

A Bibliometric Analysis of the International Medical Literature on Predatory Publishing

Anas S. Beshyah¹, Momna Basher¹, Salem A. Beshyah^{1,2}

¹Department of Medicine, Dubai Medical College, Dubai, ²Department of Endocrinology, Mediclinic Airport Road Hospital, Abu Dhabi, United Arab Emirates

Abstract

Introduction: Predatory journals threaten the quality, honesty, and credibility of published scholarly work. This study aimed to provide a quantitative overview of the issues of predatory publishing and journals in international literature. **Materials and Methods:** We searched the Scopus database for “predatory journalism and publishing” in the abstract, keywords, and title between 2012 and 2018. The Scopus tools were used online for calculations, and VOSviewer was used to construct the visualization maps. Documents were analyzed for bibliographic and citation characteristics such as publication years, languages, countries or regions, journals, articles, and authors. **Results:** Four hundred and eleven articles were retrieved; 31.3% were “open access,” 46.0% were original research articles. Medical journals were of varying impact. Authors from the USA and affiliated institutions were the most dominant. One author has a clearly evident dedication to the subject being the first to coin the term “predatory” journals. Visualization maps showed sparse associations between most prolific authors, journals, and institutions. **Conclusions:** This study is the first bibliometric analysis of the threat of predatory journalism to medical research. Increasing anxiety is evident with an uncoordinated strive to fight it. The study represents a starting point to identify and quantify the gaps in the field. It should help pinpoint possible directions and potential collaborations for future action.

Keywords: Bibliometric analysis, citation analysis, health journals, predatory journals, predatory publishing, research ethics


INTRODUCTION

Open access (OA) to science model of publishing made it possible for the full text of OA articles to be freely read on the website, as the publishing is not funded by subscriptions. However, a very serious complication of the OA movement was the surge of journals and publishers that lack any legitimate foundation who simply use online publishing solely for financial gain.

They act in total disregard to principles of scholarly publishing; hence, the name “predatory journals” (PJs)

Address for correspondence: Dr. Anas S. Beshyah,
P.O. Box 59472, Abu Dhabi, United Arab Emirates.
E-mail: anas.beshyah@gmail.com

Submitted: 23-02-2020 **Revised:** 24-02-2020
Accepted: 25-02-2020 **Published:** 26-03-2020

Access this article online	
Quick Response Code: 	Website: www.ijmbs.org
	DOI: 10.4103/ijmbs.ijmbs_25_20

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How to cite this article: Beshyah AS, Basher M, Beshyah SA. A bibliometric analysis of the international medical literature on predatory publishing. *Ibnosina J Med Biomed Sci* 2020;12:23-32.

was coined.^[1] PJs lack the basic industry standards, sound peer-review practices, or any commitment to scholarly publication ethics, yet they may portray an apparently legitimate face enabled by improved web designing software skills.^[1] Authors in developing countries are the core target for PJ as well as other forms of false academia.^[2] The situation is complicated with the low awareness of predatory publishing among potential authors in developing regions.^[3]

Predatory publishing has caused a high level of anxiety in the scholarly community.^[1-3] A global action at the highest levels has been called for to stop illegitimate publishing or reduce it to the barest minimum.^[1,2] The responsibility of fighting the PA movement lies collectively with authors, journal editors, academic institutions, and publishing organizations.^[1,2] To support the antipredatory publishing movement, recognition of the scholars who are committed to this cause, their affiliations, resources, and their expertise should help encourage collaborations with more trust.^[2] Therefore, a systematic approach is required to analyze these attributes.

The bibliometric methodology is being employed in several academic branches to characterize the volume of literature productivity and explore the research trends regarding a given region, population, or phenomenon.^[4] Several recently published bibliometric reports have elucidated important issues concerning specific ethnic groups, special socioeconomic circumstances, patterns of professional management practices, or unique personal behaviors.^[5,6] Hitherto, there has been no quantification of the global research production regarding trends and influence of predatory publishing in genuine scholarly literature. With the rising threat, we have contemplated this bibliometric analysis on predatory journalism and their unethical publishing practices. Such a study should quantify the body of scholarly work, scope its global distribution, and map the extent of interaction between the key players in the struggle to defeat predatory journalism.

MATERIALS AND METHODS

Objectives

We aimed to quantify the global scholarly work production on predatory publishing using the

bibliometric methodology. The aims were to scope the literature on predatory publishing at the global level and to determine its relative growth rate, collaborative measures, and productivity. We also wished to identify the most prolific authors, institutions, journals, and countries concerned with the subject.

