Scientometric profile of global male breast cancer research

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An analysis of 4165 papers published during 2005–2014 on male breast cancer and indexed by Science Citation Index-Expanded indicates that the publication output in this nascent field is increasing steadily. The output is scattered among 91 countries, and USA ranks first in the publication output as well as impact in terms of citations per paper (CPP) and relative citation impact (RCI). The global compound annual growth rate during the period of study is 6.2. Change in transformative activity index is highest for the People's Republic of China (PRC). However, impact of research output is low for PRC. The research output is highly scattered in terms of prolific institutions, authors and journals publishing research results. Most of the prolific institutions are located in USA. Among the prolific institutions, the highest value of CPP and RCI was for Massachusetts General Hospital (USA), and among authors the highest value of CPP and RCI was for Thompson D. from the University of Cambridge (England).

Keywords: Citation analysis, male breast cancer, publication output, scientometric assessment, transformative activity index.

BREAST cancer in men is a rare condition, accounting for only 1% of all cases of the disease[1–3]. Breast cancer is 100 times more common in women than men. The incidence of male breast cancer (MBC) has increased over the past 25 years[4]. The worldwide variation of MBC resembles that of female breast cancer (FBC), with higher rates in North America and Europe and lower rates in Asia. The epidemiology of MBC is similar to that of FBC. Surgery is still the major therapeutic option for both female and male breast cancer[5]. Several studies related to scientometrics of breast cancer research have been reported in the literature[6–10]. For instance, Moodley *et al.*[6] examined cancer research in South Africa using Pubmed, Scopus, Web of Science (WoS) and EBSCO databases during 2004–2014, and found that the research activity has increased considerably in the country. The study also examined quality of research using impact factor (IF) of the journals where the research results were published. Biglu[7] examined Iran's volume of scientific production on breast cancer using MEDLINE database during 2000–2014 and found that Iranian researchers published only 578 scientific documents. Maximum emphasis was on the subfield of epidemiology. About 37% of Iranian articles were published in journals with IF between 0.693 and 4.469. Among all journals publishing Iranian articles, majority of papers were published in journals from Thailand followed by USA and UK. Perez-Santos and Anaya-Ruiz[8] explored scientific output and research performance of individuals and institutions in breast cancer of Mexico using WoS database from 2003 to 2012. Based on an output of 256 articles, it was found that majority of the papers were published by the National Autonomous University of Mexico (22.3%), closely followed by National Institute of Cancerology (21.9%) and Social Security Mexican Institute (20.3%). The area which got maximum emphasis was clinical observation. Nazir *et al.*[9] and Glynn[10] had undertaken cross-national assessment of breast cancer research using Scopus and WoS databases for the periods 2002–2012 and 1945–2008 respectively. Both the studies found that US-topped the list in output as well as impact of research output. In all these studies breast cancer is discussed in the context of women. There is no bibliometric study that examines global research output on MBC. The present study is an attempt in that direction, which makes a scientometric assessment of the global research efforts in terms of the number of countries, institutions and authors undertaking research on different aspects of MBC.

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Objectives

Following are the objectives of the study.

- To examine the pattern of global MBC research output during 2005–2014.

- To examine geographical distribution of the research output and also study the transformative activity index (TAI) for each prolific country.
- To examine impact of the research output of most prolific countries using citations per paper (CPP), relative citation impact (RCI) and percentage of publications not cited (PNC).
- To identify the most prolific institutions involved in MBC research and examine the impact of their research output.
- To identify the most prolific authors and the impact of their research output.
- To examine the pattern of citations of the research output and identify highly cited papers.
- To identify the journals in which the research results related to MBC were published.

