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Assessing the scientific research productivity of a leading toxicology journal: A case study of *Human & Experimental Toxicology* from 2003 to 2012

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Abstract

Background: Bibliometric studies are increasingly being used for research assessments. Bibliometric indicators involve the application of statistical methods to scientific publications to obtain the bibliographics for each journal. The main objective of this study was to conduct a bibliometric evaluation of *Human & Experimental Toxicology* retrieved from the Scopus database.
Methods: This study obtained data from Scopus published from 1 January 2003 till 31 December 2012. The keywords entered in Scopus to accomplish the objective of this study were 'Human', 'Experimental' and 'Toxicology' as 'Source Title'. Research productivity was evaluated based on a methodology developed and used in other bibliometric studies by analysing (a) total and trends in *Human & Experimental Toxicology* contributions in research between 2003 and 2012; (b) *Human & Experimental Toxicology* authorship patterns and productivity; (c) collaboration patterns; and (d) the citations received by the publications.
Results: There were 1229 research articles published in *Human & Experimental Toxicology*. Of the articles included, 947 (77.1%) were original articles and 104 (8.5%) were review articles. The Hirsch-index of the retrieved documents was 35. The largest number of publications in *Human & Experimental Toxicology* was from the United States (19.6%), followed by India (12.8%) and Turkey (10.9%). The total number of citations was 9119, with a median (interquartile range) of 3 (1–9) in 6797 documents. The highest median (interquartile range) number of citations was 8 (2.7–12.7) for France, followed by 7.5 (2–22.5) for Iran and 6 (3–13.5) for the United Kingdom. The country most often citing articles that were published in *Human & Experimental Toxicology* was the United States, which made citations in 1508 documents, followed by India with citations in 792 documents.
Conclusion: The documents in *Human & Experimental Toxicology* focus principally on original data, with very few review articles. Review articles tend to have higher citation rates than original articles, and hence, the editors and authors of *Human & Experimental Toxicology* might usefully promote the submission of reviews in the future to improve the impact of the journal.

Keywords

Bibliometric, human and experimental toxicology, Scopus, citations

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Background

Human & Experimental Toxicology (HET) is a fully peer-reviewed international journal that publishes preclinical and clinical pharmacology and toxicology original research and review articles on experimental and clinical studies of functional, biochemical, and structural disorders.[1] It was established in 1981 as *Human Toxicology* and obtained its current

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name in 1990. It is published by SAGE Publications and the Editor-in-Chief is Kai Savolainen. *HET* is abstracted and indexed in Science Citation Index and Scopus. It is searchable from PubMed but not from PubMed Central.[1]

Toxicology has greatly changed its fields of knowledge and application in relation to scientific evolution and the requirements of society. Toxicologists participate in fundamental and applied research into the toxic effects of chemicals, their mechanisms of action, toxicodynamics, toxicokinetics, and education in toxicology.[2] Toxicology, as a multidisciplinary field, offers career opportunities for graduates with different areas of interest including pharmacology and pharmaceutics, environmental science, agricultural and biological sciences, medicine, biochemistry, genetics and molecular biology, neuroscience, chemistry, social sciences and epidemiology, planetary sciences, immunology, and veterinary.[2–5]

Bibliometric analysis is a useful tool to obtain information about the current state of scientific production in particular areas and allows researchers to identify and undertake new lines of research.[6] Bibliometric indicators involve the application of statistical methods to scientific publications to obtain the bibliographics for each journal, particularly in scientific productivity-related information, which are necessary to the evaluation, planning, and management of a given scientific journal. These methods are mainly quantitative, and are also used to make pronouncements about qualitative pictures of scientific activities.[7,8] Based on the considerations above, bibliometric analysis describing publication trends may give an indication of the progress of the toxicology profession, as reflected in the peer-reviewed record in toxicological journals.

The objectives of this study were to analyse research output from *HET* and to examine the authorship pattern and citations retrieved from the Scopus database. Such a study will lead to a better understanding of the current and future status of research in *HET*. Furthermore, the results of the study will help editors and authors to shape *HET* research in the next decade.

