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The story behind Oncotarget? A bibliometric analysis

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Abstract
Being the most proliferative journal of oncology a cancer research of the past decade, the Open Access journal Oncotarget had reached more than 20,000 publications and a relatively high impact factor score in the past years. In 2018, the journal citation report decided to withdraw the status of an impact factor journal. Since there was a large discussion in the scientific community and specific reasons for the withdrawal were not stated, this bibliometric analysis was performed to assess if Oncotarget exhibits any differences in its bibliometric structure compared to other journals. For this purpose, we used the "New Quality and Quantity Indices in Sciences" platform and analyzed 20,000 Oncotarget articles. Density equalizing mapping technique helps to construct maps of cancer research in Oncotarget and shows that it has led to a unique global landscape which is not asymmetrically dominated by the Western hemisphere but exhibits a publishing architecture with a pronounced emphasis on Chinese articles.

Keywords Oncotarget · Network · Bibliometry · Architecture · Structure

Introduction

The following quotation by Andrew V. Schally, member of the Editorial Board of Oncotarget, *Nobel Prize in Physiology or Medicine, 1977,* is used as a central element of the main homepage of the journal Oncotarget: "Oncotarget is an outstanding and most important journal in the field of oncology and cancer research. Oncotarget is performing an extremely useful function for those of us working not only in cancer research, but also on other important topics in the field of medicine. Oncotarget deserves a strong support from investigators working in the area of oncology as well as from NIH." (Oncotarget 2018a, b) Having been established in 2010, the open access journal Oncotarget has

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since increased its publication output dramatically. As defined by the journal, the term *"Oncotarget"* encompasses all molecules, pathways, and cellular processes common in cancer and aging, which include neurodegeneration, atherosclerosis, lymphocytes, neurons, cancer cells and microbes." The journal aims to publish "research papers in cancer research and oncology (primary focus). Due to the complexity of tumor development and integrity of the human organism, *Oncotarget* also publishes papers in the fields of endocrinology, pathology, age-related diseases, physiology, and immunology." (Oncotarget 2018a, b) As cited by the journal, the MEDLINE stated on 6/22/2017 "This journal continues to play a major role in the publication of important basic science research papers. Editorial practices are consistently high. Ethical guidelines are consistently followed. This is an important research journal for the field." (Oncotarget 2017) However, Oncotarget was delisted from the Medline in 2017 (Zimmer 2017). That database Medline belongs to the U.S. National Library of Medicine, which gave no explanation as to why Oncotarget was removed. The journal was also excluded from the Journal Citation Reports (JCR) and the Web of Science's Science Citation Index Expanded (SCIE) by Clarivate Analytics in 2018. As a result, there will not be a Journal Impact Factor (JIF) issued by the JCR in 2018. This led to the following statement of Oncotarget: "We remain perplexed by their abrupt decision not to include *Oncotarget* in the master list of journals for 2018 without provided advanced notice or clear grounds. We are actively working to understand and rectify the situation." The journal also tells that "Oncotarget will continue to be indexed in PMC and PubMed. We have successfully completed the transition from Medline/PubMed indexing to PMC/PubMed indexing, which enables us to archive the full text of articles. All articles rapidly appear in PMC and PubMed" (Oncotarget 2018a, b). Reasons for the exclusion by Clarivate were not exactly stated (RetractionWatch).

Since it can be assumed that the authors of about 10,000 scientific articles recently published by Oncotarget and the thousands of authors with manuscripts in submission want to know about potential details, we here submitted Oncotarget articles published until 2017 to a descriptive bibliometric analysis in order to assess if there are any non-common findings.