Methodology

Science Citation Index-Expanded (SCI-E), a product of Thomson Reuters was used for the present scientometric assessment of global MBC research. Data were extracted using several keywords like 'male breast cancer' or 'male breast neoplasm' or 'male breast tumor' or 'male breast carcinoma' for the period 1 January 2005–31 December 2014 in the topic field. Downloaded data were transferred to MS Excel in various 'data blocks' under various heads or tags (like AU = Authors, TL = Title, PY = Publication Year, DT = Document Type, etc.) on the basis of content of the blocks. Data were then arranged country-wise according to the first author's affiliation. The search yielded 4413 records that dealt with different aspects of MBC research. Bibliographic details for each record included document type, title of the paper, author and his affiliation, name of the journal with its place of publication, and the number of citations received by each paper. From these downloaded records, 225 of them that were published as corrections, news items, editorial material, meeting abstracts, reprints and book reviews were removed. Of the remaining 4188 records, 20 did not contain sufficient information like author name, affiliation and country, and hence were not included in the analysis. Thus, the total number of papers analysed was 4168, which included 3633 articles, 112 proceedings papers published as journal articles, 384 reviews and 39 letters. These were published in 14 different languages; 4055 (97.2%) were published in English and the rest 113 in French (39), German (26), Spanish (21), Turkish (7), Korean (6) and Polish and Italian 4 each. Thus, the total number of papers in these 7 languages was 107 (2.6%) of the total output. The remaining six papers were published one each in Chinese, Czech, Japanese, Portuguese, Serbian and Slovenian.

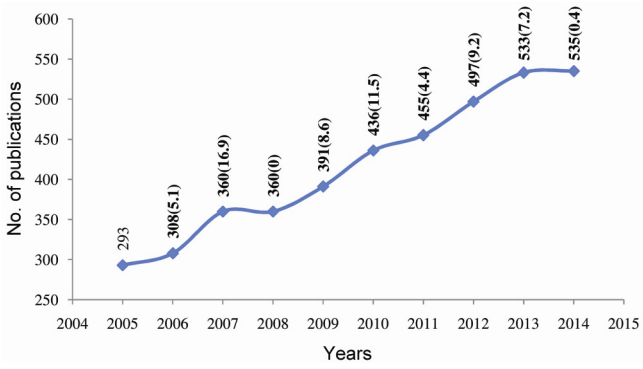

Figure 1. Growth pattern of world publication output on male breast cancer research.

Results and discussion

Pattern of research output

During the period of 10 years from 2005 to 2014, 4168 papers were published on different aspects of MBC research. Figure 1 shows the pattern of output and annual growth rate of publication output during the years 2005–2014. The graph shows continuous rising trend from 2005 to 2014. However, the annual rate of growth (numbers mentioned in brackets in Figure 1) is inconsistent and fluctuates during the study period. It was highest in 2007 and has declined in later years. It is observed that the number of publications during 2013 and 2014 is almost the same. The lowest (293) number of papers was published in 2005. It is also observed that the publications approximately doubled in the ten-year span of 2005 to 2014. The compound annual growth rate (CAGR) was calculated using the formula given below and is available at www.investopedia.com/calculator/cagr.aspx. CAGR (mean annual growth rate) was found to be 6.2 during the study. Annual growth rate is lower than CAGR for 2006, 2008, 2011 and 2014.

$$\text{CAGR} = \left(\frac{\text{Ending value}}{\text{Begining value}} \right)^{1/n-1} - 1.$$

Geographical distribution of research output and change in output in two blocks

The MBC research output originated from 91 countries scattered all over the globe, unlike FBC research where the output came from 155 different countries. Also, the ranking of countries based on the pattern of output in MBC was different from female breast cancer (FBC) except USA which ranked first both in FBC as well as MBC[10]. Table 1 lists 20 countries publishing 50 or more publications. The share of these countries was about 86% of the total output. Remaining 14% output was scattered among 71 countries. Among the most prolific countries, USA

Table 1. Transformative activity index (TAI) of prolific countries

Country	# Papers (TAI) during 2005–2009	# Papers (TAI) during 2010–2014	Change in TAI	Total no. of papers
USA	572 (116)	626 (89)	(–) 27	1198
PRC	53 (51)	201 (134)	83	254
Italy	88 (89)	153 (108)	19	241
Germany	104 (107)	130 (94)	(–) 13	234
Japan	93 (110)	112 (93)	(–) 17	205
England	103 (127)	94 (81)	(–) 46	197
Canada	64 (103)	88 (98)	(–) 5	152
Australia	45 (91)	76 (107)	16	121
Turkey	38 (78)	80 (115)	37	118
France	47 (100)	68 (100)	0	115
India	38 (81)	76 (113)	32	114
South Korea	31 (79)	65 (115)	36	96
The Netherlands	35 (99)	51 (101)	2	86
Taiwan	23 (66)	62 (124)	58	85
Spain	33 (100)	47 (100)	0	80
Brazil	20 (66)	54 (124)	58	74
Sweden	30 (114)	34 (90)	(–) 24	64
Denmark	24 (103)	33 (98)	(–) 5	57
Greece	23 (98)	34 (101)	3	57
Iran	23 (106)	30 (96)	(–) 10	53
Seventy-one other countries	225 (97)	342 (102)	5	567
Total	1712	2456		4168

topped the list with more than one-fourth (28.7%) share of publication output. Other high-output countries were People's Republic of China (PRC), Italy, Germany and Japan. These countries contributed about 6%, 5.8%, 5.6% and 4.9% of papers respectively of the total output. These five countries together accounted for more than half (51.2%) the share of the total output. Rest of the 34.8% output was scattered among 16 countries, with India at the 11th position contributing 114 (2.7%) papers.

