Update of the 100 Most Cited Articles on Breast Cancer: A Bibliometric Analysis

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ABSTRACT

Objective: The aim of this study was to perform a bibliometric analysis of the 100 most cited articles related to breast cancer.

Materials and Methods: The research was done on the Web of Science (WOS) database. Only research articles were included in the study. Results were obtained by typing the term "breast cancer" in the WOS Search box. The results were sorted according to the number of WOS core citations and all database citations, the first author of the article, the institution of the first author, publication year, article category, and countries.

Results: The most cited article had 10236 citations. Nearly three-quarters (70%) of the articles were from the USA and most articles were published by Harvard University. Thirty-seven percent of the articles were in the medicine, general and internal medicine categories.

Conclusion: This bibliometric analysis identified the 100 most cited research articles about breast cancer and provided a record of historical developments and trends in breast cancer research.

Keywords: Breast cancer; citation; research

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Key Points

- The result of this research about the 100 most cited articles on breast cancer may help to understand important studies on breast cancer and shed light on future studies.

Introduction

Breast cancer is the most prevalent cancer globally, as well as a leading cause of cancer-related death among women (1). Substantial support for breast cancer awareness and research funding has helped created advances in the diagnosis and treatment of breast cancer (2). Early detection, a novel personalized approach to treatment, and a better knowledge of the disease have all contributed to an improvement in breast cancer survival rates and a steady decline in the number of deaths related with the disease (3). Current guidance on preventing and treating breast cancer, as well as what might cause it, has come mainly from information discovered from research studies (4). The most significant component of the methodological qualities of studies is associated with an increase in citations and a high impact factor of the journal in which it was published (5). To the best of our knowledge, there is only one early study that has performed a bibliometric analysis of the attributes of the 100 most cited articles about studies concerning breast cancer (6). The aim of this study was to evaluate the current status of the 100 most frequently cited articles.

Materials and Methods

A Web of Science (WOS) (Clarivate Analytics, Philadelphia, PA, United States) search was used to collect the information for this investigation. The journals indexed in the Science Citation Index Expanded (SCI-E) were included. There were no restrictions on the journals. Over 9200 of the world's most influential publications from 178 scientific areas are now indexed in the Science Citation Index Expanded™. More than 53 million records and 1.18 billion cited references date from 1900 to the present (7).

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Inclusion Criteria

The term "breast cancer" was typed into the search box of WOS basic research with the selection of all the years and the search was performed on 11.02.2022. The search produced 621,351 published articles between 1978 and 2022. As filters, English language, SCI-E scope and research article type were selected, resulting in a reduction to 376,105 articles. These were then ranked in order of citation frequency, from highest to lowest. The study was conducted by generating a shortlist of the top 100 cited publications from this search list, which were classified by journal, study category, country and location where the research was published, authors, and publication date.

Exclusion Criteria

Articles in indexes other than SCI-E, published in languages other than English, and other types of articles, such as reviews, meeting abstracts, letters, book chapters, etc., were excluded. Also, cancer statistics articles were excluded, despite receiving more citations than the included research articles.

Written informed consent was not necessary because no patient data was included in the study. The study complied with the Declaration of Helsinki.

Statistical Analysis

No inferential statistical analysis was undertaken. All the data is given in percentages, numbers and charts.

Results

The articles included in the study are listed according to the total number of citations in the WOS database and in the all databases (WOS database, Arabic Citation Index, BIOSIS Citation Index, Chinese Science Citation Database, Data Citation Index, Russian Science Citation Index and SciELO Citation Index). According

to our results, the most cited article was by Charles M. Perou and his colleagues, with 10,236 citations in the WOS database, and the least cited article was by Lisa A Carey and her colleagues, with 1,403 citations. Considering the number of publications, the most cited author was D.J. Slamon with 25,000 citations, followed by B. Fisher with 11,809 citations, T. Sorlie with 11,343 citations, Charles M. Perou with 10,236 citations, and N.K. Aaronson with 9247 citations (Table 1). It was evident that all articles received more than 1000 citations and all were published between 1985 and 2021. Twelve of the most cited articles were published in 2007, and there was one publication each for 1987, 1992, 1993, 1995, 2000, 2018, and 2021 among the most cited articles (Figure 1).

These most cited articles were published in 20, high-impact factor journals, with 24 articles published in the New England Journal of Medicine, 13 in Nature, 11 in the Journal of Clinical Oncology, and 11 in Science (Table 2). Seventy of the studies originated from the United States of America (USA), 13 publications from the United Kingdom (UK), six from Italy and three from Canada (Figure 2).

The articles were sourced from 51 different centers. The institution with the most publications was Harvard University with eight articles, followed by the University of Pittsburgh with six articles, the IRCCS European Institute of Oncology (IEO) with five articles, and the University of North Carolina with five articles, while 32 institutions had only one publication each (Table 3).