Methods

NewQIS platform

This study is part of the "New Quality and Quantity Indices in Science" (NewQIS) project that was established in 2007-9 at the Charité School of Medicine in Berlin, Humboldt University and Free University Berlin (Groneberg-Kloft et al. 2009a, b). NewQIS is a computed platform that combines classic bibliometric approaches with visualizing techniques. It has been used for numerous purposes so far including the assessment of global research activities in specific diseases (Bruggmann et al. 2017a, b, Gotting et al. 2017), fields of medicine (Groneberg-Kloft et al. 2008a, b; Groneberg-Kloft et al. 2009), medical techniques (Bruggmann et al. 2015), or public health issues (Vitzthum et al. 2010; Groneberg-Kloft et al. 2013; Schreiber et al. 2016). NewQIS can also be used to study single journals (Scutaru et al. 2010). Since the methodology is formalized and highly structured, all NewQIS studies share a high degree of homogeneity in the methods sections and methodology discussion sections.

Data source and time span

For the present study, data was retrieved from the Web of Science (Clarivate) (Sevinc 2004, 2005) as previously described (Koster et al. 2016; Bruggmann et al. 2017). The time span for the current analysis was 2010–2017 until the amount of 20,000 publications has been reached.

Search strategies

All published articles of the journal "ONCOTARGET" were included in the analysis. There were no additional filters applied.

Analysis parameters

For countries with at least 30 published items in "ONCOTARGET", the average citation per published article was calculated, as previously described. Also, a modified h-index was calculated to the analyze articles originating from a specific country (Bruggmann et al. 2016; Groneberg et al. 2016).

In order to assess the international network of collaborations, a bilateral cooperation between two countries was defined when at least one author originated from one country and at least one other author from a second country. A matrix with all participant countries was computed within the NewQIS platform as previously described (Groneberg et al. 2015, 2016). The thickness of the vectors quantifies the number of cooperation articles between the two countries. A visualization threshold of at least eight cooperation articles between the countries was set in order to improve the readability.

Density-equalizing mapping projections

Density-equalizing mapping projections (DEMP) were used as described in previous studies (Bruggmann et al. 2016). In brief, the country territories were re-sized according to the particular variable of interest, i.e. the number of published items of single countries in "ONCOTARGET", or the total citations of single countries. For the re-sizing procedure the area of each country, calculations were based on Gastner and Newman's algorithm (Gastner and Newman 2004).

Results

Countries' number of published items in Oncotarget

The number of published items was used as an index of quantity of publishing productivity. In total, a number of 21,961 articles (n) was published by Oncotarget included in the database of the Web of Science until now. We set our evaluation time frame from 2010 until the overall amount of 20,000 articles was published in December 2017.

In the country-specific analysis, China was found to be the most proliferative nation with a total of 9163 articles. The United States were in second place with $n = 5929$,

followed by Italy ($n=1435$), Germany ($n=1242$) and South Korea ($n=1057$). Then the United Kingdom had $n=929$ articles, followed by Taiwan ($n=804$), France ($n=746$), and Japan ($n=733$) (Fig. 1a). Density-equalizing mapping was then used to illustrate the global proportions of publication activity of each country in Oncotarget by territorial resizing. As evident from the total article analysis, it is obvious that the cartogram is dominated by China, followed by the US. Together, both countries participated in about 16,000 articles from the total of 20,000 articles. This is about 80% of all articles.

Development of publication output over time

Since 2010 (the first year listed in WoS) with $n=90$ a strong increase each year until it reaches a number of 8075 articles in 2017 could be stated (Fig. 1b).

Interestingly, there is a time-evolution of the percentage of Chinese articles present in Oncotarget. In 2010, there were 5 from the overall 90 articles of Chinese origin (5.55%)