Table 1 also shows the publication output of different countries in two blocks of 2005–2009 and 2010–2014. It indicates that absolute publication output increased for USA, PRC, Italy, Germany, Japan, India, etc. in the second block. The highest increase in publication output was for PRC. However, a marginal decline was observed for England.

Since the absolute output is confounded by the size of the country as well as the size of the specialty, we used TAI of Guan and Ma[11] to examine the relative change in output during the two blocks, 2005–2009 and 2010–2014. The methodology to calculate TAI is similar to that used for calculating the activity index (AI), and was used earlier by Karki and Garg[12], and Kumar and Garg[13] in their studies on alkaloid chemistry research in India, and computer science research in India and China respectively.

Mathematically

$$\mathrm{TAI} = \{(C_i/C_o)/(W_i/W_o)\} \times 100,$$

where C_i denotes the number of publications of a specific country in the ith block, C_o the total number of publications of the country during the study period, W_i the number of publications of all countries in the ith block and W_o is the total number of publication of all countries during the study period.

Figure 2 shows the change in the value of TAI for the prolific countries listed in Table 2. From the figure, it is clear that the activity has increased significantly for PRC, Brazil, Taiwan, Turkey, South Korea, India, Italy and Australia in the second block and decreased significantly for England, USA, Sweden, Japan, Germany and Iran. The maximum rise is observed for PRC followed by Taiwan and Brazil, while maximum decline is noticed for England.

Impact of research output of prolific countries

A wide range of bibliometric indicators are available in the literature to assess the impact of the research output of countries and institutions. We have used CPP, RCI and PNC. CPP is computed as the average number of citations per paper (total number of citations/total number of papers (TNC/TNP)). It has been widely used in bibliometric studies as it normalizes a large disparity in volumes of published output among prolific countries and small nations for a meaningful comparison of research performance.

RCI measures both the influence and visibility of a nation's research in the global context. It was developed by the Institute of Scientific Information (now Thomson Reuters, USA) and has been used by Dwivedi *et al.*[14] to examine the impact of the research output from India in organic chemistry.

Table 2. Prolific countries and their citation impact

Country	TNP	World share (%)	TNC	World share (%)	CPP*	RCI	PNC (% TNP)
USA	1198	28.7	38,596	50.7	32	1.7	102 (8.5)
PRC	254	6.1	2117	2.8	8	0.5	57 (22.4)
Italy	241	5.8	3566	4.7	15	0.8	36 (14.9)
Germany	234	5.6	2966	3.9	13	0.7	33 (14.1)
Japan	205	4.9	2398	3.2	12	0.7	21 (10.2)
England	197	4.7	4439	5.8	23	1.2	13 (6.6)
Canada	152	3.6	2316	3.0	15	0.8	27 (17.7)
Australia	121	2.9	2145	2.8	18	1.0	10 (8.3)
Turkey	118	2.8	544	0.7	5	0.2	30 (25.4)
France	115	2.7	2355	3.1	20	1.1	13 (11.3)
India	114	2.7	866	1.1	8	0.4	20 (17.5)
South Korea	96	2.3	1027	1.4	11	0.6	14 (14.6)
The Netherlands	86	2.1	2032	2.7	24	1.4	8 (9.3)
Taiwan	85	2.0	819	1.1	10	0.6	7 (8.2)
Spain	80	1.9	834	1.1	10	0.6	14 (17.5)
Brazil	74	1.8	437	0.6	6	0.3	11 (14.9)
Sweden	64	1.5	1397	1.8	22	1.2	3 (4.7)
Denmark	57	1.4	1094	1.4	19	1.0	2 (3.5)
Greece	57	1.4	345	0.5	6	0.4	7 (12.3)
Iran	53	1.3	626	0.8	12	0.6	7 (13.2)
Others	567	13.6	5185	6.8	9	0.5	95 (16.7)
	4168	100	76,104	100	18.3	1.0	530 (12.7)

TNP, Total number of publication; TNC, Total number of citations; CPP, Citations per paper; RCI, Relative citation impact; PNC, Percentage of publications not cited; *CPP rounded-off to the nearest whole number.