According to WOS publication categories, 37% of the articles were in the field of medicine, general and internal medicine, medicine, research & experimental, cell biology; pathology and surgery were the least published categories in this list. In addition, when the categories we created according to the content of the articles were examined, most articles were on genetics and drug research (47% and 24%, respectively) (Table 4).
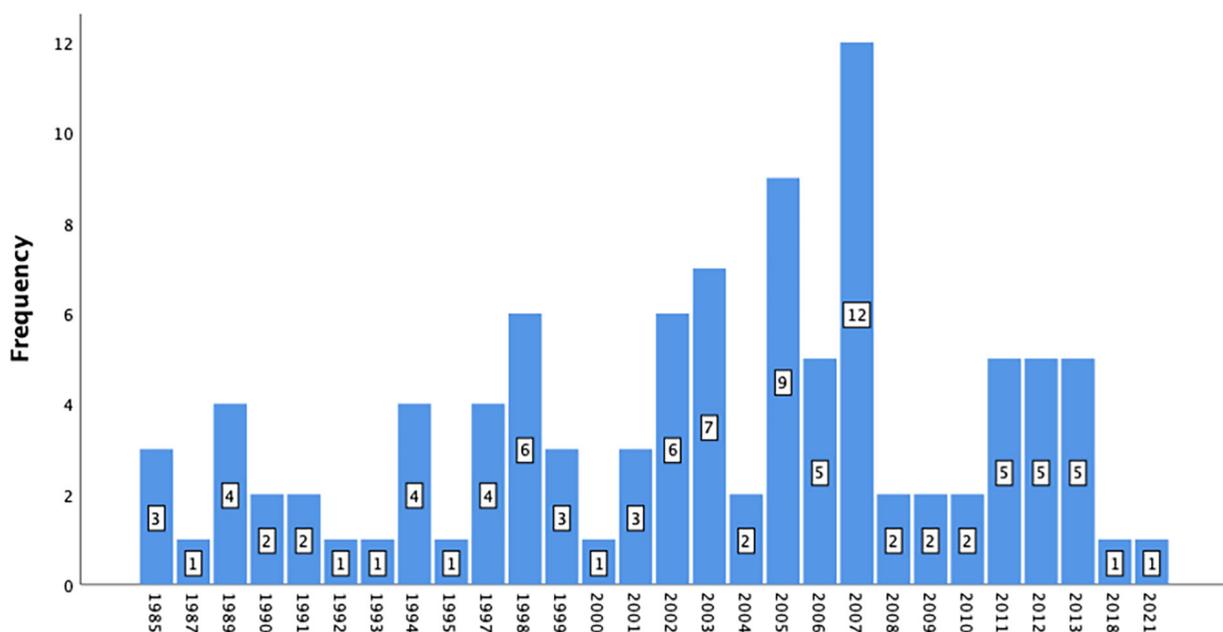

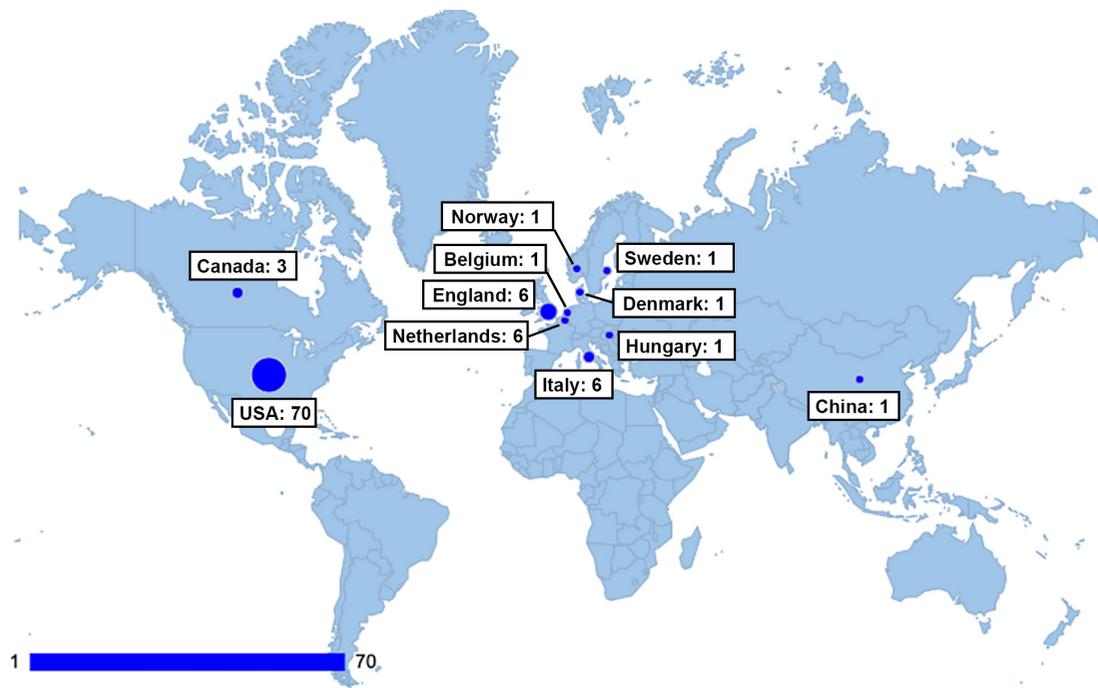**Figure 1.** Distribution of the most cited articles by publication year