Methods

This study relied on data from Scopus published from 1 January 2003 to 31 December 2012. It is assumed that the most recent decade would project the best picture of the pattern of publications and the citations received. A comprehensive online search was performed using SciVerse, Scopus, which is one of the world's largest abstract and citation databases of peer-reviewed literature. Scopus contains 41 million records and covers nearly 18,000 titles from 5000 publishers worldwide, and provides 100% MEDLINE coverage.[9]

The Scopus database was developed by Elsevier and combines the characteristics of both Web of Science and PubMed. These characteristics allow for enhanced service for educational and academic needs, medical literature research, and bibliometric analysis. Scopus offers a basic search, or an advanced search. In the basic search, the results for the chosen keywords can be limited by the date of publication, by addition to Scopus, by subject area, and by document type.[10,11] The search output from Scopus can be presented as a list of 20–200 items per page, and extracted documents can be exported to Microsoft Office Excel®. The results can be refined by document type, author name, source title, publications per year, and/or subject area, and a new search can be initiated within the results.[10,11]

The keywords entered in Scopus to accomplish the objective of this study were 'Human', 'Experimental', and 'Toxicology' as 'Source Title'. The subject areas selected for this research were health sciences, life sciences, social sciences, and physical sciences during a 10-year period (2003–2012). The resultant search was as follows: your query: (SRCTITLE(human) AND SRCTITLE(experimental) AND SRCTITLE(toxicology)) AND PUBYEAR > 2002 AND PUBYEAR < 2013.

The collated data were used to generate the following information: (a) total and trends in *HET* contributions in research between 2003 and 2012; (b) *HET* authorship patterns and productivity; (c) collaboration patterns; and (d) the citations received by the publications.

Ethical approval

The Institutional Review Board (IRB) at An-Najah National University does not require submission of an IRB application for such study. The IRB considered that there is no risk for human subjects in such publications since the data are based on published literature and secondary data, and did not involve any interactions with human subjects. In addition, the Editor-in-Chief of *HET* gave us the right to submit our manuscript in *SAGE Open Medicine*.

Statistical analysis

Data from Scopus were exported to Excel and then to the Statistical Package for Social Sciences (SPSS; SPSS Inc., Chicago, IL, USA) program version 15 for analysis. Categorical data are expressed as numbers with percentages. Variables that are not normally distributed are expressed as median (Q1–Q3: interquartile range). The Hirsch-index (*h*-index) for the data collected from Scopus is presented. The *h*-index represents the number of citations received for each of the documents in descending order, while the *h*-graph measures the impact of a set of documents and displays the number of citations per document. The journal's impact factors (IFs) were evaluated using the Journal Citation Report (JCR; Web of Knowledge) 2012 science edition by Thomson Reuters (New York, USA).

Results

There were 1229 research documents published in *HET* during the period from 2003 to 2012. Of the documents included,

947 (77.1%) were original journal articles, 104 (8.5%) were review articles, 71 (5.8%) were meeting/conference articles, 25 (2.0%) were letters, and 82 (6.6%) were other types of publications, with an average of 123 documents per year. The average number of included documents published per year was 123, with a range from 85 to 232. A nonlinear, bimodal distribution of documents published per year was observed, with peak publications in 2011 (Figure 1).

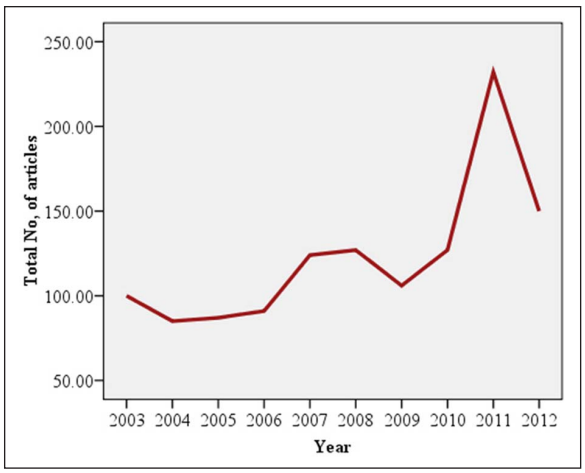

Figure 1. Total articles included in the bibliometric analysis by publication year.

In Table 1, a list of 20 countries is presented whose researchers published the largest number of articles in *HET* during the period from 2003 to 2012. When the data were analysed by country, the largest number of publications in *HET* was from the United States (19.6%), followed by India (12.8%) and Turkey (10.9%) (Table 1). The total number of citations at the time of data analysis (8 September 2013) was 9119, with a median (interquartile range) of 3 (1–9) in 6797 documents. The highest median (interquartile range) number of citations was 8 (2.7–12.7) for France, followed by 7.5 (2–22.5) for Iran, and 6 (3–13.5) for the United Kingdom. Of the 1229 documents considered for the *h*-index, 35 had been cited at least 35 times at the time of data analysis (8 September 2013). The highest *h*-index was 22 for the United States, followed by 21 for the India, and 20 for Iran. Furthermore, the highest number of collaborations with international authors for each country was held by the United States, with 26 countries, followed by 12 countries for the United Kingdom (Table 1).