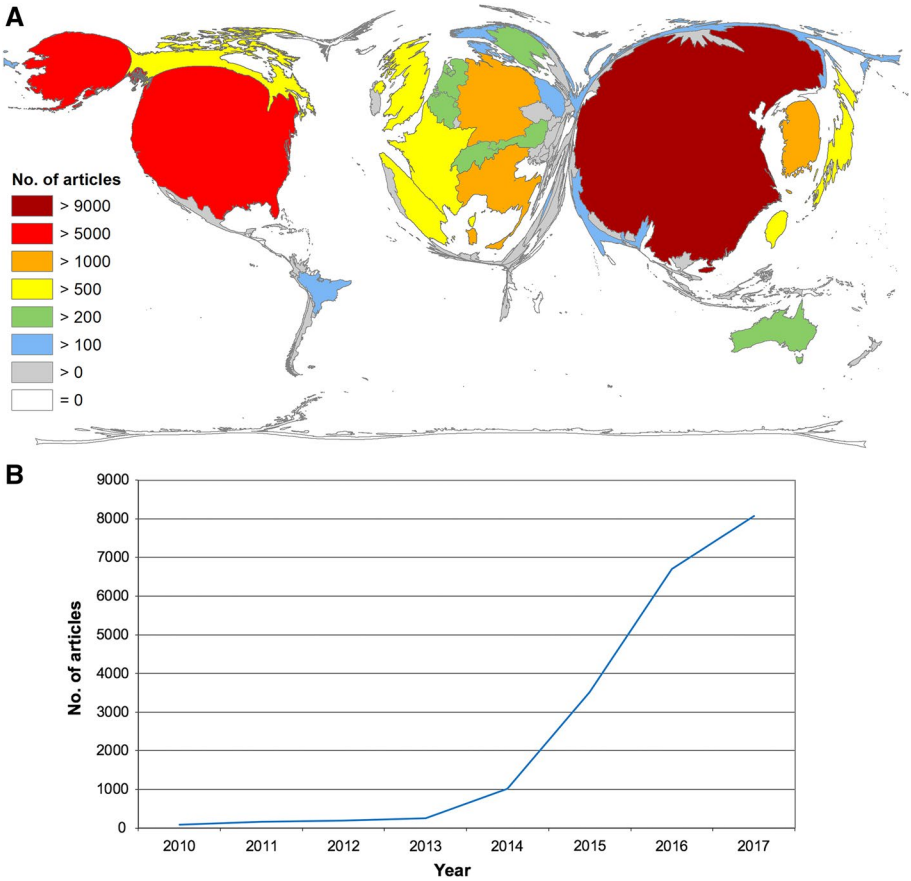

Fig. 1 Publication output. **a** Density-equalizing map illustrating the number of contributions for each country in Oncotarget for the period 2010–2017. The area of each country was scaled in proportion to its total number of publications. **b** Evolution of article numbers in the period 2010–2017

and in 2011 only 2 Chinese articles were published in Oncotarget (1.3%) followed with 3.22% in 2012 ($n=6$), 8.33% in 2013. In 2014, already 23.38% were Chinese publications, and in 2015, with $n=1172$, 33.31% of the articles were Chinese. In 2016, the leading publishing country became China before the US with a share of 46.32% ($n=3106$). Eventually in 2017, more than the half of all publications of Oncotarget was published by Chinese scientists ($n=5451$, 56.79%).

Network of international collaborations in Oncotarget

With the rising numbers of published articles, there is also an increase of international research cooperations present. In 2010, the number of international cooperations was 21 (Fig. 2a). The year 2016 holds the largest number of cooperation articles with $n=2062$, followed by 2015 with $n=1147$ (Fig. 2). 2017 is supposed to excel 2016, but it was not terminated at the search time, so that its values are not comparable and lay with $n=1774$ back. To visualize research networking for Oncotarget articles, a chart technique (Fig. 2) was used and it was found that the overall dominating countries also exhibited the by far highest number of joint articles with 1707 cooperation works between USA and China. This is followed by the cooperations of USA/Italy ($n=355$), USA/Germany ($n=256$), USA/Japan ($n=217$) and USA/UK ($n=209$) (Fig. 2).