Figure 2. Countries from which publications originate

Table 1. The top 100 cited articles in breast cancer in order

No	First author	Article title	Journal	Times cited, WOS Core	Times cited, all databases
1	Perou, CM	Molecular portraits of human breast tumours	Nature. 2000 Aug 17;406(6797):747-52.	10,236	10,700
2	Slamon, DJ	Human-breast cancer correlation of relapse and survival with amplification of the her-2 neu oncogene	Science. 1987 Jan 9;235(4785):177-82.	9387	9636
3	Aaronson, NK	The european organization for research and treatment of cancer qlq-c30: a quality of life instrument for use in international clinical trials in oncology	J Natl Cancer Inst. 1993 Mar 3;85(5):365-76.	9247	9464
4	Wang, X	Effect of Capecitabine Maintenance Therapy Using Lower Dosage and Higher Frequency vs Observation on Disease-Free Survival Among Patients With Early-Stage Triple-Negative Breast Cancer Who Had Received Standard Treatment The SYSUCC-001 Randomized Clinical Trial	JAMA. 2021 Jan 5;325(1):50-58.	8914	9284
5	Slamon, DJ	Use of chemotherapy plus a monoclonal antibody against HER2 for metastatic breast cancer that overexpresses HER2.	N Engl J Med. 2001 Mar 15;344(11):783-92.	7942	8211
6	Sorlie, T	Gene expression patterns of breast carcinomas distinguish tumor subclasses with clinical implications	Proc Natl Acad Sci U S A. 2001 Sep 11;98(19):10869-74.	7588	7798
7	Al-Hajj, M	Prospective identification of tumorigenic breast cancer cells	Proc Natl Acad Sci U S A. 2003 Apr 1;100(7):3983-8.	7419	7987
8	Koboldt, DC	Comprehensive molecular portraits of human breast tumours	Nature. 2012 Oct 4;490(7418):61-70.	7295	7404
9	Van't Veer, LJ	Gene expression profiling predicts clinical outcome of breast cancer	Nature. 2002 Jan 31;415(6871):530-6.	6840	6970

Table 1. continued

No	First author	Article title	Journal	Times cited, WoS Core	Times cited, all databases
10	Slamon, Dj	Studies of the her-2/neu proto-oncogene in human-breast and ovarian-cancer	Science. 1989 May 12;244(4905):707-12.	6050	6158
11	Weidner, N	Tumor angiogenesis and metastasis - correlation in invasive breast-carcinoma	N Engl J Med. 1991 Jan 3;324(1):1-8.	4906	5402
12	Miki, Y	A strong candidate for the breast and ovarian-cancer susceptibility gene BRCA1	Science. 1994 Oct 7;266(5182):66-71.	4753	4898
13	Van De Vijver, MJ	A gene-expression signature as a predictor of survival in breast cancer.	N Engl J Med. 2002 Dec 19;347(25):1999-2009.	4575	4672
14	Fisher, B	Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer	N Engl J Med. 2002 Oct 17;347(16):1233-41.	4375	4613
15	Elston, Cw	Pathological prognostic factors in breast-cancer .I. the value of histological grade in breast-cancer - experience from a large study with long-term follow-up	Histopathology. 2002 Sep;41(3A):154-61.	4179	4285
16	Fisher, B	Tamoxifen for prevention of breast cancer: Report of the National Surgical Adjuvant Breast and Bowel Project P-1 study	J Natl Cancer Inst. 1998 Sep 16;90(18):1371-88.	4057	4129
17	Muller, A	Involvement of chemokine receptors in breast cancer metastasis	Nature. 2001 Mar 1;410(6824):50-6.	4048	4403
18	Romond, EH	Trastuzumab plus adjuvant chemotherapy for operable HER2-positive breast cancer	N Engl J Med. 2005 Oct 20;353(16):1673-84.	3947	4095
19	Li, J	PTEN, a putative protein tyrosine phosphatase gene mutated in human brain, breast, and prostate cancer	Science. 1997 Mar 28;275(5308):1943-7.	3889	4264
20	Sorlie, T	Repeated observation of breast tumor subtypes in independent gene expression data sets	Proc Natl Acad Sci U S A. 2003 Jul 8;100(14):8418-23.	3755	3929
21	Piccart-Gebhart, MJ	Trastuzumab after adjuvant chemotherapy in HER2-positive breast cancer	N Engl J Med. 2005 Oct 20;353(16):1659-72.	3660	3790
22	Cristofanilli, M	Circulating tumor cells, disease progression, and survival in metastatic breast cancer	N Engl J Med. 2004 Aug 19;351(8):781-91.	3210	3311
23	Curtis, C	The genomic and transcriptomic architecture of 2,000 breast tumours reveals novel subgroups	Nature. 2012 Apr 18;486(7403):346-52.	3144	3188
24	Iorio, MV	MicroRNA gene expression deregulation in human breast cancer	Cancer Res. 2005 Aug 15;65(16):7065-70.	3132	3345
25	Malkin, D	Germ line p53 mutations in a familial syndrome of breast-cancer, sarcomas, and other neoplasms	Science. 1990 Nov 30;250(4985):1233-8.	2998	3050
26	Lehmann, BD	Identification of human triple-negative breast cancer subtypes and preclinical models for selection of targeted therapies	J Clin Invest. 2011 Jul;121(7):2750-67.	2879	2974
27	Dent, R	Triple-negative breast cancer: Clinical features and patterns of recurrence	Clin Cancer Res. 2007 Aug 1;13(15 Pt 1):4429-34.	2755	2943
28	Veronesi, U	Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer	N Engl J Med. 2002 Oct 17;347(16):1227-32.	2734	2915