Table 2 shows the top 20 most productive institutions in *HET*. The most productive institution was Tehran University

Table 1. The top 20 ranking of the most productive countries that published the largest number of articles in *Human & Experimental Toxicology* during the period from 2003 to 2012.

SCR[a]	Countries	Articles (%)	Cit	CitArt	Median Cite (Q1–Q3)	*h*-index	Collaborations with foreign countries
1st	United States	241 (19.6)	1800	190	3(1–9)	22	26
2nd	India	157 (12.8)	1358	147	4(1.5–12)	21	8
3rd	Turkey	134 (10.9)	952	124	4(1–10)	17	3
4th	Iran	70 (5.7)	1067	60	7.5(2–22.5)	20	5
5th	China	53 (4.3)	159	38	2(0.0–4.5)	7	4
6th	Brazil	45 (3.7)	259	39	4(2–8)	10	5
6th	United Kingdom	45 (3.7)	403	41	6(3–13.5)	12	12
8th	Germany	42 (3.4)	319	32	3.5(0.7–11)	11	7
9th	South Korea	40 (3.3)	177	32	3(1–5)	7	3
10th	Taiwan	39 (3.2)	203	30	3(1–8)	9	2
11th	Italy	38 (3.1)	263	29	3(0.7–7.5)	9	6
12th	Japan	35 (2.8)	175	25	3(0–8)	8	6
13th	France	30 (2.4)	324	28	8(2.7–12.7)	11	7
14th	Poland	29 (2.4)	255	24	4(1–9.5)	8	4
15th	Finland	27 (2.2)	241	22	4(1–9)	8	11
16th	Netherlands	25 (2.0)	226	20	4(1–9.5)	8	10
17th	Canada	23 (1.9)	185	22	5(2–13)	9	9
18th	South Africa	20 (1.6)	69	16	2(1–6)	6	2
19th	Nigeria	18 (1.5)	85	14	2(0.7–4.7)	4	2
19th	Spain	18 (1.5)	173	18	5(3–7.5)	7	8
–	Others (47 countries)	238 (19.4)	1800	205	4(1–8)	20	–

SCR: Standard Competition Ranking; Articles (%): the number of articles and percentages from the total of 1229; Cit: the number of citations; CitArt: the number of citing articles; H: Hirsch-index; Q1–Q3: interquartile range.

[a]Equal countries have the same ranking number, and then a gap is left in the ranking numbers.

Table 2. The top 20 ranking of the most productive institutions during the study period.

SCR[a]	Institution, country	No. of documents (%)[b]
1st	Tehran University of Medical Sciences, Iran	43 (3.5)
2nd	University of Massachusetts Amherst, USA	26 (2.1)
3rd	Indian Institute of Toxicology Research, India	21 (1.7)
4th	Texas Department of State Health Services, USA	19 (1.5)
6th	Yüzüncü Yil Üniversitesi, Turkey	17 (1.4)
7th	Universidade de Sao Paulo, Brazil	15 (1.2)
7th	University of Madras, India	15 (1.2)
7th	Työterveyslaitos, Finland	15 (1.2)
7th	Jamia Hamdard University, India	15 (1.2)
7th	Loghman-Hakim Hospital, Iran	15 (1.2)
12th	Süleyman Demirel Üniversitesi, Turkey	13 (1.1)
12th	Johns Hopkins Bloomberg School of Public Health, USA	13 (1.1)
12th	China Medical University Taichung, Taiwan	13 (1.1)
12th	China Medical University Hospital Taichung, Taiwan	13 (1.1)
16th	Hamdard University, India	12 (1.0)
17th	European Commission Joint Research Centre, Ispra, Italy	11 (0.9)
18th	UNESP-Universidade Estadual Paulista, Brazil	10 (0.8)
18th	University College of Medical Sciences, India	10 (0.8)
18th	Mustafa Kemal Üniversitesi, Turkey	10 (0.8)
18th	Maastricht University, Netherlands	10 (0.8)
18th	Veterans General Hospital-Kaohsiung Taiwan, Taiwan	10 (0.8)

SCR: Standard Competition Ranking.
[a]Equal institutes have the same ranking number, and then a gap is left in the ranking numbers.
[b]Percentage of publications for each institute from the total number of documents.

of Medical Sciences (3.5% of total publications), followed by University of Massachusetts Amherst (2.1%), Indian Institute of Toxicology Research (1.7%), and Texas Department of State Health Services (1.5%). Table 3 presents a list of the 21 most productive authors of *HET*, who have published at least seven documents in it during the last 10 years. In Table 4, a list of the most cited documents from 2003 to 2012 is shown. The most cited research area in the list of the most cited documents from *HET* was molecular biology (13 documents out of 20). Four authors who were represented as productive authors had articles among the top citations (Table 4).