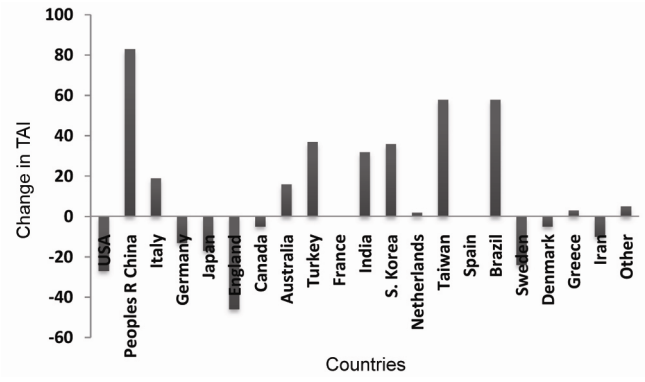

Figure 2. Change in the value of transformative activity index for prolific countries.

$$\text{RCI} = \frac{\text{A country's share of world citations (C\%)}}{\text{A country's share of world publications (P\%)}}.$$

RCI = 1 indicates that a country's citation rate is equal to the world's citation rate; RCI > 1 indicates that a country's citation rate is higher than the world's citation rate and RCI < 1 indicates that a country's citation rate is less than the world's citation rate.

Table 2 lists 20 prolific countries with their TNP, TNC, share of world publications and citations as well as the values of CPP, RCI and PNC. The global average value of CPP is 18.3. It is highest for USA (32) followed by The Netherlands (24), England (23) and Sweden (22). It is lowest for Turkey (5), Brazil and Greece (6 each) and China and India (8 each). One of the possible reasons for high CPP for USA, The Netherlands, England and Sweden might be the low values of PNC for these countries. Based on this, it can be assumed that the impact of research of these countries is commensurate with their research output. The value of CPP for France and Denmark is close to the world average. The standing of different countries based on the values of RCI also indicates the same trends as CPP. The lower values of CPP and RCI for the remaining countries imply that the papers published by these countries are less cited and thus, the impact of research of these countries is not commensurate with their research output. For Australia, the values of CPP and RCI are just equal to the world average. The ranking of countries based on these two parameters follows almost similar trends.

Prolific institutions and the impact of their research output

The identification of prolific institutions and authors has been an important aspect of all bibliometric studies. This may help scientists identify an institution for further research or for jobs. Similarly, it may help an institution in identifying a competent scientist in a field of study. These indicators may also be useful for peer review of articles by journals in a field. These also indicate the concentration or scattering of institutions among nations

Table 3. Prolific institutions and their citation impact

Institutions	TNP	World share (%)	TNC	World share (%)	CPP	RCI
National Cancer Institute (USA)	50	1.2	849	1.1	16.9	0.9
University of Texas MD Anderson Cancer Centre (USA)	40	1.0	838	1.1	20.9	1.1
Harvard University (USA)	32	0.8	1469	1.9	45.9	2.7
Karolinska Institute (Sweden)	28	0.7	461	0.6	16.5	0.9
University of Toronto (Canada)	25	0.6	503	0.7	20.1	1.2
Nanjing Medical University (PRC)	22	0.5	215	0.3	9.8	0.6
University Roma La Sapienza (Italy)	20	0.5	228	0.3	11.4	0.6
Mayo Clinic (USA)	19	0.5	204	0.3	10.7	0.6
Memorial Sloan Kettering Cancer Centre (USA)	19	0.5	361	0.5	19.0	1.0
Duke University (USA)	18	0.4	682	0.9	37.9	2.3
Brigham Women Hospital (USA)	17	0.4	416	0.6	24.5	1.5
John Hopkins University (USA)	17	0.4	270	0.4	15.9	1
McGill University (Canada)	16	0.4	353	0.5	22.1	1.3
Seoul National University (South Korea)	16	0.4	134	0.2	8.4	0.5
German Cancer Research Centre (Germany)	15	0.4	401	0.5	27.0	1.3
Massachusetts General Hospital (USA)	15	0.4	11,196	14.7	746.4	36.7
University of California, San Francisco (USA)	15	0.4	155	0.2	10.3	0.5
1796 other institutions	3768	90.4	57,369	75.4	15.2	0.8
	4168	100	76,104	100	18.3	1.0