Table 1. continued

No	First author	Article title	Journal	Times cited, WoS Core	Times cited, all databases
29	Orimo, A	Stromal fibroblasts present in invasive human breast carcinomas promote tumor growth and angiogenesis through elevated SDF-1/CXCL12 secretion	Cell. 2005 May 6;121(3):335-48.	2637	2741
30	Wolff, AC	American Society of Clinical Oncology/College of American Pathologists guideline recommendations for human epidermal growth factor receptor 2 testing in breast cancer	J Clin Oncol. 2007 Jan 1;25(1):118-45.	2633	2746
31	Carey, LA	Race, breast cancer subtypes, and survival in the Carolina Breast Cancer Study	JAMA. 2006 Jun 7;295(21):2492-502.	2608	2754
32	Sjoblom, T	The consensus coding sequences of human breast and colorectal cancers	Science. 2006 Oct 13;314(5797):268-74.	2589	3551
33	Wooster, R	Identification of the breast-cancer susceptibility gene BRCA2	Nature. 1995 Dec 21-28;378(6559):789-92.	2550	2611
34	Parker, JS	Supervised Risk Predictor of Breast Cancer Based on Intrinsic Subtypes	J Clin Oncol. 2009 Mar 10;27(8):1160-7.	2547	2597
35	Wolff, AC	Recommendations for Human Epidermal Growth Factor Receptor 2 Testing in Breast Cancer: American Society of Clinical Oncology/College of American Pathologists Clinical Practice Guideline Update	J Clin Oncol. 2013 Nov 1;31(31):3997-4013.	2388	2489
36	Miller, K	Paclitaxel plus bevacizumab versus paclitaxel alone for metastatic breast cancer	N Engl J Med. 2007 Dec 27;357(26):2666-76.	2383	2457
37	Geyer, CE	Lapatinib plus capecitabine for HER2-positive advanced breast cancer	N Engl J Med. 2006 Dec 28;355(26):2733-43.	2379	2451
38	Vogel, CL	Efficacy and safety of trastuzumab as a single agent in first-line treatment of HER2-overexpressing metastatic breast cancer	J Clin Oncol. 2002 Feb 1;20(3):719-26.	2373	2471
39	Goldhirsch, A	Strategies for subtypes-dealing with the diversity of breast cancer: highlights of the St Gallen International Expert Consensus on the Primary Therapy of Early Breast Cancer 2011	Ann Oncol. 2011 Aug;22(8):1736-47.	2330	2545
40	Wood, LD	The genomic landscapes of human breast and colorectal cancers	Science. 2007 Nov 16;318(5853):1108-13.	2308	2361
41	Karnoub, AE	Mesenchymal stem cells within tumour stroma promote breast cancer metastasis	Nature. 2007 Oct 4;449(7162):557-63.	2289	2405
42	Banks, E	Breast cancer and hormone-replacement therapy in the Million Women Study	Lancet. 2003; 362: 419–27.	2255	2318
43	Gail, MH	Projecting individualized probabilities of developing breast-cancer for white females who are being examined annually	J Natl Cancer Inst. 1989 Dec 20;81(24):1879-86.	2224	2275

Table 1. continued

No	First author	Article title	Journal	Times cited, WoS Core	Times cited, all databases
44	Neve, RM	A collection of breast cancer cell lines for the study of functionally distinct cancer subtypes	Cancer Cell. 2006 Dec;10(6):515-27.	2222	2246
45	Ford, D	Genetic heterogeneity and penetrance analysis of the BRCA1 and BRCA2 genes in breast cancer families	Am J Hum Genet. 1998 Mar;62(3):676-89.	2174	2210
46	Cobleigh, MA	Multinational study of the efficacy and safety of humanized anti-HER2 monoclonal antibody in women who have HER2-overexpressing metastatic breast cancer that has progressed after chemotherapy for metastatic disease	J Clin Oncol. 1999 Sep;17(9):2639-48.	2149	2219
47	Wang, YX	Gene-expression pro-files to predict distant metastasis of lymph-node-negative primary breast cancer	Lancet. 2005 Feb 19-25;365(9460):671-9.	2097	2151
48	Minn, AJ	Genes that mediate breast cancer metastasis to lung	Nature. 2005 Jul 28;436(7050):518-24.	2070	2138
49	Verma, S	Trastuzumab Emtansine for HER2-Positive Advanced Breast Cancer	N Engl J Med. 2012 Nov 8;367(19):1783-91.	2054	2124
50	Giuliano, AE	Lymphatic mapping and sentinel lymphadenectomy for breast-cancer	Ann Surg. 1994 Sep;220(3):391-8	2023	2118
51	Ma, L	Tumour invasion and metastasis initiated by microRNA 10b in breast cancer	Nature. 2007 Oct 11;449(7163):682-8.	2010	2184
52	Overgaard, M	Postoperative radiotherapy in high-risk premenopausal women with breast cancer who receive adjuvant chemotherapy. Danish Breast Cancer Cooperative Group 82b Trial	N Engl J Med. 1997 Oct 2;337(14):949-55.	1963	2016
53	Darby, SC	Risk of Ischemic Heart Disease in Women after Radiotherapy for Breast Cancer	N Engl J Med. 2013 Mar 14;368(11):987-98.	1957	2038
54	Goldhirsch, A	Personalizing the treatment of women with early breast cancer: highlights of the St Gallen International Expert Consensus on the Primary Therapy of Early Breast Cancer 2013	Ann Oncol. 2013 Sep;24(9):2206-23.	1949	2151
55	Fisher, B	Effect of preoperative chemotherapy on the outcome of women with operable breast cancer	J Clin Oncol. 1998 Aug;16(8):2672-85.	1944	2029
56	Nielsen, TO	Immunohistochemical and clinical characterization of the basal-like subtype of invasive breast carcinoma	Clin Cancer Res. 2004 Aug 15;10(16):5367-74.	1912	2069
57	Baselga, J	Everolimus in Postmenopausal Hormone-Receptor-Positive Advanced Breast Cancer	N Engl J Med. 2012 Feb 9;366(6):520-9.	1902	1977