Design and search strategy

This is a theme-based bibliometric analysis study using data obtained from the Scopus database (Elsevier). Literature productivity was evaluated using established methodology used in previously published bibliometric analyses.^[5,6] The terms “predatory journalism” in various formats and combinations (“Predatory publishing” OR “Predatory Journals” OR “Predatory Journalism” OR “Predatory Editors” OR “Predatory Publishers”) were used in the search in the title, keywords, and abstract fields. The scope of the research went from January 1, 2012, to December 31, 2018, reflecting all of the published work on the subject. There was no restriction on types of documents, except those published as errata or are still in press and exclusion of records published in 2019. The time trend of the numbers of retrieved records using the same search terms per year was examined in both PubMed and Scopus databases to ensure consistency of coverage [Figure 1]. We characterized the publishing tendency by describing basic features by analyzing the distribution of languages, keywords, authors, journals, countries, authorship pattern, and coauthorship relations.

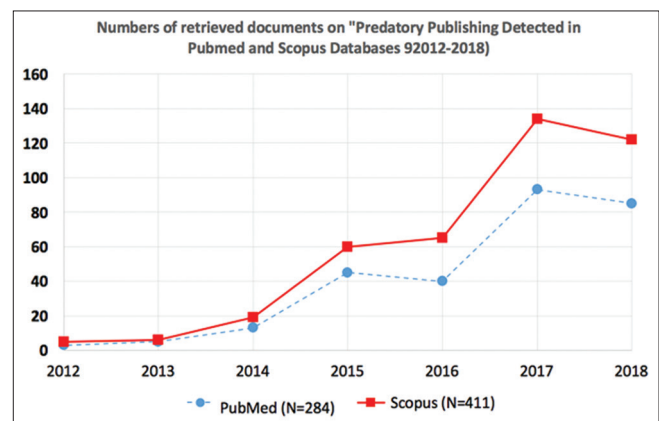


Figure 1: Time trend of the numbers of retrieved records per year using the search terms “predatory publishing” in Scopus and PubMed databases during the study period between 2012 and 2018

Bibliometric and citation analysis

The following metrics were calculated: growth rate over the years, collaborative measures, most prolific countries, institutional productivity, patterns of the most involved journals, most productive authors, and citation. All studied metrics are presented in accordance with the commonly used ranking order known as “standard competition ranking.” The perceived quality of publications related to predatory publishing was evaluated using the established *h*-index, which is defined as “the number of papers with a citation number more than or equal to *h*” as described previously.^[7] Furthermore, the quality of the journals where the articles were published was evaluated by two commonly used metrics, namely, (a) Journal Citation Report (Web of Knowledge) and (b) the SCImago Journal Rank (SJR).

Data extraction and statistics

The analysis was based on Scopus database only. The Scopus tools were used online for making the various calculations. Besides, the data were also downloaded as spreadsheet (Excel, Microsoft) for further analyses and export to the visualization software. Although the database was interrogated on several occasions to assess relevance and establish familiarity with retrieved the results, all data were examined by online tools and downloaded and stored for further analysis finally on the same day (April 19, 2019) for consistency. To construct bibliometric diagrams, we used a special visualization software (VOSviewer for Mac OS, version 1.6.10, Centre for Science and Technology Studies, at the Leiden University, the Netherlands).^[8] Throughout the article, results are presented as mean \pm standard deviation for continuous variables and as absolute (numbers) or relative (percentages) frequencies for categorical variables.

RESULTS

Article type, language, and access

A total of 411 publications between 2012 and 2018 were retrieved. Of the total number, the full texts of 141 documents were available for OA by nonsubscribers. Almost two-thirds (62.3%) were published in the last 2 years of the study period;

the vast majority (396; 96.4%) were published in English, followed by Spanish (10), French (3), and German (2) with single article in 7 other languages. Data-based original articles were less than half (188; 46.0%), whereas almost half of the records (49.9%) were opinion-based documents such as editorials (103; 24.7%), letters (43; 10.5%), notes (31; 7.6%), reviews (28; 6.8%), and other types of records (18; 4.4%) between book chapters, short surveys, and conference papers. Errata and articles in press were not included.

