre feasibility study	2016	Emer M Guinan	22	10	16
45	mTOR and HDAC Inhibitors Converge on the TXNIP/Thioredoxin Pathway to Cause Catastrophic Oxidative Stress and Regression of RAS-Driven Tumors	2017	Clare F. Malone	40	32	16
46	Oxidative Stress and Cancer	2019	James E. Klaunig	32	32	16
47	Cytochrome P450 2E1 (CYP2E1) regulates the response to oxidative stress and migration of breast cancer cells	2013	Travis Leung	50	14	16
48	GLUT1 protects prostate cancer cells from glucose deprivation-induced oxidative stress	2018	Pedro Gonzalez	20	19	15
49	Intake of dietary antioxidants is inversely associated with biomarkers of oxidative stress among men with prostate cancer	2015	Terrence M. Vance	13	5	15
50	Oxidative Stress and Its Significant Roles in Neurodegenerative Diseases and Cancer	2014	Raynoo Thanan	203	70	15

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

Journal name	Number of articles	IF*	Q category**	H index**
Cancer Cell	5	26.602	Q1	316
Free Radical Biology & Medicine	3	6.17	Q1	254
Scientific Reports	2	3.998	Q1	179
International Journal of Cancer	2	5.145	Q1	225
Cancer Research	2	9.130	Q1	434
Cancer Letters	2	7.360	Q1	172
Cancer Discovery	2	29.497	Q1	138
Supportive Care in Cancer	1	2.698	Q2	105
Reproductive Biology and Endocrinology	1	3.235	Q1	83
Redox Biology	1	9.986	Q1	73
Recent Patents on Inflammation & Allergy Drug Discovery	1	2.070	Q3	24
Proceedings of the National Academy of Sciences of the United States of America	1	9.412	Q1	737
Oxidative Medicine & Cellular Longetivity	1	4.580	Q1	79
Oncotarget	1	5.168	Q1	108
Nutrition and Cancer	1	2.322	Q2	122
Molecular Nutrition & Food Research	1	4.653	Q1	122
Molecular Metabolism	1	6.448	Q1	52
Molecular Carcinogenesis	1	3.825	Q2	94
Letters in Applied Microbiology	1	2.173	Q2	104
Journal of Nutrition Education and Behavior	1	2.520	Q2	77
International Journal of Radiation Biology	1	2.368	Q2	90
International Journal of Molecular Sciences	1	4.556	Q1	140
Frontiers in immunology	1	6.43	Q1	102
FASEB Journal	1	4.966	Q1	267
Current Pharmaceutical Design	1	2.412	Q2	149
Clinical Cancer Research	1	10.107	Q1	310
Chemotherapy	1	1.29	Q2	52
Chemico-Biological Interactions	1	20.57	Q1	244
Cell Death & Disease	1	5.91	Q1	96
Cancers	1	6.126	Q1	64
Cancer Prevention Research	1	4.02	Q1	87
British Journal of Nutrition.	1	4.02	Q1	178
British Journal of Cancer	1	3.334	Q1	224
Breast Cancer Research	1	5.79	Q1	140
BioMed Research International	1	4.99	Q2	109
Asian Pacific Journal of Cancer Prevention	1	2.583	Q4	70
Archives of Toxicology	1	2.52	Q1	103
American Journal of Physiology: Cell Physiology	1	5.98	Q2	174

* IF: Impact Factor. 2018 Journal Citation Reports. Web of Science Group. 2019
**2020 Scimago Journal and Country Rank

Table 3. Classification of the 50 most cited articles according to main subjects and level of evidence*

Main subject	Level 2	Level 4	Total (n=)
Oxidative Stress-Cancer			
Oxidative stress- Breast cancer	4	1	5
Oxidative Stress – Prostate cancer	4		4
Oxidative Stress- Colon Cancer	1	1	2
Oxidative stress- Inflammation and cancer		2	2
Oxidative Stress- Skin cancer		2	2
Oxidative Stress- Lung Cancer	2		2
Oxidative stress- Human head and neck cancer cells	1		1
Oxidative stress- Human leukemia cancer cells	1		1
Metabolic oxidative stress - Prolonged cell injury		1	1
Oxidative Stress- Embryonal Rhabdomyosarcoma	1		1
Iron-Dependent Oxidative Stress-Melanoma Subtypes	1		1
Oxidative stress- Oral squamous cell carcinoma	1		1
Nuclear receptor- Mediated oxidative stress- prostate cancer	1		1
Chemotherapy derived oxidant stress- Cancer patients	1		1
Heme iron- Oxidative stress-cancer	1		1
Oxidative Stress- Squamous cell carcinoma	1		1
Oxidative stress- Cancer cell proliferation	1		1
Oxidative stress- Melanoma Tumors	1		1
Statin-Mediated Oxidative Stress- Synergistic Antitumor Response		1	1
Oxidative stress- Hepatocellular carcinoma	1		1
Oxidative stress- Anoikis of ovarian cancer cells	1		1
Oxidative stress- Colorectal tumors	1		1
Oxidative stress and Chronic inflammation- Human carcinogenesis		1	1
Oxidative stress- Cancer-associated genes	1		1
Oxidative stress- Antitumors		1	1
Oxidative stress- Oesophageal cancer	1		1
Catastrophic oxidative stress and- RAS-driven tumors	1		1
Total	33	17	50