Table 5 reveals year-wise journal citations. It is noted that 2012 had the largest number of citations, with 1.3 citations per article. A perusal of citation patterns shows that a majority of citations pertain to journal articles 6415 (94.3%). A total of 59 (0.8%) citations are from books and 131 (1.9%) citations pertain to proceedings, while 192 (2.9%) citations pertain to other sources. From this study, it is clear that most of the authors used journal articles. Table 6 shows the frequency and percentage of journals citing *HET* articles. The most common citations were from *HET* itself. The remaining journals in the top 20 were also closely related to the interface of Toxicology. It is important to note, however, that these 20 journals account for less than one-fifth (19.2%) of total citations of the documents in our sample. All top 20 journal titles had their IFs listed in the JCR 2012. Table 7 shows the top 20 ranking of prolific authors most often citing documents that were published in *HET* during the period of study. The most prolific authors most often citing documents that were published in *HET* were M. Abdollahi from Iran who made citations in 122 documents, followed by K. Kuca from the Czech Republic who made citations in 35 documents, T. Hartung from the United States who made citations in 33 documents, and S. Shadnia from Iran who made citations in 30 documents. Furthermore, Table 8 shows the top 20 ranking of countries of authors most often citing documents that were published in *HET.* Authors from 117 different countries cited *HET* articles once or more. The top countries for citing documents that were published in *HET* were the United States, with citations in 1508 documents, followed by India with citations in 792 articles, China with citations in 442 documents, and Iran with citations in 371 documents.

Discussion

Previous bibliometric studies of publications in toxicology have been studied at the international or national level, highlighting toxicology research in general without any specific interest being paid to individual journals or to the citations concerned by certain toxicology journals.[12–18] Here, we have

Table 3. The top 20 ranking of prolific authors who published most frequently in *Human & Experimental Toxicology*, 2003 to 2012, with their affiliations and publication patterns.

SCR[a]	Author	No. (%)[b] of publications	No. (%)[c] of publications as first author	No. (%)[d] of publications as corresponding author	Affiliation
1st	M. Abdollahi	30 (2.4)	0 (0.0)	14 (46.7)	Mazandaran University of Medical Sciences, Department of Pharmacology and Toxicology, Sari, Iran
2nd	E. J. Calabrese	25 (2.0)	16 (64.0)	17(68.0)	University of Massachusetts Amherst, Department of Public Health, Amherst, United States
3rd	M. B. Forrester	19 (1.5)	16 (84.2)	16 (84.2)	Texas Department of State Health Services, Epidemiology and Disease Surveillance Unit, Austin, United States
4th	S. Shadnia	15 (1.2)	6 (40.0)	0 (0.0)	Loghman-Hakim Hospital, Clinical Toxicology Department, Tehran, Iran
5th	J. G. Chung	11 (0.9)	0 (0.0)	9 (81.8)	China Medical University Taichung, Department of Biological Science and Technology, Taichung, Taiwan
6th	S. Hoffmann	10 (0.8)	2 (20.0)	2 (20.0)	Universität Konstanz, Konstanz, Germany
6th	T. Hartung	10 (0.8)	1 (10.0)	1 (10.0)	Johns Hopkins University, Bloomberg School of Public Health, Baltimore, United States
8th	C. Griesinger	9 (0.7)	8 (88.9)	8 (88.9)	European Commission Joint Research Centre, Ispra, European Centre for the Validation of Alternative Methods (ECVAM), Ispra, Italy
9th	A. Pajoumand	8 (0.7)	0 (0.0)	0 (0.0)	Loghman-Hakim Hospital, Toxicological Research Center, Tehran, Iran
9th	C. R. Jan	8 (0.7)	0 (0.0)	6 (75.0)	Veterans General Hospital-Kaohsiung Taiwan, Department of Medical Education and Research, Kaohsiung, Taiwan
9th	A. Kinsner	8 (0.7)	1 (12.5)	1 (12.5)	European Commission Joint Research Centre, Vitro Methods Unit, Ispra, Italy
9th	J. S. Yang	8 (0.7)	1 (12.5)	0 (0.0)	China Medical University Taichung, Department of Pharmacology, Taichung, Taiwan
9th	K. Savolainen	8 (0.7)	1 (12.5)	2 (25.0)	Finnish Institute Occupational Health, Nano safety Research Center, Helsinki, Finland
9th	J. Liesivuori	8 (0.7)	0 (0.0)	0 (0.0)	University of Turku, Department of Pharmacology, Drug Development and Therapeutics, Abo (Turku), Finland
9th	S. Coecke	8 (0.7)	0 (0.0)	0 (0.0)	European Commission Joint Research Centre, Ispra, Ispra, Italy
9th	H. Van Loveren	8 (0.7)	1 (12.5)	3 (37.5)	Maastricht University, Department of Toxicogenomics, Maastricht, Netherlands
9th	Y. Tuncok	8 (0.7)	0 (0.0)	4 (50.0)	DokuzEylul University, Faculty of Medicine, Department of Pharmacology, Izmir, Turkey
18th	M. Akhtar	7 (0.6)	1 (14.3)	3 (42.9)	Jamia Hamdard Faculty of Pharmacy, Department of Pharmacology, New Delhi, India
18th	S. W. Ip	7 (0.6)	1 (14.3)	0 (0.0)	China Medical University Taichung, Department of Nutrition, Taichung, Taiwan
18th	S. Satar	7 (0.6)	0 (0.0)	0 (0.0)	Department of Emergency, Adana Numune Research and Education Hospital, Adana, Turkey
18th	A. B. Pant	7 (0.6)	0 (0.0)	3 (42.9)	Council of Scientific and Industrial Research India, New Delhi, India