Content analysis

Medicine (200) dominated over other subject areas, followed by, in decreasing order, social science (116) and nursing (66). Other articles were in computer science (36); biochemistry, genetics, and molecular biology (21); engineering (19); and business, management, and accounting (18). Few involved pharmacology, toxicology, and pharmaceuticals (13) and arts and humanities (11). The top author's keywords (used over 30 times) in decreasing order included publishing or publication (207, 169), human or humans (181, 121), peer review (133), periodicals (124), standards (98), ethics (87), open access publishing or open access (73, 64), scientific or medical literature, (55, 53), predatory journal or predatory publishing (52, 41), medical research or peer review research (49, 45), access to information (44), priority journal (44), scientist (42), fraud or scientific misconduct (41, 32), internet (41), and some generic words such as article, editorial, or letter (37, 35, and 34). A visualization map of the co-occurrence of the keywords used by authors is shown in Figure 2. The most commonly 23 authors' keywords in a minimum of five articles are shown in five clusters.

Authorship trends

Details of the top 20 most-cited articles are shown in Table 1. Articles' characteristics presented include type and theme of the article, journal, country of origin, access, and number of citations.^[2,9-27] The most prolific authors are presented in Tables 2 and 3.^[2,12-30] A single author (J Beall) who coined the term “PJs” in 2012 authored the highest number of articles on the subject (19 articles). Furthermore, the network of coauthorship for the most prolific authors

was examined [Figure 3]. Six clusters could be identified. The figure illustrates that clusters which are located closer to each other indicate related topics. Careful inspection of these clusters indicates that publications with international collaboration are low in number and that most of the clusters are based on local or personal connections. Furthermore, the focus or intensity of interest of research worker's on predatory journalism is measured by percentage of work on predatory journalism out of the author's own total scholarly contributions [Table 3].

Analysis of affiliation, funding, and collaborations

A total of 65 countries contributed to the published work. More than a quarter of the articles (115; 28.1%) were affiliated with USA-based institutions and had the largest number of citations (1131) even allowing

Table 1: Types and the primary language of Scopus-retrieved publications on predatory publishing between 2012 and 2018 (n=411)

Types of document*		Primary languages**	
Type	n (%)	Language	n (%)
Original article	188 (46.0)	English	396 (96.4)
Editorial	103 (24.7)	Spanish	10 (2.4)
Letter	43 (10.5)	French	3 (0.7)
Note	31 (7.6)	German	2 (0.5)
Review	28 (6.8)	Czech, Danish, Hungarian,	7(1.7)
Conference paper	7 (1.7)	Portuguese, Russian, Swedish, Turkish	
Short survey	6 (1.5)		
Book (1); chapter (4)	5 (1.2)		

*Excluding errata and articles in press, **Bilingual articles may have led to the total number of languages being exceeding the total number of article

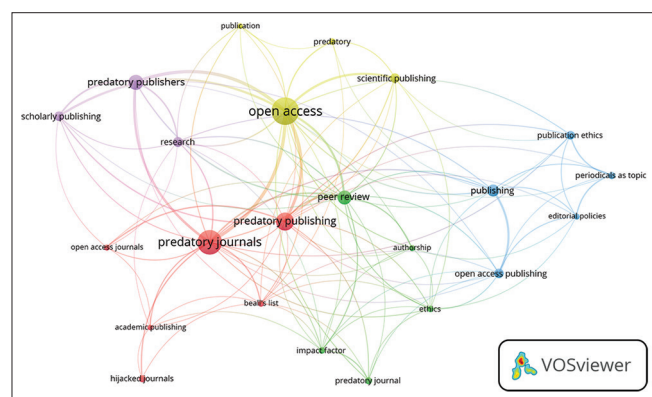


Figure 2: Visualization map of co-occurrence network of key words of articles on predatory journalism published between 2012 and 2018. The most commonly used 23 authors' key words in a minimum of five articles are shown in five clusters. The size of the words and thickness of the lines reflects the frequency of the words and thickness of the lines reflects the number of shared words. Clusters located close to each other in the figure indicate related topics

for self-citation (1088). Articles affiliated with Indian institutions came in the second position (45), followed by Canada (36) and United Kingdom (30). Details of other less prolific countries are given in Table 4.

Institutions associated with the top ten most prolific authors, along with their scholarly workers, are provided in Table 3. The institution-wise analysis revealed affiliations in decreasing order by the University of Colorado at Denver, USA (15); University of Manchester, UK (10); University of Ottawa, Canada (7); and University of Birmingham (7). The top funders were the National Institutes of Health (6), Wellcome Trust (3), followed by the “Canadian Institutes of Health Research”, Foundation for the National Institutes of Health, National Research Foundation and University of Ibadan (2 each). However, funders of 379 articles were reportedly undefined. The remainder were listed as the funders for single articles. There is evidence for a low level of international collaboration being evident in less than one-third of publications. Most of the work is done within small groups of “clusters” [Figure 3].