Table 1. continued					
No	**First author**	**Article title**	**Journal**	**Times cited, WoS Core**	**Times cited, all databases**
58	Hall, JM	Linkage of early-onset familial breast-cancer to chromosome-17q21	Science. 1990 Dec 21;250(4988):1684-9.	1898	1951
59	Giuliano, AE	Axillary Dissection vs No Axillary Dissection in Women With Invasive Breast Cancer and Sentinel Node Metastasis A Randomized Clinical Trial	JAMA. 2011 Feb 9;305(6):569-75.	1869	1956
60	Kang, YB	A multigenic program mediating breast cancer metastasis to bone	Cancer Cell. 2003 Jun;3(6):537-49.	1860	1925
61	Hammond, MEH	American Society of Clinical Oncology/College of American Pathologists Guideline Recommendations for Immunohistochemical Testing of Estrogen and Progesterone Receptors in Breast Cancer	J Clin Oncol. 2010 Jun 1;28(16):2784-95.	1847	1917
62	Gyorffy, B	An online survival analysis tool to rapidly assess the effect of 22,277 genes on breast cancer prognosis using microarray data of 1,809 patients	Breast Cancer Res Treat. 2010 Oct;123(3):725-31.	1834	1862
63	Paik, S	Gene expression and benefit of chemotherapy in women with node-negative, estrogen receptor-positive breast cancer	J Clin Oncol. 2006 Aug 10;24(23):3726-34.	1833	1877
64	Liedtke, C	Response to neoadjuvant therapy and long-term survival in patients with triple-negative breast cancer	J Clin Oncol. 2008 Mar 10;26(8):1275-81.	1779	1874
65	Doyle, LA	A multidrug resistance transporter from human MCF-7 breast cancer cells	Proc Natl Acad Sci U S A. 1998 Dec 22;95(26):15665-70.	1760	1866
66	Carter, CL	Relation of tumor size, lymph-node status, and survival in 24,740 breast-cancer cases	Cancer. 1989 Jan 1;63(1):181-7.	1757	1792
67	Easton, DF	Genome-wide association study identifies novel breast cancer susceptibility loci	Nature. 2007 Jun 28;447(7148):1087-93.	1751	1816
68	Howell, A	Results of the ATAC (Arimidex, Tamoxifen, Alone or in Combination) trial after completion of 5 years' adjuvant treatment for breast cancer	Lancet. 2005 Jan 1-7;365(9453):60-2.	1721	1777
69	Berry, DA	Effect of screening and adjuvant therapy on mortality from breast cancer	N Engl J Med. 2005 Oct 27;353(17):1784-92.	1687	1726
70	Saslow, D	American Cancer Society guidelines for breast screening with MRI as an adjunct to mammography	CA Cancer J Clin. 2007 Mar-Apr;57(2):75-89.	1657	1702
71	Weidner, N	Tumor angiogenesis - a new significant and independent prognostic indicator in early-stage breast-carcinoma	J Natl Cancer Inst. 1992 Dec 16;84(24):1875-87.	1643	1943