SCR: Standard Competition Ranking.
[a]Equal authors have the same ranking number, and then a gap is left in the ranking numbers.
[b]Percentage of publications for each author out of the total number of documents.
[c]Percentage of publications for prolific author as first author from the total number of documents for each author.
[d]Percentage of publications for prolific author as corresponding author from the total number of documents for each author.

Table 4. The top 20 ranking of cited articles from *Human & Experimental Toxicology* during the period from 2003 to 2012.

SCR[a]	Authors with year of publication	Title	Research Area	Time cited
1st	Castro et al. (2006)	Toxic side effects of drugs used to treat Chagas' disease (American trypanosomiasis)	Clinical report	145
2nd	Akhgari et al. (2003)	Biochemical evidence for free radical-induced lipid peroxidation as a mechanism for subchronic toxicity of malathion in blood and liver of rats	Molecular biology	141
3rd	Schwarze et al. (2006)	Particulate matter properties and health effects: Consistency of epidemiological and toxicological studies	Clinical report	130
4th	Stepnowski et al. (2004)	Evaluating the cytotoxicity of ionic liquids using human cell line HeLa	Molecular biology	103
5th	Shadnia et al. (2005)	Evaluation of oxidative stress and genotoxicity in organophosphorus insecticide formulators	Molecular biology	96
6th	Vahidnia et al. (2007)	Arsenic neurotoxicity - A review	Clinical report	74
7th	Guzelian et al. (2005)	Evidence-based toxicology: A comprehensive framework for causation	Clinical report	70
8th	Filipic et al. (2006)	Molecular mechanisms of cadmium induced mutagenicity	Molecular biology	67
9th	Hoffmann and Hartung (2006)	Toward an evidence-based toxicology	Clinical report	65
10th	Azzam and Little (2004)	The radiation-induced bystander effect: Evidence and significance	Molecular biology	63
11th	Calabrese (2010)	Hormesis is central to toxicology, pharmacology and risk assessment	Molecular biology	59
11th	Falck et al. (2009)	Genotoxic effects of nanosized and fine TiO_2	Molecular biology	59
13th	Weltje et al. (2005)	Reproductive stimulation by low doses of xenoestrogens contrasts with the view of hormesis as an adaptive response	Molecular biology	57
13th	Ahmad et al. (2005)	Neuroprotective effects of Withaniasomnifera on 6-hydroxydopamine induced Parkinsonism in rats	Molecular biology	57
15th	Pollycove and Feinendegen (2003)	Radiation-induced versus endogenous DNA damage: Possible effect of inducible protective responses in mitigating endogenous damage	Molecular biology	56
16th	Shadnia et al. (2007)	Pattern of acute poisoning in Tehran-Iran in 2003	Clinical report	55
17th	Haque et al. (2003)	Aqueous extract of walnut (Juglansregia L.) protects mice against cyclophosphamide-induced biochemical toxicity	Molecular biology	54
18th	Abdollahi et al. (2003)	Protection by sildenafil and theophylline of lead acetate-induced oxidative stress in rat submandibular gland and saliva	Molecular biology	52
19th	Shukla et al. (2003)	Protective effect of curcumin against lead neurotoxicity in rat	Molecular biology	51
20th	Baud (2007)	Cyanide: Critical issues in diagnosis and treatment	Clinical report	50