and authors among institutions. However, the number of prolific research institutions from a country or the number of prolific scientists depend upon several factors like grants received from the government, or industry support for research in a particular area, or economic growth of a country, or because of the interest of the scientist working in the field. In the present study total output came from 1813 institutions located in different parts of the globe. Table 3 lists 17 most prolific institutions that contributed 15 or more of the total publications. Among these, 10 were from USA, 2 from Canada and 1 each from Sweden, PRC, Italy, South Korea and Germany. These 17 institutions produced about 10% of the total global output and obtained about one-fourth (24.6%) of all the citations. Remaining 1796 institutions produced the rest of the output. This indicates that the MBC research is highly scattered unlike biomedical research in other fields such as malaria vaccine[15] and dengue research[16]. In these two sub-disciplines of biomedical research, prolific institutions contributed about 45% and 33% of the total research output respectively. Table 3 provides details about TNP, TNC, CPP and RCI of the 17 prolific institutions. Data presented in Table 3 indicate that the values of CPP and RCI are less than the global average for Nanjing Medical University (PRC), University Roma La Sapienza (Italy), Mayo Clinic (USA), John Hopkins University (USA), Seoul National University (South Korea) and University of California, San Francisco (USA). This implies that the impact of these institutions is not commensurate with their research output. However, among all the institutions, the highest values of CPP and RCI were for Massachusetts General Hospital (USA). Other institutions for which the CPP and RCI values were significantly higher than the global average were Harvard University (USA), Duke University (USA), German Cancer Research Centre (Germany) and Brigham Women Hospital (USA). This implies that the research performed at these institutions made more impact in terms of citations than the other prolific institutions listed in Table 3.

Most prolific authors and the impact of their research output

Prolific authors who numbered 35 contributed 122 papers. These authors were scattered in 18 countries. These were USA and Italy (five each), Germany (3) and Australia, England, Japan, The Netherlands, Norway, South Korea and Sweden (two each). Rest eight countries, namely Canada, France, Greece, India, PRC, Singapore, Switzerland and Taiwan had one author each. Most of the prolific authors were not affiliated to prolific institutions. Among all the listed authors, CPP and RCI values for only nine authors were more than the global average; for rest of the authors, they were less than the global average. These authors have been marked in bold in Table 4. Among these authors, the highest CPP was for Thompson, D. from Cambridge University (England) followed by Bosetti, C. of the Mario Negri Institute of Pharmacology Research (Italy) and Park S. M. of the National Cancer Centre (South Korea). The value of CPP for rest of the authors was less than the global average.

Citation profile of the male breast cancer research output

Citation analysis measures the impact of each article by counting the number of times they are cited by other articles. High levels of citation to a scientific publication