Table 1. continued

No	First author	Article title	Journal	Times cited, WoS Core	Times cited, all databases
72	Slamon, D	Adjuvant Trastuzumab in HER2-Positive Breast Cancer	N Engl J Med 2011; 365:1273-1283	1621	1682
73	Schmid, P	Atezolizumab and Nab-Paclitaxel in Advanced Triple-Negative Breast Cancer	N Engl J Med 2018; 379:2108-2121	1615	1669
74	Baselga, J	Pertuzumab plus Trastuzumab plus Docetaxel for Metastatic Breast Cancer	N Engl J Med. 2012 Jan 12;366(2):109-19.	1614	1673
75	Yu, M	Circulating Breast Tumor Cells Exhibit Dynamic Changes in Epithelial and Mesenchymal Composition	Science. 2013 Feb 1;339(6119):580-4.	1595	1667
76	Qian, BZ	CCL2 recruits inflammatory monocytes to facilitate breast-tumour metastasis	Nature. 2011 Jun 8;475(7355):222-5.	1578	1626
77	Harvey, JM	Estrogen receptor status by immunohistochemistry is superior to the ligand-binding assay for predicting response to adjuvant endocrine therapy in breast cancer	J Clin Oncol. 1999 May;17(5):1474-81.	1555	1601
78	Tabar, L	Reduction in mortality from breast-cancer after mass-screening with mammography	Lancet. 1985 Apr 13;1(8433):829-32.	1543	1557
79	Krag, D	The sentinel node in breast cancer - A multicenter validation study	N Engl J Med. 1998 Oct 1;339(14):941-6.	1532	1587
80	King, MC	Breast and ovarian cancer risks due to inherited mutations in BRCA1 and BRCA2	Science. 2003 Oct 24;302(5645):643-6.	1531	1583
81	Liaw, D	Germline mutations of the PTEN gene in Cowden disease, an inherited breast and thyroid cancer syndrome	Nat Genet. 1997 May;16(1):64-7.	1526	1558
82	Veronesi, U	Sentinel-node biopsy to avoid axillary dissection in breast cancer with clinically negative lymph-nodes	Lancet. 1997 Jun 28;349(9069):1864-7.	1523	1571
83	Baum, M	Anastrozole alone or in combination with tamoxifen versus tamoxifen alone for adjuvant treatment of postmenopausal women with early breast cancer: first results of the ATAC randomised trial	Lancet. 2002 Jun 22;359(9324):2131-9.	1486	1528
84	Yu, F	let-7 regulates self renewal and tumorigenicity of breast cancer cells	Cell. 2007 Dec 14;131(6):1109-23.	1480	1633
85	Tavazoie, SF	Endogenous human microRNAs that suppress breast cancer metastasis	Nature. 2008 Jan 10;451(7175):147-52.	1476	1606
86	Spiegel, D	Effect of psychosocial treatment on survival of patients with metastatic breast-cancer	Lancet. 1989 Oct 14;2(8668):888-91.	1475	1490

Table 1. continued

No	First author	Article title	Journal	Times cited, WoS Core	Times cited, all databases
87	Veronesi, U	A randomized comparison of sentinel-node biopsy with routine axillary dissection in breast cancer	N Engl J Med. 2003 Aug 7;349(6):546-53.	1469	1533
88	Sotiriou, C	Breast cancer classification and prognosis based on gene expression profiles from a population-based study	Proc Natl Acad Sci U S A. 2003 Sep 2;100(18):10393-8.	1458	1511
89	Boyd, NF	Mammographic density and the risk and detection of breast cancer	N Engl J Med. 2007 Jan 18;356(3):227-36.	1448	1475
90	Hankinson, SE	Circulating concentrations of insulin-like growth factor-I and risk of breast cancer	Lancet. 1998 May 9;351(9113):1393-6.	1446	1484
91	Ford, D	Risks of cancer in brca1-mutation carriers	Lancet. 1994 Mar 19;343(8899):692-5.	1439	1461
92	Fisher, B	Five-year results of a randomized clinical-trial comparing total mastectomy and segmental mastectomy with or without radiation in the treatment of breast-cancer	N Engl J Med. 1985 Mar 14;312(11):665-73.	1433	1453
93	Dupont, WD	Risk-factors for breast-cancer in women with proliferative breast disease	N Engl J Med. 1985 Jan 17;312(3):146-51.	1432	1470
94	Wooster, R	Localization of a breast-cancer susceptibility gene, BRCA2, to chromosome 13q12-13	Science. 1994 Sep 30;265(5181):2088-90.	1429	1471
95	Cummings, SR	The effect of raloxifene on risk of breast cancer in postmenopausal women - Results from the MORE randomized trial	JAMA. 1999 Jun 16;281(23):2189-97.	1418	1460
96	Gradishar, WJ	Phase III trial of nanoparticle albumin-bound paclitaxel compared with polyethylated castor oil-based paclitaxel in women with breast cancer	J Clin Oncol. 2005 Nov 1;23(31):7794-803.	1417	1483
97	Cheang, Maggie C. U.	Ki67 Index, HER2 Status, and Prognosis of Patients With Luminal B Breast Cancer	J Natl Cancer Inst. 2009 May 20;101(10):736-50.	1414	1497
98	Dawson, Sarah-Jane	Analysis of Circulating Tumor DNA to Monitor Metastatic Breast Cancer	N Engl J Med. 2013 Mar 28;368(13):1199-209.	1413	1481
99	Bauer, Katrina R	Descriptive analysis of estrogen receptor (ER)negative, progesterone receptor (PR)-negative, and HER2-negative invasive breast cancer, the so-called triple-negative phenotype - A population-based study from the California Cancer Registry	Cancer. 2007 May 1;109(9):1721-8.	1408	1508
100	Carey, LA	The triple negative paradox: Primary tumor chemosensitivity of breast cancer subtypes	Clin Cancer Res. 2007 Apr 15;13(8):2329-34.	1403	1523

Table 2. Journals in which the most cited articles were published

Journal name	Record count	Percentage
New England Journal of Medicine	24	24.0
Nature	13	13.0
Journal of Clinical Oncology	11	11.0
Science	11	11.0
Lancet	9	9.0
Proceedings of the National Academy of Sciences of the United States of America	5	5.0
Cell	4	4.0
Jama-Journal of the American Medical Association	4	4.0
Clinical Cancer Research	3	3.0
Journal of the National Cancer Institute	3	3.0
Annals of Oncology	2	2.0
Cancer	2	2.0
Journal of the National Cancer Institute	2	2.0
American Journal of Human Genetics	1	1.0
Annals of Surgery	1	1.0
Breast Cancer Research and Treatment	1	1.0
CA-A Cancer Journal for Clinicians	1	1.0
Cancer Research	1	1.0
Histopathology	1	1.0
Journal of Clinical Investigation	1	1.0