SCR: Standard Competition Ranking.
[a]Equal articles have the same ranking number, and then a gap is left in the ranking numbers.

complemented the previous bibliometric studies with a detailed analysis of publications in, and citations to, the *HET*. We have provided a comprehensive analysis of articles published in *HET* during the past 10 years. We see this bibliometric analysis as reasonably summarizing data of a journal that is one of the most familiar and cited toxicology research peer-reviewed journals. Interpretation of publication trend data potentially provides an indirect indication of the progress of the toxicology profession, as reflected by the peer-reviewed record in toxicological journals.[16]

As expected, the United States was the most productive country with its researchers being the corresponding authors or co-authors of 19.6% of all documents. These documents also amassed the largest number of citations (Citations = 1800). Furthermore, the United States also collected the largest number of citations for documents that were published in *HET* during the period of study.

We accounted that contributions from the 'rest of the world' (outside of the United States) showed to increase steadily during the period of study. Particularly, the bibliometric data indicated that Turkey and Iran have been the major research contributors from the Middle East, whereas India and China produced the most research articles from the Asia-Pacific region. The 20 most productive countries that were published in *HET* include many nations familiar from any other scientific productivity ranking.[19] Toxicology in

Turkey and Iran has experienced a rapid development and showed a great progress in education and research in conjunction with the economic development in these countries over the past two decades.[14,20–22] Based on the *SCImago Journal & Country Rank*, which is a portal that includes the journals and country-scientific indicators developed from the information contained in the Scopus database (Elsevier B.V.), Turkey has the first rank in the scientific productivity in the field of 'Toxicology' among Middle East countries by publishing 1488 articles from 1996 to 2012, while Iran has published 873 articles at the same time and is ranked the second in the Middle East.[23] These results are similar to the findings of our study.

The average citation rate for documents from *HET* was 7.4 citations per document. This is slightly less than the average citation rate for most journals in other scientific disciplines.[16,24] Overall, toxicology journals as a group have low citation numbers compared to other scientific disciplines.[17,18,24] This is likely endorsed to several factors. First, the number of researchers of toxicology is small, which means relatively fewer documents have been published in peer-reviewed toxicology journals compared with other disciplines. Second, the apparent narrow focus of toxicology journals may encourage researchers who have some connection to the field of toxicology to publish their results in journals that may have a larger audience than that of toxicology journals.[16,25] This exact situation was demonstrated in the emergency medicine literature by Callaham et al.;[26] they reported that publications in emergency medicine journals were cited more than 3 times as often when published in non-emergency medicine journals. Comparing toxicology to areas such as molecular biology and genetics, where new discoveries are made almost every day, human toxicology is a more slowly advancing science. This can result in wide disparities between the citations of journals in different fields

Table 5. Distribution of documents that cited 1229 articles from *Human & Experimental Toxicology* during the period from 2003 to 2012.

Year	Total N = 6797 (%)
2003	21 (0.3)
2004	96 (1.4)
2005	227 (3.3)
2006	323 (4.8)
2007	512 (7.5)
2008	722 (10.6)
2009	903 (13.3)
2010	1062 (15.6)
2011	1304 (19.2)
2012	1627 (23.9)

Table 6. The top 20 ranking of journals most often citing articles that were published in *Human & Experimental Toxicology* during the period from 2003 to 2012 with their impact factors.