A journal-wise analysis revealed the top 10 journals interested in predatory journalism over the study period are summarized in Table 5.

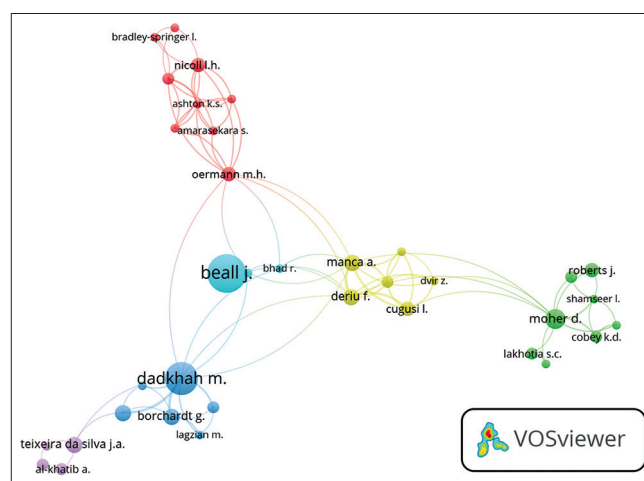


Figure 3: Visualization map of co-occurrence network of authors of articles on predatory journalism published between 2012 and 2018. The most prolific 36 authors in six clusters were identified. The size of the circle reflects the numbers of articles by authors and thickness of the lines reflects the number of shared authorship. Clusters located close to each other in the figure indicate related topics

Table 2: The top most cited 20 articles on “predatory publishing” during the study period (2012-2018). First authors, years of publications, titles/themes, types of article, journals, countries of origin, access, and number of citations are shown

SCR ^a	First author, Year ^b	Title/theme	Type ^c	Journal	Country	Access	Citation ^d
1 st	Beall J, 2012	Predatory publishers are corrupting open access (the seminal article that coined the class of journals).	Note	Nature	UK	Open	273
2 nd	Shen C, 2015	“Predatory” open access: A longitudinal study of article volumes and market characteristics	Article	BMC Medicine	UK	Open	225
3 rd	Clark J, 2015	Firm action needed on predatory journals	Editorial	BMJ (Online)	UK	-	101
4 th	Xia J, 2015	Who publishes in “predatory” journals?	Article	J Assoc Inform Sci Technol	USA	-	88
5 th	Beall J, 2013	Medical publishing triage - chronicling predatory open access publishers	Article	Ann Med Surgery	Netherlands	Open	64
6 th	Sorokowski P, 2017	Predatory journals recruit fake editor	Note	Nature	UK	Open	61
7 th	Shamseer L, 2017	Potential predatory and legitimate biomedical journals: Can you tell the difference?	Article	BMC Medicine	UK	Open	58
8 th	Beall J, 2017	What I learned from predatory publishers	Article	Biochemia Medica	Croatia	Open	56
9 th	Berger M, 2015	Beyond Beall’s list: Better understanding predatory publishers	Note	College and Research Libraries News	USA	Open	54
10 th	Bartholomew RE, 2014	Science for sale: The rise of predatory journals	Editorial	JRSM	UK	-	52
10 th	Moher D, 2015	You are invited to submit. (on soliciting practices by predatory journals)	Note	BMC Medicine	UK	Open	52
12 th	Beall J, 2016	Predatory journals: Ban predators from the scientific record (a call for action)	Letter	Nature	UK	Open	46
13 th	Bowman JD, 2014	Predatory publishing, questionable peer review and fraudulent conferences	Article	Am J Pharmaceut Edu	USA	-	45
14 th	Jalalian M, 2014	Hijacked journals and predatory publishers: Is there a need to re-think how to assess the quality of academic research?	Article	Walailak J Science Technology	Thailand	-	42
15 th	Wicherts JM, 2016	Peer review quality and transparency of the peer-review process in open access and subscription journals	Article	PLoS ONE	USA	Open	39
16 th	Beall J, 2013	Predatory publishing is just one of the consequences of gold open access	Note	Learned Publishing	UK	Open	38
17 th	Beall J, 2016	Dangerous predatory publishers threaten medical research	Note	Journal of Korean Medical Science	Korea	Open	36
18 th	Moher D, 2016	Stop predatory publishers now: Act collaboratively	Short Survey	Ann Internal Medicine	USA	-	34
19 th	Beall J, 2016	Best practices for scholarly authors in the age of predatory journals	Review	Ann R Coll Surg Engl	UK	-	33
19 th	Gasparyan AY, 2015	Publishing ethics and predatory practices: A dilemma for all stakeholders of science communication	Review	Journal of Korean Medical Science	Korea	Open	33
19 th	Lukić T, 2014	Predatory and fake scientific journals/publishers - a global outbreak with rising trend	Review	Geographica Pannonica	Serbia	Open	33
19	Seethapathy GS, 2016	India’s scientific publication in predatory journals	Article	Current Science	India	Open	33

