

Review article

Three-Decade Quantitative Evaluation of Cancer-Related Research in Nigeria from 1990-2019

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SUMMARY

Introduction: There exists a knowledge gap in the quality and quantity of cancer-related research in Nigeria. This review gives a report on cancer research literature indexed in the Web of Science (WoS) in Nigeria from 1990 - 2019.

Materials and methods: The data used in the present study were published research papers retrieved from the Web of Science.

Results: A total of 629 research articles were published within this period across 276 journals. The highest number of articles was published in 2019 (n = 62), while the least was in 1992 (n = 2). However, the last ten years witnessed explosive growth, and it accounted for 63% of the total number of articles. The most relevant authors are Olapade HI (33 articles), Huo D (28 articles), and Ogundiran TO (21 articles). The most relevant sources in the area of cancer research in Nigeria are Nigerian Journal of Clinical Practice (52 articles), East African Medical Journal (23 articles), and African Health Sciences (21 articles). The most relevant author's affiliations are University of Ibadan (n=206), University of Nigeria, Nsukka (n = 115), and Obafemi Awolowo University (n = 105).

Conclusion: The results from this study show that Nigerian institutions need to collaborate extensively with foreign institutions and partner with industries in order to improve the quality of their research output.

Keywords: cancer research, Nigeria, bibliometric, quantitative analysis, collaboration network

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INTRODUCTION

Cancer is an uncontrolled growth of cells in the body (1). These unusual cells that can infiltrate normal body tissues are referred to as cancer or malignant or tumour cells (2). Cancer-causing risk factors include ionizing radiation; chemical compound, hormones; inherited genetic defects (3); and unhealthy lifestyle like excessive smoking and alcohol consumption (4). There are over 200 types of cancer which are majorly named base on the type of cell or their site in the body (5). For example, lung cancer, colorectal cancer, breast cancer, cervical cancer, prostate cancer, ovarian cancer, leukemia, brain tumor, lymphoma, and so on derived their names from the site in the body (6). Their signs and symptoms vary based on the type and stage; common symptoms include weight loss, pain, fatigue, persistent cough or voice change, fever, lumps, or tissue masses, skin changes, change in bowel or bladder function (7). Treatment protocols include chemotherapy, radiation therapy, surgery and immunotherapy. These interventions also vary according to the type and stage of cancer (8). Colorectal cancer control and preventive measures include reduced intake of fat-dense food, consistent physical activity, increased intake of high fibre diets, antioxidants and other micronutrients, moderate intake of alcohol, as well as a cessation of tobacco smoking (9). There is a need to study cancer incidence in hospitals, to do coordinated multi-institutional research and have access to critical cancer diagnostic tools and treatment facilities (10). Adetifa and Ojikutu (11) opined that literacy rate and occupation are important factors in the prevalence and trend of breast cancer.

There are about 12.7 million new cases of cancer globally with about 7.6 million deaths in 2008, as well as 8.8 million deaths in 2015, and it is predicted to keep increasing, with an estimate of 13.1 million deaths in 2030 (12 - 14). Its record as the second leading cause of death and increasing trends globally are worrisome. Globally, cancer-induced death holds a higher percentage than those caused by malaria, HIV/AIDS, and tuberculosis combined together (15). The increasing world cancer rate is attributed to a rapidly rising population, increased chemicalized food ingestion, ageing population, westernized lifestyle, and socioeconomic status (16). World cancer death rate is also relatively high due to inadequate cancer awareness, late laboratory tests/diagnosis, and lack of affordable cancer treatment centers (8).