SCR[a]	Journal	Frequency (%)	IF (2012)[a]
1st	*Human & Experimental Toxicology*	251 (3.7)	1.453
2nd	*Food and Chemical Toxicology*	94 (1.4)	3.01
3rd	*Toxicology*	87 (1.3)	4.017
4th	*Toxicology and Applied Pharmacology*	82 (1.2)	3.975
5th	*Toxicology Letters*	78 (1.1)	3.145
6th	*Clinical Toxicology*	69 (1.0)	2.592
7th	*Toxicological Sciences*	51 (0.8)	4.328
7th	*Toxicology in Vitro*	51 (0.8)	2.65
9th	*Journal of Applied Toxicology*	49 (0.7)	2.597
10th	*Environmental Health Perspectives*	48 (0.7)	7.260
11th	*Neurotoxicology*	47 (0.7)	2.652
11th	*Pesticide Biochemistry and Physiology*	47 (0.7)	2.111
13th	*Environmental Toxicology and Pharmacology*	45 (0.7)	2.005
14th	*Regulatory Toxicology and Pharmacology*	44 (0.6)	2.132
15th	*Toxicology and Industrial Health*	41 (0.6)	1.555
16th	*PLoS One*	40 (0.6)	3.730
16th	*Chemico-Biological Interactions*	40 (0.6)	2.967
18th	*International Journal of Pharmacology*	36 (0.5)	1.202
18th	*Ecotoxicology and Environmental Safety*	36 (0.5)	2.203
20th	*Basic and Clinical Pharmacology and Toxicology*	34 (0.5)	2.124
20th	*Toxicology Mechanisms and Methods*	34 (0.5)	1.367

SCR: Standard Competition Ranking; IF: impact factor; ISI: Institute for Scientific Information; JCR: Journal Citation Report.
[a]Equal journals have the same ranking number, and then a gap is left in the ranking numbers.
[a]The impact factor was reported according to ISI JCR 2012.

Table 7. The top 20 ranking of prolific authors most often citing articles that were published in *Human &Experimental Toxicology* during the period from 2003 to 2012.

SCR[a]	Author	No. of cited publications	Affiliation
1st	M. Abdollahi	122	Mazandaran University of Medical Sciences, Department of Pharmacology and Toxicology, Sari Iran
2nd	K. Kuca	35	University of Hradec Kralove, Department of Chemistry, Hradec Kralove, Czech Republic
3rd	T. Hartung	33	Johns Hopkins University, Bloomberg School of Public Health, Baltimore, United States
4th	S. Shadnia	30	Loghman-Hakim Hospital, Clinical Toxicology Department, Tehran, Iran
5th	M. Baeeri	26	Tehran University of Medical Sciences, Faculty of Pharmacy, Tehran, Iran
6th	Y. H. Siddique	24	Aligarh Muslim University, Department of Zoology, Aligarh, India
7th	E. J. Calabrese	23	University of Massachusetts Amherst, Department of Public Health, Amherst, United States
8th	M. Afzal	22	Aligarh Muslim University, Department of Zoology, Aligarh, India
8th	S. Sultana	22	Jamia Hamdard University, Department of Medical Elementology and Toxicology, New Delhi, India
10th	A. Mohammadirad	21	Tehran University of Medical Sciences, Faculty of Pharmacy, Tehran, Iran
11th	C. R. Jan	20	Veterans General Hospital-Kaohsiung Taiwan, Department of Medical Education and Research, Kaohsiung, Taiwan
11th	O. Mehrpour	20	Birjand University of Medical Sciences, Department of Clinical Toxicology and Forensic Medicine, Birjand, Iran
13th	G. Ara	19	Aligarh Muslim University, Department of Zoology, Aligarh, India
13th	P. Varalakshmi	19	University of Madras, Department of Medical Biochemistry, Chennai, India
15th	T. Beg	18	Aligarh Muslim University, Department of Zoology, Aligarh, India
15th	S. J. S. Flora	18	Defence Research & Development Establishment India, Division of Pharmacology and Toxicology, Gwalior, India
17th	H. Sanaei-Zadeh	17	Shiraz University of Medical Sciences, School of Medicine, Tehran, Iran
17th	B. D. Banerjee	17	University College of Medical Sciences, Department of Biochemistry, New Delhi, India
19th	I. Iavicoli	16	Catholic University of the Sacred Heart, Rome, Institute of Occupational Medicine, Rome, Italy
19th	I. Altuntas	16	Suleyman Demirel University, Faculty of Medicine, Department of Biochemistry, Isparta, Turkey
19th	S. Nikfar	16	Iranian Ministry of Health and Medical Education, Food and Drug Laboratory Research Center, Tehran, Iran
19th	D. Jun	16	Faculty Hospital at Hradec Kralove, Hospital Pharmacy, Hradec Kralove, Czech Republic

SCR: Standard Competition Ranking.
[a]Equal authors have the same ranking number, and then a gap is left in the ranking numbers.

in comparison to a journal with a narrow field.[24] This may be one reason why journals like the *New England Journal of Medicine, Lancet, JAMA, Science*, and *Nature*, whose content encompasses the entire scope of general medicine, are always among the journals with the highest citations, which in turn leads to high IF. Since human toxicology is a very constricted field with a very small readership, it should not be astonishing that toxicology journals have small numbers of citations, which leads to average IFs.[16,27]