Fig. 2 International network analysis, threshold > 8 collaboration articles, numbers in brackets (number of articles/number of collaboration articles)

Citation parameters of Oncotarget publications

In order to assess citation parameters, the total citations (*c*), average citations per article (citation rate = cr) and the modified country h-index (hI) were calculated and visualized by density equalizing mapping. In total, Oncotarget articles originating from the US reached the highest number of citations ($c = 43{,}645$) (Fig. 3a). The citation rate of the US was with cr = 7.36 ranked only 7th. In comparison, the citation rate of Chinese articles was only 4.04 taking the last rank of countries with more than 30 publications in Oncotarget (threshold) (Fig. 3b). China received 37,026 citations (rank 2). Italy ($c = 10{,}939$), Germany ($c = 8054$), the UK ($c = 6737$) and France ($c = 4614$) ranked 3rd to 6th regarding the total citation numbers, and also had higher average citation scores than Chinese articles. Regarding the country-specific h-Index analyses, China was ranked second with 49 articles being cited at least 49 times. The US led this ranking with hI = 63, Italy was ranked third with hI = 40, followed by Germany (hI = 34), the UK (hI = 32), and Canada (hI = 30) (Fig. 3c).

Discussion

The journal impact factor (JIF), a citation index, established by Eugene Garfield and issued by the Journal Citation Report (JCR) (Garfield 1964, 1996) of Clarivate, formerly Thompson Reuters, has been relatively high for Oncotarget since its establishment as a JCR listed journal and the journal obviously attracted a dramatically increasing number of submissions over the past years. The JIF level remained relatively stable ranging from 4.784 in 2011 to 6.627 in 2013 and 5.168 in 2016 although the number of articles published yearly by Oncotarget increased from $n = 90$ articles in 2010 to $n = 8075$ in 2017. Being a major publication source for as much as about 10,000 articles per year, Oncotarget was announced to be removed of the JCR in late 2017 which led to a discussion in the media and scientific community.

Using the NewQIS platform, we here performed a descriptive bibliometric analysis of 20,000 Oncotarget articles published since its inclusion to the WoS in 2010. Against the usual global research landscapes which are all dominated by US scientists and institutions—as depicted by hundreds of bibliometric studies over the past years—the publication landscape of Oncotarget is clearly dominated by Chinese articles in the last years with an increasing trend.

Such a domination could be reasonable if the research topic would be i.e. Traditional Chinese Medicine or if the journal was based in China. But Oncotarget is an US based journal and the research topic is oncology, recently widened to all areas of biomedicine. Therefore, this country-specific imbalance towards Chinese articles in the past few years can clearly be characterized as an anomaly since nearly every field of biomedicine is clearly dominated by the US, as shown previously (Groneberg-Kloft et al. 2008). Although an anomaly, this finding may definitely not be an acceptable reason for the exclusion. In this respect, Clarivate Analytics clearly states: "Neither does Clarivate Analytics favor journals or research from authors in any nation or region. More than ever, research is a global enterprise and the best and most influential titles and studies are increasingly flowing from Asia and regions previously underrepresented, such as the Middle East."(Pendlebury 2018) Usually, journals get excluded if anomalies in the citation patterns are found. How are the Chinese articles cited overall? For the Chinese articles published in Oncotarget, it can be