^aSCR, Equal authors were given the same ranking number, and then a gap is left in the ranking numbers. ^bReferences,^[2,12-30] ^cAccording to Scopus; some of the article are nearer to view points and editorials than to full articles in content and style, ^dInclusive of self-citations. SCR: Standard competition ranking

The relative contributions of the journals are shown as the percentage of the total global productions and impact represented by the numbers of citations, citation/article ratio varied more widely. Furthermore, the volume and impact are presented as article frequency, citations, and citation/article ratio. In addition, two frequently used metrics (SJR and *h*-index) are provided.

Citation analysis

The majority of the articles were cited at least once [Table 6]. Citation frequency increased in line with the increase of the articles reaching a maximal number of citations in 2015 (783 of which 784 were not self-citations). However, the impact measured as a citation-to-article ratio (citation per article ratio) varied widely depending on the time since

Table 3: The 10 topmost prolific authors on predatory journalism over the study period (2012-2018) and their authorship contribution to the issue of “predatory journalism” expressed as authorship frequency and also as proportion of their total research production. Also, the authors’ h-index and country of affiliation are presented

SCR ^a	Author	Authorship and citations			Subject/total publications ratio (%)	h-index	Institution, Country
		n	Citations 2012-2018	C/A ratio			
1 st	J Beall	19	603 (591)	31.7	19/54	10	University of Colorado at Denver, USA
2 nd	M Dadkhah	15	67 (55)	4.5	15/49	8	Foulad Institute of Technology, Isfahan, Iran
3 rd	A R Memon	9	26 (8)	2.9	9/24	4	Peoples University of Medical and Health Sciences for Women, Nawabshah, Pakistan
4 th	A Y Gasparyan	7	83 (70)	11.9	7/98	23	University of Birmingham, Birmingham, UK
4 th	G D Kitas	7	83 (70)	11.9	7/409	59	University of Manchester, Manchester, UK
4 th	D Moher	7	139 (116)	19.9	7/200	37	University of Ottawa, Canada, Ottawa, Canada
7 th	G Borchart	5	11 (9)	2.2	5/36	10	Progressive Science Institute, Berkeley, USA
7 th	F Deriu	5	33 (25)	6.6	5/80	16	Università degli Studi di Sassari, Sassari, Italy
9 th	T Maliszewski	5	33 (27)	6.6	5/6	4	Akademia Pomorska W Slupsku, Poland
9 th	A Manca	5	34 (25)	6.8	5/38	9	Università degli Studi di Sassari, Sassari, Italy
9 th	B Nurmashev	5	49 (42)	9.8	5/13	6	South Kazakhstan State Pharmaceutical Academy, Kazakhstan
9 th	J A Teixeira da Silva	5	24 (19)	4.8	5/456	33	Independent Research (retired), Japan.
9 th	M Yessirkepov	5	59 (46)	11.8	5/25	7	South Kazakhstan Medical Academy, Shymkent, Kazakhstan.

^aSCR. Equal authors are given the same ranking, and a gap is left in the ranking numbers. USA: United States of America, UK: United Kingdom, SCR: Standard competition ranking, C/A ratio: Citation/article ration

Table 4: Country-wise analysis of the contribution (production and impact)^a of the most active 10 countries to publishing on predatory journalism during the study period (2012-2018)