Table 4. Most prolific authors and the impact of their output

Authors	Institutions	TNP	TNC	CPP	RCI
Kornegoor, R.	University Medical Centre Utrecht (The Netherlands)	6	78	13	0.7
Bosetti, C.	Mario Negri Institute of Pharmacology Research (Italy)	5	253	50.6	2.8
Ottini, L.	University Roma La Sapienza (Italy)	5	71	14.2	0.8
Deb, S.	Peter MacCallum Cancer Centre (Australia)	4	11	2.8	0.1
Gudbergsson, S. B.	University of Oslo (Norway)	4	68	17	0.9
Hemminki, K.	German Cancer Research Centre (Germany)	4	48	12	0.6
Hill, C.	Institute Gustave Roussy (France)	4	100	25	1.3
Johansson, I.	Lund University (Sweden)	4	43	10.8	0.6
Levi, F.	University Lausane + CHU Vaudois (Switzerland)	4	30	7.5	0.4
Merrill, R. M.	Brigham Young University (USA)	4	56	14	0.7
Meyer, A.	Hannover Medical School (Germany)	4	45	11.3	0.6
Minamiya, Y.	Akita University (Japan)	4	50	12.5	0.7
Pillai, K.	University of New South Wales (Australia)	4	9	2.3	0.1
Amarantidis, K.	University General Hospital (Greece)	3	14	4.7	0.3
Aquila, S.	University Calabria (Italy)	3	27	9.0	0.6
Cho, Y. M.	National Institute of Health Science (Japan)	3	7	2.3	0.2
Evans, D. G. R.	St Marys Hospital (England)	3	42	14	0.9
Gadi, V. K.	University of Washington (USA)	3	92	30.7	1.7
Geue, K.	University of Leipzig (Germany)	3	24	8.0	0.4
Gooren, L. J.	Vrije University Amsterdam (The Netherlands)	3	77	25.7	1.6
Jones, L. W.	Duke University (USA)	3	68	22.7	1.3
Kwong, A.	University of Hong Kong (PRC)	3	10	3.3	0.2
Liang, J. A.	China Medical University Hospital (Taiwan)	3	30	10.0	0.6
Lim, G. H.	Health Promotion Board (Singapore)	3	29	9.7	0.6
Murthy, N. S.	National Cancer Registry Programme, ICMR (India)	3	41	13.7	0.7
Nilsson, C.	Vastmanland City Hospital (Sweden)	3	21	7.0	0.4
Park, S. M.	National Cancer Centre (South Korea)	3	133	44.3	2.4
Saif, M. W.	Yale University (USA)	3	50	16.7	1.0
Siegfried, J. M.	University of Pittsburgh (USA)	3	62	20.7	1.1
Silvestri, V.	University Roma La Sapienza (Italy)	3	36	12.0	0.7
Slagter, M. H.	Mt Sinai Hospital (Canada)	3	25	8.3	0.4
Syse, A.	Cancer Registry (Norway)	3	33	11.0	0.6
Thompson, D.	University of Cambridge (England)	3	219	73.0	4.2
Tommasi, S.	National Cancer Centre (Italy)	3	55	18.3	1.0
Vo, T. T. B.	Chungbuk National University (South Korea)	3	62	20.7	1.1

Table 5. Distribution of citations

No. of citations	No. of papers	Total citations	No. of citations	No. of papers	Total citations
0	530	0	11–20	702	10,344
1	411	411	21–30	335	8250
2	314	628	31–40	155	5410
3	250	750	41–50	95	4281
4	231	924	51–75	126	7743
5	193	965	76–100	61	5247
6–10	689	5350	>100	76	25,801
		Total papers = 4168			
		Total citations = 76,104			
		Citation/paper = 18.3			

are interpreted as signs of scientific influence, impact and visibility. An author's visibility can be measured through a determination of how often his/her publications have been cited in publications by other authors. Table 5 shows the citation pattern of the papers published. Citations were examined till 15 July 2015, on which the data were downloaded. During this period, 76,104 citations were received by 4168 papers and the average rate of CPP was 18.3. Of the total papers included in the analysis, 530 (12.7%) did not receive any citation. Of the 530 uncited papers, 435 (82%) were published by most prolific countries and the rest 18% by other countries. Maximum number of papers received citation in the range 11–20, whereas only 76 papers received more than 100 citations. Table 6 lists the highly cited authors. These 13 authors received 16,699 (i.e. 22%) of all citations. However, it will be important

Table 6. Highly cited authors

Bibliographical details of top highly cited papers which received 250 or more citations	TNC
Jemal, A. *et al.*, *CA-A Cancer Journal for Clinicians*, 2011, **61**(2), 34	11,047
Siegel, R., *CA-A Cancer Journal for Clinicians*, 2012, **62**(4), 348	801
Diamanti-Kandarakis, E. *et al.*, *Endocrine Reviews*, 2009, **30**(4), 293–342	757
Einstein, A. J., Henzlova, M. J. and Rajagopalan, S., *JAMA – Journal of the American Medical Association*, 2007, **298**(3), 317–323	714
Ferley, J. *et al.*, *European Journal of Cancer*, 2013, **49**(6), 1374–403	470
Berger, M. F. *et al*., *Nature*, 2011, **470**, 214–220	452
Vom Saal, F. S. and Hughes, C., *Environmental Health Perspectives*, 2005, **113**(8), 926–933	439
Arts, I. C. and Hollman, P. C., *American Journal of Clinical Nutrition*, 2005, **81**(1), 317s–325s	380
Karim-Kos, H. E. *et al.*, *European Journal of Cancer*, 2008, **44**(10), 1345–1389	364
Demark-Wahnefried, W., Aziz, N. M., Rowland, J. H. and Pinto, B. M., *Journal of Clinical Oncology*, 2005, **23**(24), 5814–5830	349
Wilson, A. S., Power, B. E. and Molloy, P. L., *Bichemica Biophysica Acta*, 2007, **1775**(1), 138–1362	338
Shiqematsu, H. *et al.*, *Cancer Research*, 2005, **65**(5), 1642–1646	313
Miqliorati, C. A. *et al*., *Cancer*, 2005, **104**(1), 83–93	275