Table 4. Correlation analysis

		Total citations	Recent citations	Impact Factor(IF)	H INDEX	Q CATEGORY
Altmetric score	r	0.164	0.123	-0.064	0.079	0.338
	p	0.255	0.396	0.659	0.583	0.016
Total citations	r	1	0.932	0.067	0.188	0.055
	p		0.001	0.643	0.192	0.705
Recent citations	r		1	0.229	0.267	-0.009
	p			0.110	0.061	0.948
Impact Factor(IF)	r			1	0.567	-0.714
	p				0.001	0.001
H INDEX	r				1	-0.464
						0.001

r was obtained from Pearson or Spearman rank correlation coefficient, n=50

Discussion

Unlike bibliometric article evaluation system based on citations given in Web of Science, altmetric scoring system, also known as the alternative article evaluation system, is social attention based. The Altmetric attention score is an automatically calculated, weighted count of all of the social attention for a research output received. The score of a publication rises as more people mention by social media and multimedia platforms (Publons, Pubpeer, Wikipedia, Open Syllabus Project, patent offices, blogs, Twitter, Linked In, Google+, Sina Weibo and Pinterest, YouTube, Reddit) of it [13,14].

The Altmetric study by Celik et al. investigated the top 50 cited cancer articles with the highest Altmetric scores. Altmetric score was found between 7-1709 in this publication [8].

Another altmetric study was performed by Hassona et al. about oral cancer and they reported altmetric score between 21-1307 [15]. In our research, we found altmetric score between 15-445 and there was no correlation between altmetric score and total citations. Altmetric score rises with negative and positive comments on social media. Nevertheless, articles with the highest total citations may not attract much attention on social media because of their content [16]. In our study, the article with the highest altmetric score has only 20 total citations. On the other hand, the article with 3.2k citations ranks 24th in the altmetric score order.

Impact factors are related to the total citations for a given journal in a specific year and H-index evaluates both the productivity and citation impact of the publications of a scientist or scholar. These two indexes provide important evaluation tools to appraise the quality of research output [17,18,19].

The levels of evidence are key factors for evidence based medicine and provide guide for researchers [20]. In our study, only level 2 and level 4 evidence levels were found (according to SIGN 50). This may be due to the fact that more controlled trial and review articles on oxidative stress-cancer have been published.

We noticed that the most mentioned social media platforms of the articles in our study are Facebook, Twitter and Google+user, respectively. Facebook reported to have 2.38 billion monthly active users and 1.56 billion daily active users as of March 31, 2019 [21]. Nearly 330 million averaged monthly active users are reported on Twitter in 2017 [22]. Thus, it is an expected situation for T50 articles to be mentioned on these social media platforms. In another altmetric study of Maggio et al., Twitter and Facebook were the second and third most popular social media platforms [23].

When we look at the research categories of our T50 articles, most of them are in the category of "Medicine and Health Sciences", "Oncology and Carcinogenesis", "Biochemistry and Cell Biology" and ‘’Biology Science’’.

An altmetric study also offers us the geographic breakdown and profiles of Twitter users by categorizing them as Twitter demographics [24]. Twitter demographic distribution of our T50 articles consists of scientists, practitioners (doctors, other healthcare professionals) and public people. There has been a change in the past few years, showing increased numbers of scholars paying attention to social media like members of public [25]. According to a 2014 Nature poll, 13% of scientists use Twitter, while an analysis published in PLoS One in 2017 indicated that over 45.000 scientists have accounts. Between 2015 and 2020, the number of social media users in the UK increased, reaching about 48.6 million users in 2020 [26], and the total number of Twitter users in the UK is 15.25 million [27]. Twitter is particularly popular in the United States, where the microblogging site had 69.3 million users as of January 2021, while Spain has 7.5 million Twitter users as of 2021 [28].

Furthermore, 16% of the articles that attracked attention in our T50 articles were related to chronic inflamation and oxidative stress cause cancer development. 10% of the articles (n=%) were about oxidative stress and breast cancer and 8% of the articles were about prostate cancer and oxidative stress. 12% of the T50 articles focused on anti-oxidant nutritional factors that reduce oxidative stress and fights aganist to cancer progress. Unlike the remaining ones, in two of T50 articles, it was reported that oxidative stress kills cancer cells. In these articles, statins and cannabinoids were shown having anti-tumoral activity to induce oxidative stress.

Conclusion

Our study evaluated social media attention for the first time about cancer and oxidative stress searching academic literature. Social media is proposed as an alternative to conventional power structures in science and research [29]. Given the increasing use of online social media platform metrics that measure online impact of an article is novel and becoming progressively more convenient [14]. Social media is dramatically changing traditional academic healthcare conversations [30] and it is proposed as a secondary chance for articles that might not have been accepted in high-impact journals [24]. Proper strategies may give oppurtunity to researchers for disseminating their studies in scholar and non-scholar platforms.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
The research was carried out in conformity with the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" by all authors of this scientific work. This study did not require ethical approval because it was an altmetric analysis of currently published classical studies.