SCR ^b	Country	Articles, n (%)	h- index	Citations (non-self)	C/A ratio	Ever cited, n (%)	
						Yes	No
1 st	United States	115 (28.1)	19	1131 (1088)	18.3	89 (77.4)	26 (22.6)
2 nd	India	45 (11.0)	8	164 (146)	3.6	27 (60.0)	18 (40.0)
3 rd	Canada	36 (8.8)	9	315 (296)	8.8	31 (86.1)	5 (13.9)
4 th	United Kingdom	30 (7.3)	10	327 (301)	10.9	24 (80)	6 (20)
5 th	Iran	17 (4.2)	4	90 (81)	5.3	13 (76.5)	4 (24.5)
6 th	Australia	14 (3.4)	5	100 (92)	7.1	12 (85.7)	2 (14.3)
7 th	Italy	13 (3.2)	6	71 (56)	5.5	10 (76.9)	3 (23.1)
7 th	Japan	13 (3.2)	5	57 (39)	4.4	11 (84.6)	2 (15.4)
7 th	Pakistan	13 (3.2)	3	32 (13)	2.5	7 (53.8)	6 (46.2)
10 th	Russia	11 (2.7)	6	89 (75)	8.2	10 (90.9)	1 (9.1)

^aProduction is expressed as absolute number of article and percentage contribution to total global (n=409) and the impact is expressed as total number of citations, C/A ratio and the number and percentage of articles ever cited or never cited, ^bSCR Standard competition ranking is made with equally productive countries being given the same ranking number, and a gap is left in the ranking number. ^cOther countries involved to a lesser extent include Poland (9); Kazakhstan, South Africa and Spain (8 each); Portugal (7); Germany, Nigeria and Romania (5 each); Chile, Czech Republic, France, Jordan, Malaysia, Saudi Arabia, Sweden, and Turkey (4 each), Bangladesh, Brazil, Colombia, Finland, Israel, Netherlands, New Zealand, Singapore, Slovakia, South Korea (3 each); Argentina, Austria, Croatia, Cuba, Ethiopia, Indonesia, Ireland, Kenya, Mexico, and Serbia (2 each). One contribution each was affiliated with the following countries: Bahrain, Belgium, Bulgaria, China, Denmark, Egypt, Greece, Grenada, Hungary, Kuwait, Latvia, Lithuania, Malta, Norway, Panama, Qatar, Slovenia, Switzerland, United Arab Emirates whereas the affiliations of 52 contributions were counted undefined. C/A ratio: Citation/article ration, SCR: Standard competition ranking

publication. Citation data associated with articles, authors, countries, and journals are presented in Tables 1-4, respectively.

DISCUSSION

This study is the first bibliometric study on predatory publishing.

We have made important observations regarding the research productivity on predatory publishing, a significant danger that has recently threatened the credibility of scholarly publishing.^[2-5] The study is particularly important due to the poor awareness about PJs in both developed and developing

Table 5: The top 10 journals publishing on predatory journalism over the study period (2012-2018). The relative contributions are shown as percentage of the total global productions ($n=411$) and impact represented by the numbers of total number of citations, the citation/article ratio and impact of the journal is represented by the three bibliometric metrics (Cite score, SJR, and SNIP)

SCR*	Journal**	Frequency, n (%)	Citations	C/A ratio	Doc h -index	Cite Score	SJR	SNIP
1 st	Journal of Korean Medical Science	11 (2.7)	130 (115)	11.8	8	0.692	0.815	1.56
2 nd	Nature	9 (2.2)	357 (354)	39.7	4	17.875	8.524	14.59
3 rd	Current Science	8 (1.9)	67 (60)	8.4	5	0.311	0.709	0.700
4 th	Science and Engineering Ethics	7 (1.7)	42 (32)	6.0	3	1.570	0.466	0.991
5 th	Scientometrics	7 (1.7)	28 (26)	4.0	4	2.720	1.125	1.378
6 th	Learned Publishing	6 (1.5)	70 (68)	11.7	4	1.12	0.702	1.076
7 th	Medical Journal Armed Forces India	6 (1.5)	18 (16)	3.0	3	0.48	0.286	0.638
8 th	Publishing Research Quarterly	6 (1.5)	20 (13)	3.3	3	0.46	0.28	0.698
9 th	Acta Medica Portuguesa	5 (1.2)	7 (7)	1.4	3	0.43	0.21	0.27
10 th	Biochemia Medica	5 (1.2)	64 (61)	12.8	3	3.63	0.961	2.224

C/A ratio gives average number of citations per article calculated by dividing the total citation by the number of articles for each journal. *SCR standard competition ranking is calculated by giving same rank to journals with numbers of equal articles were and a gap is left in the ranking numbers, **Less involved journals included: Asian Journal of Psychiatry, Journal of The College of Physicians and Surgeons Pakistan and Journal of The Pakistan Medical Association (4 articles each), BMC Medicine, Indian Journal of Medical Microbiology, Journal of Advanced Nursing, Journal of Sexual Medicine, Kome, Scientist, Triplec (3 articles each) and ACM International Conference Proceeding Series and Acta Dermato Venereologica (2 articles each). C/A ratio: Citation/article ration, SCR: Standard competition ranking, SJR: SCImago Journal Rank, SNIP: Source Normalized Impact per Paper, ACM: Association of Computing Machinery