Discussion and Conclusion

Citation analysis is used to find important papers on a certain subject. It aids in the analysis of scientific influence while also acknowledging substantial/pioneering contributions made by predecessors and noteworthy research advancement. There are numerous bibliometric article analyses conducted in various areas of medicine (8-11). To the best of our knowledge, there is only one previous article about the 100 most cited articles concerning breast cancer, and it was published in 2017 (6). Since research areas can change due to advances in science and technology, we found that the total number of citations in this study, which we aimed to evaluate the current status of the 100 most frequently cited articles, reached 280,906, an increase of approximately 1.6 times compared to 2017. This result suggests that interest in quality publications on breast cancer has increased. Also, 41 of the articles in the list were found to have changed. The vast majority of articles on the list were on chemotherapy and genetic studies.

The number of citations may be related to the time since publication. As the publication time increases, the number of citations also increases. In our study, we observed that 12 articles from 2007 and 9 articles from 2005 entered the list (Figure 1). However, many factors, such as the content of the article, its quality and the journal in which it was published, can affect the number of citations. Therefore, although it was published in 2021, the study by Xi Wang and his colleagues was the fourth most cited article (6).

As expected, the most cited articles were published in the medical journals with the highest impact factors. In the present study, most articles were published in the New England Journal of Medicine, followed by articles in Nature, the Journal of Clinical Oncology, and Science, respectively. The first three articles on the list were published in Nature, Science and the Journal of the National Cancer Institute, respectively. It is feasible to hypothesize that the audience of a general medical journal is particularly interested in the topic of breast cancer, or that authors of breast cancer research choose popular medical journals to reach more researchers and readers. One of the important points in the study was that 70% of the articles originated from the USA. Similar to our study, in the bibliographic studies in the literature, 70%–93% of the research articles were USA based (8-11). The fact that these quality studies originate from the USA can be explained by the large patient population and the presence of many well-funded cancer centers.

The first most cited article was "Molecular portraits of human breast tumours" written by Perou et al. (12) in 2000. In this study, in which they made a molecular portrait of breast cancer, they created a molecular subtype classification of breast cancer (12). Today, this molecular classification is still in use and therefore the topic of this article remains relevant.

The second most cited article was "Human breast cancer: correlation of relapse and survival with amplification of the HER-2/neu oncogene" written by Slamon et al. (13) in 1987. In this study, they showed that the *HER-2/neu* oncogene may play a role in the biological behavior and pathogenesis of human breast cancer. Also, they found that amplification of the *HER-2/neu* gene is an important predictor of both overall survival and time to relapse in patients with breast cancer, and that the *HER-2/neu* oncogene plays a role in the biological behavior and pathogenesis of human breast cancer.

Table 3. Distribution of institutions according to the number of published articles

Institution	Record count	Record percentage
Harvard University	8	8.0
University of Pittsburgh	6	6.0
IRCCS European Institute of Oncology (IEO)	5	5.0
University of North Carolina	5	5.0
University of California	4	4.0
University of Cambridge	4	4.0
University of Texas	4	4.0
David Geffen School of Medicine at UCLA	3	3.0
Johns Hopkins University	3	3.0
Massachusetts Institute of Technology (MIT)	3	3.0
Memorial Sloan Kettering Cancer Center	3	3.0
National Institutes of Health (NIH) - USA	3	3.0
University of London	3	3.0
University of Toronto	3	3.0
University of Utah	3	3.0
Merck & Company	2	2.0
Cancer Research UK	2	2.0
Stanford University	2	2.0
Vanderbilt University	2	2.0
Aarhus University	1	1.0
Allegheny General Hospital	1	1.0
American Cancer Society	1	1.0
American Society of Clinical Oncology	1	1.0
Christie NHS Foundation Trust	1	1.0
Columbia University	1	1.0
Falun Hospital	1	1.0
Hungarian Academy of Sciences	1	1.0
Indiana University	1	1.0
John Wayne Cancer Institute	1	1.0
Johnson & Johnson	1	1.0
Joyce Eisenberg Keefer Breast Center	1	1.0
Netherlands Cancer Institute	1	1.0
Northwestern University	1	1.0
Nottingham City Hospital	1	1.0
Ohio State University	1	1.0
Rush University	1	1.0
Saint James's University Hospital	1	1.0
State Key Lab Oncology South China	1	1.0
UCLA Jonsson Comprehensive Cancer Center	1	1.0
ULSS 8 Berica	1	1.0
United States Department of Energy (DOE)	1	1.0
Universite Libre de Bruxelles	1	1.0
University Maryland	1	1.0
University of Edinburgh	1	1.0
University of Miami	1	1.0
University of Michigan	1	1.0
University of Oslo	1	1.0
University of Oxford	1	1.0
University of Vermont	1	1.0
University of Washington	1	1.0
Yeshiva University	1	1.0