On the other hand, according to the JCR 2012, *HET* IF is 1.453, and it is ranked the 65th out of 85 peer-reviewed toxicology journals listed in the category of Toxicology. Compared to other journals in the Toxicology category, the highest IF was for *Annual Review of Pharmacology and Toxicology* (21.543), and the lowest IF was for *Archiv fur Lebensmittelhygiene* (0.267). In addition, according to the JCR 2012, *HET* articles number during the year 2012 is 138, and it is ranked the 23rd out of 85 regarding the number of articles published in that year. The highest articles number in year 2012 was for *Food and Chemical Toxicology* (690), and the lowest articles number was for *Journal of Health Science*, and it was 0. Furthermore, *HET* 2012 total cites was 2506, and it is ranked the 43rd out of 85. Compared to other journals in the Toxicology category, the highest total cites was for *Toxicology and Applied Pharmacology* (15,852), while the lowest total cites was for *Toxin Reviews*, and it was 118 (analysis of data not shown in result).[28]

It was observed that most countries such as the United States, India, China, and Iran demonstrate a high country citation rate: researchers from these countries are

Table 8. The top 20 ranking of countries most often citing articles that were published in *Human & Experimental Toxicology* during the period from 2003 to 2012.

SCR	Countries	Articles (%)
1st	United States of America	1508 (22.19)
2nd	India	792 (11.65)
3rd	China	442 (6.50)
4th	Iran	371 (5.46)
5th	United Kingdom	367 (5.40)
6th	Germany	360 (5.30)
7th	Turkey	348 (5.12)
8th	Italy	301 (4.43)
9th	Brazil	244 (3.59)
10th	Canada	240 (3.53)
11th	France	236 (3.47)
12th	Spain	189 (2.78)
13th	Japan	181 (2.66)
14th	South Korea	156 (2.30)
15th	Netherlands	152 (2.24)
16th	Poland	145 (2.13)
17th	Taiwan	143 (2.10)
18th	Egypt	121 (1.78)
19th	Sweden	120 (1.77)
20th	Australia	106 (1.56)
–	Others (97 countries)	–

SCR: Standard Competition Ranking.

disproportionably more likely to cite documents that were produced by their own country rather than representative by any other nation.[29] Furthermore, a strong cooperative 'ingroup' network slants researchers to probe the same research questions and use similar methodology and data interpretations, the result of which leads to share document citations.[30] However, these country links are visibly overshadowed by a larger international network operating within *HET*. It is not surprising that many prolific authors who cited documents that were published in *HET* are also among the most productive authors such as M. Abdollahi; T. Hartung; S. Shadnia; E. J. Calabrese; and C. R. Jan. It was also interesting to see authors who have the highly cited documents from *HET* are also among the most prolific authors, such as M. Abdollahi; S. Shadnia; and E. J. Calabrese.

The most cited documents from *HET* were review articles. In general, journals that publish a large number of reviews tend to have higher citation rates than original articles.[31–34] Furthermore, reviews are among the most cited articles because reviews often cite previously published works from the same journal. This exact scenario was demonstrated by Jang and Rusyniak;[24] they found that most journals ranked in the top 20 by Institute for Scientific Information (ISI) were devoted solely to reviews.

To the best of our knowledge, this study is the first of its kind to obtain initial data regarding bibliometric analysis of articles published in one of the most leading toxicology journals. This study is not without limitations, most of which are the same as those of bibliometric studies performed in other biomedical fields. This study was limited to citations extracted from Scopus, bearing *HET* in the references and, therefore, cannot be generalized to the literature covered by other databases such as Google Scholar. However, the study does give a clear picture about the characteristics of the documents from *HET* published in foreign channels, especially those indexed by Scopus. Although the number of citations for each publication might differ from one search engine to another, the Scopus search engine remains one of the best available tools for analysing and tracking citations, and comparing citations among different research groups and different institutions.[11,35] A study that compared PubMed, Scopus, Web of Knowledge, and Google Scholar has found that PubMed remains an important resource for clinicians and researchers, while Scopus covers a wider journal range and offers the capability to do citation analysis.[10,35–37]

Conclusion

The documents in *HET* focus principally on original data, with very few review articles. Review articles tend to have higher citation rates than original articles, and hence, the editors and authors of *HET* might usefully promote the submission of reviews in the future to improve the impact of the journal. Furthermore, they need to encourage authors to cite their own literature, which would further help to increase the impact of the journal.

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