Table 6: Citations analysis of all articles ($n=411$) published during the study period (2012-2018) on predatory publishing

Year	Articles per year, n (%)	Total citations* (nonself-citations)	C/A ratio*	Articles with citations	Articles without citations
2012	5 (1.2)	267 (265)	53.4	4	1
2013	6 (1.5)	149 (140)	26.5	6	0
2014	19 (4.6)	263 (257)	13.8	18	1
2015	60 (14.6)	783 (784)	13.1	52	8
2016	65 (15.8)	523 (481)	8.0	54	11
2017	134 (32.6)	549 (489)	4.1	91	43
2018	122 (29.7)	97 (76)	0.8	41	81

C/A number of citations per article calculated by dividing the total number of citations retrieved for each year by the total number of publications in that year. *Citations counted for all records 2012-2018; low C/A ratio is predicted from the short duration between the publication and the study (search date). C/A ratio: Citation/article ration

regions of the world.^[4] The period we covered in the study has witnessed an exponential rise in the literature production reflecting the anxiety caused by the rising threat of predatory publishing and fake academia exemplified by the articles included in this paper. The literature was mapped using descriptive bibliometric methods to analyze the productivity of individuals, institutions, and nations. We also demonstrated the relative research intensity, the level of the research work being clinical or basic, levels of scientific impact measured by citation, and extent of collaboration to identify institutions and key opinion leaders concerned with the subject. We used similar descriptive methodology used in recent studies.^[5,6] We have used the Scopus online database since it includes almost all PubMed journals. Furthermore, Scopus has the advantage of containing all the authors' country affiliations

needed for establishing patterns of international and institutional collaborations and individual countries' production rates. Furthermore, Scopus is recognized as the most extensive international multidisciplinary database, and it covers a wider range of publications from both developing and developed regions than other databases. Also, the newly developed visualization maps are being increasingly. and they were employed in the study to visually illustrate relations between authors and concepts.

Taking into consideration the short duration since the recognition of the predatory phenomenon, a reasonably good number of articles for the present study (411 articles) were retrieved.^[1] All relevant articles should have been identified by including the three crucial fields in the search, namely, title, abstract, and keywords. Furthermore, the

search phrase is very unique and therefore no false positive identifications of irrelevant records occurred. The homology between PubMed and Scopus databases and the higher numerical yield in Scopus is also reassuring [Figure 1]. The minor difference can be attributed to the problem being discussed in nonmedical journals too. However, medicine was the most affected, as shown in our survey. OA to full text was possible in a relatively high proportion (one-third) of the articles, which is encouraging. We noted the remarkably high ratio of opinion-type documents in contrast to the volume of original data-based work seen in different contexts [Tables 1, 3 and 4]. Perhaps, this could be attributed to the short duration since the term was coined and the increasing anxiety to the scholarly publishing that forced many people to express their concerns in letters, notes, editorials, and reviews rather than conduct research studies [Tables 1-3].

USA-based authors and affiliated institutions were dominant on all counts of productivity and impact such as numbers of articles, citations, and citation/article ration reflected in excellent article *h*-index. India, Canada, and the United Kingdom followed on with variable citation and impact metrics. The unusually large number of articles from India reflects the fact that India was the source of so many journals and publishers recognized as predatory.^[1]

Predictably, the single author (J Beall), who coined the term in 2012, coauthored the highest number of articles ($n = 19$) on the topic although, notably, single authorship was often [Figure 2].^[1] Furthermore, he was the author with the highest number of citations (603 citations). The analysis showed that several authors showed a high degree of dedication to the subject [Tables 2 and 3]. Some of these authors work in small groups [Figure 2]. The number of publications and the extent of international collaborations were low for such global threat. Furthermore, the collaborations seemed more of personal connections than institutional collaboration [Table 2 and Figure 2]. Given the global nature of the predatory threat, urgent formal collaborations are needed to share experiences, come up with generalizable

conclusions that can be translated into practical action plans.