Table 7. Distribution of output by journal publishing countries

Journal publishing country	Number of papers (%)	Number of journals (%)
USA	1529 (36.7)	397 (31.0)
England	1100 (26.4)	337 (26.3)
The Netherlands	270 (6.5)	91 (7.1)
Germany	221 (5.3)	72 (5.6)
Thailand	137 (3.3)	2 (0.2)
Ireland	100 (2.4)	22 (1.7)
Greece	84 (2.0)	11 (0.8)
Switzerland	74 (1.8)	34 (2.7)
Italy	71 (1.7)	23 (1.8)
France	56 (1.3)	24 (1.9)
Japan	56 (1.3)	28 (2.2)
Sub-total	3698 (88.7)	1041 (81.3)
Forty-one other countries	470 (11.3)	239 (18.7)
Total	4168 (100)	1280 (100)

to mention here that none of the highly cited authors was listed among the prolific authors.

Journals used for communicating research results

The total output was scattered in 1280 journals. These journals were published from 52 different countries which were scattered over different parts of the globe. Table 7 lists 11 countries from which most of the journals originated. Among these publishing countries, USA topped the list with 397 journals followed by England with 337 journals. Journals from USA published about 36.7% of the total papers. About 88% of the total output appeared in journals originating from these 11 countries. This also indicates that the field of MBC is emerging as the output is scattered in a large number of journals.

Table 8 shows the most common journals which published 20 or more papers. Among these, *Asian Pacific Journal of Cancer Prevention* from Thailand has published maximum 136 papers followed by *PLoS ONE* from USA with 81 papers. Of the 20 journals used for publishing research results, 10 were from USA and 5 from the UK.

Conclusion

The present study is a scientometric assessment of research output and its impact in terms of citations received by these papers in MBC-related literature. The study gives information about the global research architecture in terms of output, countries and institutions involved in research, and the impact of their output in terms of CPP, RCI and PNC. The results clearly depict a steady growth of the literature during 2005–2014. The study reveals that a large number of countries are involved in MBC research, with USA leading in terms of publications, with 29% share of total output. Though PRC is ranked second, it has low citation impact. The impact of research output measured by CPP and RCI indicates that USA,

Table 8. Most common journals used for publishing research results

Journal	No. of papers	Publishing country	JIF 2013*	*h*-index	Rank by *h*-index
Asian Pacific Journal of Cancer Prevention	136	Thailand	1.3	16	14
PLoS ONE	81	USA	3.7	12	17
Breast Cancer Research and Treatment	59	USA	4.5	17	13
Psycho-Oncology	57	UK	3.5	20	10
International Journal of Cancer	52	USA	6.2	30	4
Supportive Care in Cancer	47	Germany	2.7	15	15
Cancer	46	USA	3.7	32	3
BMC Cancer	44	UK	3.4	20	11
Journal of Clinical Oncology	44	USA	18.0	39	2
Annals of Oncology	37	UK	7.4	27	8
Cancer Epidemiology Biomarkers and Prevention	32	USA	4.6	27	7
British Journal of Cancer	31	UK	5.1	23	9
European Journal of Cancer	31	UK	5.1	40	1
Annals of Surgical Oncology	28	USA	4.1	19	12
Cancer Causes and Control	28	The Netherlands	3.2	13	16
Clinical Cancer Research	27	USA	7.8	29	6
Breast	25	USA	1.8	11	18
Tumori	25	Italy	0.9	9	19
Endocrinology	22	USA	4.7	29	5
Anticancer Research	21	Greece	1.7	7	20
Total	873				
1260 other remaining journals	3295				
Grand total	4168				

*Rounded-off to the nearest whole number.

The Netherlands, England and Sweden have higher impact in comparison to other countries. Among the institutions also, the US-based National Cancer Institute has published maximum papers with highest citations. The field of MBC research is still in an evolving state as the output is scattered in more than 1800 institutions and more than 1200 journals. These findings on MBC research should provide useful information for those tasked for the better management of such an uncommon disease like MBC. The results may vary if one uses Google Scholar or Scopus for undertaking a similar study, as the journals covered by these databases are more compared to WoS. However, the ranking of countries and institutions will not change much.

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