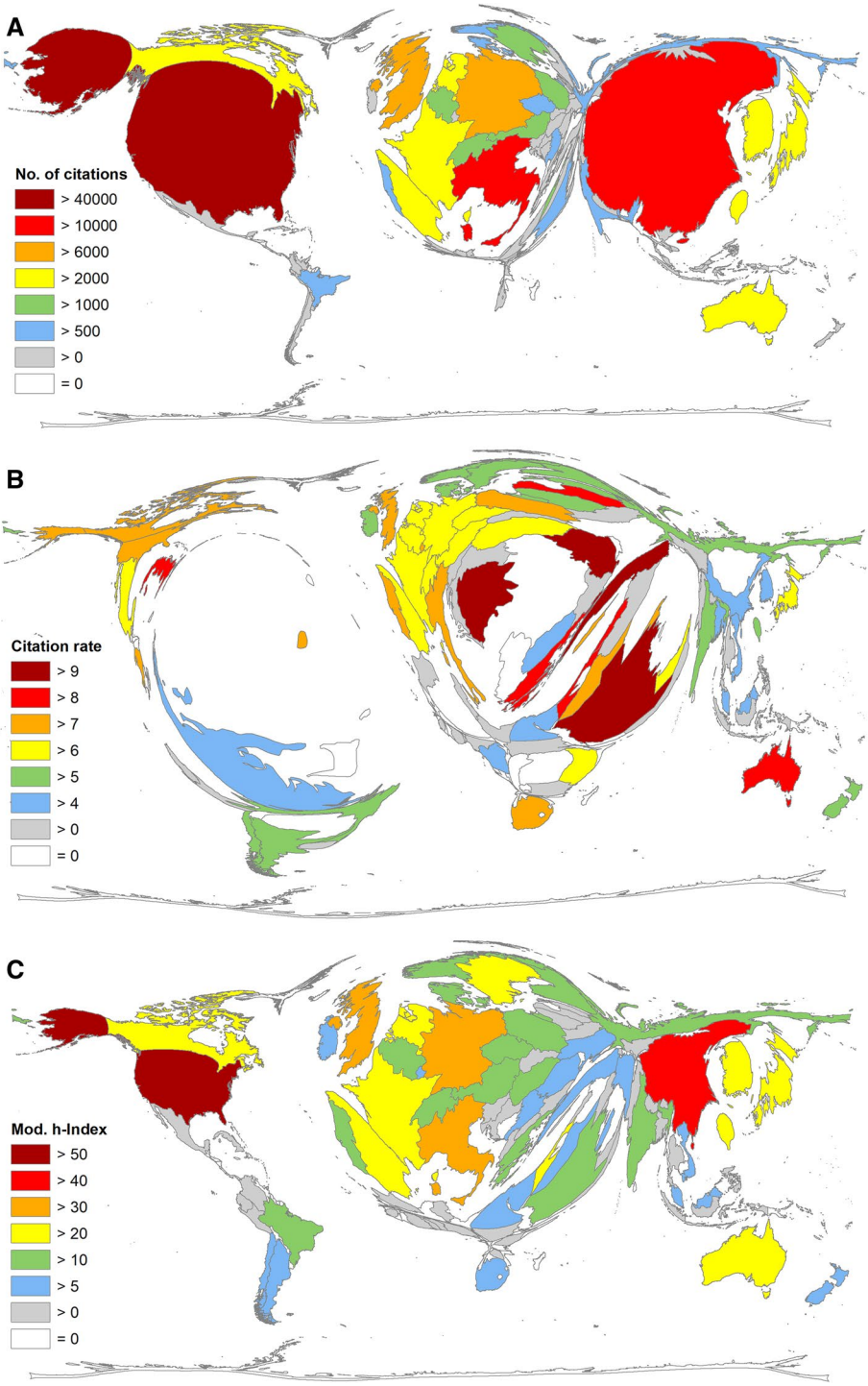

Fig. 3 Density-equalizing maps of the citation analysis of Oncotarget publications for the period 2010–2017. **a** Total number of citations. **b** Citation rate. **c** Modified h-Index