Table 4. WOS publication categories

WOS categories	Record count	Record percentage
Medicine, General & Internal	37	37.0
Multidisciplinary Sciences	28	28.0
Oncology	26	26.0
Biochemistry & Molecular Biology; Cell Biology	2	2.0
Genetics & Heredity	2	2.0
Oncology; Cell Biology	2	2.0
Cell Biology; Pathology	1	1.0
Medicine, Research & Experimental	1	1.0
Surgery	1	1.0
Research categories		
Genetic research	47	47.0
Drug research	24	24.0
Basic research	16	16.0
Surgery	8	8.0
Radiology	4	4.0
Quality of life	1	1.0
WOS: Web of science		

The third most cited article was "The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology" written by Aaronson et al. (14) in 1993. The EORTC QLQ-C30 questionnaire was developed as a reliable and valid measure of cancer patients' quality of life in multicultural clinical research settings in this multicenter survey performed by the European Organization for Research and Treatment of Cancer.

The other most cited articles are in the fields of chemotherapy, gene expression, tumor genetics, pathology, and surgery. Research in these areas has made important contributions to the understanding of breast cancer. According to WOS categories, 91% of the articles were in the field of general internal medicine, multidisciplinary sciences was the second most common category, and cancer research came third. Surgery was one of the least-published fields. As the biological behavior and pathogenesis of breast cancer are better understood, studies on chemotherapy drugs have come to the fore. A possible reason for the increase in these types of studies is the increase in funding for drug research in the treatment of breast cancer. For this reason, research on surgery may have lagged behind.

Although citation analysis is a useful method that can provide insight into trends in the literature, it is not without flaws. Only the WOS database was used in this study. Thus, publications that may be indexed in other databases, such as Scopus and Google Scholar, were not included in the list of this study. Also, self-citations, lectures and textbooks were not evaluated. A search was made by typing only the term "breast cancer" in the WOS search box. Other terms that may be related to breast cancer, such as "breast, breast neoplasm, breast surgery, etc.," were not searched. Another limitation was that the research area was examined according to the research categories determined by WOS. A more detailed investigation could not be made.

In conclusion, in this study, in which a bibliographic analysis of the 100 most cited articles in WOS on breast cancer was performed, it was observed that the number of citations increased by 1.6 times in the last 5 years. It was found that the most cited articles were published in high impact factor journals, especially the New England Journal of Medicine, most publications were from 2007, and the most cited articles were from the USA and Harvard University. Most studies focused on gene expression and chemotherapy. The result of this research may help to understand important studies on breast cancer and shed light on future studies.

References

1. Ghoncheh M, Pournamdar Z, Salehiniya H. Incidence and Mortality and Epidemiology of Breast Cancer in the World. Asian Pac J Cancer Prev 2016; 17: 43-46. (PMID: 27165206) [Crossref]

2. Lukong KE. Understanding breast cancer - The long and winding road. BBA Clin 2017; 7: 64-77. (PMID: 28194329) [Crossref]

3. Gonzalez-Angulo AM, Morales-Vasquez F, Hortobagyi GN. Overview of resistance to systemic therapy in patients with breast cancer. Adv Exp Med Biol 2007; 608: 1-22. (PMID: 17993229) [Crossref]

4. Alés-Martínez JE, Ruiz A, Chacón JI, Lluch Hernández A, Ramos M, Córdoba O, et al. Preventive treatments for breast cancer: recent developments. Clin Transl Oncol 2015; 17: 257-263. (PMID: 25445174) [Crossref]

5. Aksnes DW, Langfeldt L, Wouters P. Citations, citation indicators, and research quality: An overview of basic concepts and theories. Sage Open 2019; 9: 17. [Crossref]

6. Uysal E. Top 100 cited classic articles in breast cancer research. Eur J Breast Health 2017; 13: 129-137. (PMID: 28894852) [Crossref]

7. Web of Science: Science Citation Index Expanded. [cited 2022 Feb 19]. Available from: https://clarivate.com/webofsciencegroup/solutions/webofscience-scie/ [Crossref]

8. Celik E, Dokur M. The most cited articles on cancer immunotherapy: An update study. J BUON 2020; 25: 1178-1192. (PMID: 32521924)

9. Kazımoğlu H, Dokur M. The top 100 cited articles on urological emergencies: A bibliometric analysis. Turk J Urol 2018; 44: 239-250. (PMID: 29733798) [Crossref]

10. Ceylan SM. Top 100-Cited Articles in Tinnitus: A Bibliometric Analysis. Cyprus J Med Sci 2020; 5: 7-17. [Crossref]

11. Turhan VB, Ünsal A. Top 100 Cited Articles in Thyroid Cancer: A Bibliometric Analysis. Turk J Endocrinol Metab 2021; 25: 318-336. [Crossref]

12. Perou CM, Sørlie T, Eisen MB, van de Rijn M, Jeffrey SS, Rees CA, et al. Molecular portraits of human breast tumours. Nature 2000; 406: 747-752. (PMID: 10963602)[Crossref]

13. Slamon DJ, Clark GM, Wong SG, Levin WJ, Ullrich A, McGuire WL. Human breast cancer: correlation of relapse and survival with amplification of the HER-2/neu oncogene. Science 1987; 235: 177-182. (PMID: 3798106) [Crossref]

14. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, et al. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. J Natl Cancer Inst 1993; 85: 365-376. (PMID: 8433390) [Crossref]