References

1. Droge, W. Free radicals in the physiological control of cell function. Physiology Review, 2002;82:47-95.
2. Hanikoglu F, Hanikoglu A, Kucuksayan E.et al. Dynamic thiol/disulphide homeostasis before and after radical prostatectomy in patients with prostate cancer. Free Radic Res. 2016;50:79-84.
3. Eruslanov E, Kusmartsev S. Identification of ROS using oxidized DCFDA and flow-cytometry. Methods Mol Biol. 2010;594,57-72.
4. Gerschman R, Gilbert DL, Nye SW, Fenn WO. Influence of X-Irradiation on Oxygen Poisoning in Mice. Proc Soc Exp Bio Med. 1954;86:27-9 .
5. Haman D. Aging: a theory based on free radical and radiation chemistry. J Gerontol. 1956;11:298-300.
6. Ďuračková Z. Some current insights into oxidative stress. Physiol Res. 2010;59:459-69.

7. Schraufstätter I, Hyslop PA, Jackson JH, Cochrane CG. Oxidant-induced DNA damage of target cells. J Clin Invest. 1988;82:40-50.
8. Khandrika L, Kumar B, Koul S, et al. Oxidative stress in prostate cancer. Cancer Lett. 2009;18:125-36.
9. Celik E, Dokur M, Borku Uysal et al. Comparison of attention for cancer research on social media versus academia: an Altmetric Score Analysis. 2020.
10. Borku Uysal, B Islamoglu MS, Koc S. et al. Most notable 100 articles of COVID-19: an Altmetric study based on bibliometric analysis. Ir J Med Sci, 2021.
11. Hook DW, Porter SJ, Herzog C. Dimensions: Building Context for Search and Evaluation. Front. Res. Metr. Anal. 2018;3:23.
12. SIGN50 a Guideline developer's handbook https://www.sign.ac.uk/assets/sign50_2015.pdf Access date 2021;18-4.
13. https://www.altmetric.com/about-altmetrics/what-are-altmetrics/ Access date: 18.04.2021
14. Olmeda-Gómez C, Perianes-Rodríguez, A. Altmetrics as a research specialty (Dimensions, 2005-2018). Profesional de La Informacion, 28;2019.
15. Hassona Y, Qutachi T, Dardas L, at al. The online attention to oral cancer research: An Altmetric analysis. Oral Dis. 2019;25:1502–10.
16. Powell A, Bevan V, Brown C, Lewis WG. Altmetric versus bibliometric perspective regarding publication impact and force. World J Surg 2018;42:2745-56.
17. Bornmann L, Mutz R, Daniel, HD. Do We Need the h Index and Its Variants in Addition to Standard Bibliometric Measures?. J American Soc Infor Sci Technology. 2009;60;1286–89.
18. Bornmann L, Daniel HD. What do we know about h index? Journal of the American Society for Information Science and Technology, 2007; 58:1381-85.
19. Hui J, Wang L, Liu R, et al. A bibliometric analysis of international publication trends in premature ejaculation research (2008–2018). Int J Impot Res 2021;33:86–95.
20. Burns PB, Rohrich RJ, Chung KC. The levels of evidence and their role in evidence-based medicine. Plast Reconstr Surg, 2011;128:305-10.
21. Appel G, Grewal L, Hadi R. et al. The future of social media in marketing. J Acad Mark Sci. 2020;48:79–95.
22. Sujay R, Pujari J, Shreenivas VB, Dixit A. Timeline Analysis of Twitter User. Procedia Computer Science, 2018;132:157-66.
23. Maggio LA, Meyer HS, Artino AR Jr. Beyond Citation Rates: A Real-Time Impact Analysis of Health Professions Education Research Using Altmetrics. Acad Med. 2017;92:1449-55.
24. The Altmetric Detail Pages https://www.altmetric.com/about-our-data/altmetric-details-page/ access date 20.04.2021
25. Quintana DS. Twitter for Scientists [eBook edition], 2020
26. Forecast of social network user numbers in the United Kingdom (UK) from 2015 to 2025 https://www.statista.com/statistics/553530/predicted-number-of-social-network-users-in-the-united-kingdom-uk/ access date 23.04.2021.
27. Twitter by the numbers: Stats, demographics & Fun Facts https://www.omnicoreagency.com/twitter-statistics/ access date 23.04.2021
28. Countries with the most Twitter users 2021 https://www.statista.com/statistics/242606/number-of-active-twitter-users-in-selected-countries access date 24.04.2021.
29. Wetsman, N. How Twitter is changing medical research. Nat Med. 2020;26:11–3.
30. Choo EK, Ranney ML, Chan TM, et al. Twitter as a tool for communication and knowledge exchange in academic medicine: A guide for skeptics and Novices, Med Teacher. 2015;37:411-6.