Table 1 Most prolific articles published in Oncotarget

Authors	Country	Year	Citations	Title
Chappell, WH, Steelman, LS, Long, JM et al.	USA, Germany, Italy, Serbia, Poland	2011	287	Ras/Raf/MEK/ERK and PI3 K/PTEN/Akt/mTOR Inhibitors: rationale and importance to inhibiting these pathways in human health
Jiao, YC, Killela, PJ, Reitman, ZJ et al.	USA, Brazil	2012	244	Frequent ATRX, CIC, FUBP1 and IDH1 mutations refine the classification of malignant gliomas
Haffner, MC, Chaux, A, Meeker, AK et al.	USA	2011	212	Global 5-hydroxymethylcytosine content is significantly reduced in tissue stem/progenitor cell compartments and in human cancers
Powe, DG, Voss, MJ, Zanker, KS et al.	UK, Germany	2010	210	Beta-blocker drug therapy reduces secondary cancer formation in breast cancer and improves cancer specific survival
Li, H, Yu, BQ, Li, JF et al.	China	2014	205	Overexpression of lncRNA H19 enhances carcinogenesis and metastasis of gastric cancer
Markman, B, Dienstmann, R, Tabernero, J	Spain, Australia	2010	182	Targeting the PI3 K/Akt/mTOR pathway—beyond rapalogs
McDonald, PC, Winum, JY, Supuran, CT et al.	Canada, France, Italy	2012	178	Recent developments in targeting carbonic anhydrase IX for cancer therapeutics
McCubrey, JA, Steelman, LS, Chappell, WH et al.	USA, Italy, Germany, Serbia	2012	158	Ras/Raf/MEK/ERK and PI3 K/PTEN/Akt/mTOR Cascade inhibitors: how mutations can result in therapy resistance and how to overcome resistance
Mitra, A, Mishra, L, Li, SL	USA	2015	151	EMT, CTCs and CSCs in tumor relapse and drug-resistance
Del Barco, S, Vazquez-Martin, A, Cufi, S et al.	Spain	2011	148	Metformin: multi-faceted protection against cancer

stated that the average citation score for these articles were lower with 4.04 than of the articles published by all other top 20 publishing countries. Therefore, accepting Chinese articles did not mean a forecastable increase in the JIF but rather a decrease. Therefore, other issues must have been the reason for the exclusion,

What are these reasons? Clarivate states: "Covered titles are constantly curated to ensure that they maintain quality and performance criteria. If a journal is deselected from our coverage, for reasons of changing influence or editorial conduct, this is no more remarkable than a new journal being added. What does not change, however, are the stringent standards, both qualitative and quantitative, that our content management team applies to the review of scientific and scholarly publications for coverage in the Web of Science. In this we are independent, publisher-neutral, and stubbornly so, as we have been for 54 years."

Unfortunately, there are also news that the exclusion may have even led to suicide attempts by scientists. The platform Retraction Watch stated the following: (RetractionWatch 2018a, b) "That decision can have far-reaching effects (the removal of an JIF of journal), both for those authors who've published in these journals, and for the journals themselves, since researchers will often go elsewhere in search of journals whose rank is recognized by their tenure and promotion committees (of course, many, including us, have argued that JIF is not the best way to judge research). But this year's JCR includes an entirely new element. For the first time, Clarivate has issued an expression of concern, a tool normally used by journals to flag papers that readers should treat with caution. This year's JCR includes an expression of concern for five journals that displayed a "problematic pattern of citations:" It is enticing to speculate if the concerning news about suicides of scientists of published in delisted journals led Clarivate to the introduction of the red flag list. By the introduction of this measure, scientists are now warned that they may anticipate publishing in a non-JIF journal, if they submit to a flagged journal. On the other side, the flagged journals may now immediately act and change their editorial policies, if needed.

Can Oncotarget be used as an example for international research in oncology? Definitely not: Basing on the present findings one can state that the research published here is heavily biased towards Chinese research. A closer look into the citation analysis however shows that nine out of ten of the most cited articles are not of Chinese origin (Table 1). By contrast, five out of these ten articles are published by US scientists. Therefore, Oncotarget should not be regarded as representative for global oncology research activity.

Conclusion

Due to the large interest of the scientific community in the delisting of the journal Oncotarget that was recently delisted from the SCIE and a report of a potential suicide threat of a scientist (Lankers 2018), the present study analyses the country-specific publication activity of this journal. Our results indicate that—although being a US based journal with a primary focus on oncology—the country-specific publications pattern of Oncotarget is heavily dominated by Chinese authors. The data also demonstrates a dramatic increase in publication activity of Oncotarget in the past few years. The used techniques may be of great help to visualize publication activities of journals on a country-specific basis.

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