Tables 1 and 4 demonstrate that articles were published in medical journals of varying levels of impact.^[1,9-27] Although the Journal of Korean Medical Science had the most number of articles on the subject ($n = 11$) closely followed by nature (9), the latter had a remarkably higher citation/article ratio (39.7 vs. 11.8, respectively) compatible with the difference in their impact metrics [Table 4].

This present study is the first of its nature. The study is a starting point to quantify global literature productivity in predatory publishing and fake medical journalism. These dangers are threatening the integrity of genuine scholarly work and the reliability of medical research. They also endanger the potential translation of research to patients' care worldwide. The numbers of published articles indicate the quantity of both research activity and the concern of the academic world about the threat. Citation metrics were used to measure the interaction between scholars on the subject. The present bibliometric study also enriches the bibliometric literature in general and helps in mapping the antipredatory movement's key opinion leaders and those who are concerned about the subject, their institutions and venue of publications. This should help to facilitate cross-referring and to establish future collaborations between those who share the same interest.

The present study has some limitations, some of which are inherent to its methodology, yet they are worthy of a discussion. Bibliometric studies provide a quantitative perspective without detailed analysis of the content that is usually a remit for review articles.^[7] However, bibliometric methodology or "analyses" are now well established in all scientific specialties and they represent an integral part of the methodology of evaluation of research quality.^[4] The short life of the predatory phenomenon itself (since 2012) has imposed a relatively small number of documents available for analysis to explore points of differences and agreements between research findings and opinions as it is expected in other disciplines. Furthermore, it

is inevitable that studies and opinions on predatory publishing expressed in journals which are not indexed in Scopus could not have been included in the present study.^[2,3,6] Some researchers may have chosen to publish in national or regional journals which are not yet indexed in any international databases,^[29] perhaps because of loyalty or support to their institutions and regions.^[30] Since this is the first study of its nature, we were not able to make comparisons with previous publications. Finally, although the data showed a progressive numerical increase in the body of the published work related to predatory journalism, the high ratio of opinion-based literature than data-based research work remains a cause of concern.

CONCLUSIONS

The present study is the first bibliometric analysis of the scholarly community's response to the rising danger of predatory publishing and pseudojournalism [Box 1]. It is not simply a pure academic exercise as it has a major potential impact on patients' care [Box 2]. Hence, we felt it much suited for publication in a journal of mixed medical and biomedical readership. Principal authors, core journals, interested institutions individually and in clusters are highlighted. The study presents the first systematic overview of the volume of productivity,

Box 1: Advances in Knowledge

This is the first study to explore the scholarly response to the rising danger of predatory publishing.

We scoped the most prolific authors, interested journals, and concerned institutions.

Most of the research work and expressed opinion seem to represent isolated individuals with limited collaborations

There is a clear evidence for a fragmented response and lack of organized action against predatory publishing

Physicians and biomedical scientists have moral and ethical obligation to unify their efforts to fight and defeat the predatory publishing movement.

Knowing who is sharing one's stance should help achieve this

Box 2: Application to patient care

Data and opinions published in predatory journals may have not been peer-reviewed and may harm patients. Physicians should be aware of his to safe-guard their patients

Physicians' awareness should induce them to distance themselves from predatory journals in all shapes and forms to prevent endangering credibility of scholarly work

Knowledge and guidance for patients' care must invariably be sought from credible sources with high scholarly publishing standards

extent of visibility and potential impact of published research work and expressed key opinion in the field.

The urgent need for effective "antipredatory" is gathering momentum among both the clinical and academic physicians.^[1,10,15,19] The measuring of the trends of the scientific literature systematically using bibliometric methods in the present study article has quantified the completed research work and identified the widely held professional perceptions on this matter over and above identifying characteristics of PJs^[9,15,20] and characterizing authors who falls in their traps.^[9,11] The results should be useful for informing the prioritization and organization of the needed action to uncover and stop the threat to scholarly publishing and alert unwary researchers and potential authors. In addition, the findings should help concerned organizations recognize the gaps in knowledge about predatory journalism and foster more collaborations worldwide.^[10,15,25]

Author contribution

All authors contributed to the conception and design of the study, data collection, and analysis and to drafting and revision of the manuscript. They all approved the final version of the manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Compliance with ethical principles

No ethical approval is required. No human or animal studies were conducted by the authors

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Reviewers:

Khadija Hajidah (Duabi, UAE)
 Ashraf M Elghul (Abu Dhabi, UAE)
 Ahmed Elhassi (Benghazi, Libya)

Editors:

Elmahdi A Elkhammas (Columbus, OH, USA)