However, the mortality rate is quite different in Africa. It was ranked as the 7th leading cause of death in Africa in 2004, with a projected annual cases of 1.28 million cases and an estimated 970,000 deaths by 2030 (16 - 17). This increase may be due to differences in the climate, diet, ageing, obesity, physical inactivity, and genetic factors (18). In Nigeria, according to Globocan report (19), 102,079 cases were recorded, with about 27,304 (26.7%) breast cancer, 14,089 (13.8%) cervix-uteri cancer, 12,047 (11.8%) liver cancer, and 11,944 (11.7%) prostate cancer cases (20). The Nigerian cancer burden rose to 115,950 new cases and 70,327 deaths in 2018. Report from cancer registries in Nigeria revealed high increase in breast cancer cases recently (21). Despite the incidence and mortality of cancer in Nigeria, which is now a national burden, the data available are largely and grossly inadequate. Scientific literature research has shown little or no details about the mortality rate owing to the increased incidence of cancer in Nigeria. An approach to lessen the elevated Nigerian cancer burden may be via improved scientific research efforts, improving cancer treatment facilities, and developing a research-derived treatment regime (22). Findings from cancer research studies are a veritable tool for creating awareness on the dangers of cancer burden, policy-making, and a reference material for future studies.

Bibliometric is the quantitative determination of scientific publications in an area of interest; it is one of the available methods used for appraising research publications (23). It reveals the count of journal articles and impact and multidisciplinary collaborative status. Bibliometric gives relevant information about the progress of scientific reports, the pattern, and diffusion of knowledge within a field (24). Several cancer types of research have been done in Nigeria. Quantitative evaluation is capable of giving clues to research patterns, recognizing research progress, and providing useful information to the various stake holders. To the best of our knowledge, no document in the literature has quantified the level of cancer research in Nigeria over a long term span, hence, this present study is aimed at evaluating the volume and quality of cancer research, categorizing cancer research by the affected organ; comparing cancer incidence to the cancer mortality rate in Nigeria, determining the pattern in author affiliations as well as institutional collaborations in Nigeria over the last 30 years (1990 to

2019) with a view of identifying and bridging the gaps in cancer research in Nigeria.

MATERIALS AND METHODS

Data retrieval and analysis

The data used in the present study were published research papers retrieved from Web of Science, hence, no ethical approval is required to collect data since the study did not use animal or human models. The Web of Science (SCI-Expanded) was explored for data collection according to Moodley et al. (25). We used the title search strategy with the following keywords: ("cancer" OR "neoplasm", tumour" OR "tumor" OR "carcinoma" OR "adeno-carcinoma" OR "leukemia" OR "leukaemia" OR "sarcoma" OR "lymphoma" OR "malignant" OR "oncology" OR "metastasis" OR "oncogene" OR "chemotherapy" OR "anticancer drugs" OR "malignant" OR "cancerous tumour"). We obtained about 1.486 documents including articles (873), letters (51), notes (8), data paper (3), meeting abstracts (406), editorial materials (29), corrections (6), early access (1), reviews (100), proceedings papers (25), book chapters (5). We observed that these documents were distributed in the Web of Science Index (Science Citation Index Expanded (683), Social Sciences Citation Index (63), Arts and Humanities Citation Index (1), Emerging Sources Citation Index (154), Index Chemicus (4). Our interest was to evaluate the cancer-related research and hence we excluded other document types and focussed only on research articles. Subsequently, we further validated the data manually to remove those articles, which were not needed in the present study and arrived at 629 articles which were further exported from WoS in a Bibtext format. Furthermore, the extracted data were imported into Rstudio (version 3.6.2) and analyzed accordingly as described by Orimoloye and Ololade (26). The data were analyzed for the annual scientific production, mean annual citation, most relevant authors, documents, institutions, countries, journals, and keywords.

RESULTS

Main information

The number of research articles published within the study period was 629 across 276 journals

indexed in the Web of Science. The average time from publication was found to be 10 years (Table 1). Research articles are published to disseminate discoveries,

Table 1. Summary of information retrieved on cancer-related research in Nigeria from 1990 – 2019

Description	Results
Main information about data	
Timespan	1990:2019
Sources (Journals, Books, etc)	276
Documents	629
Average years from publication	10
Average citations per documents	23.05
Average citations per year per doc	3.417
References	16,358
Document types	
Article	629
Document contents	
Keywords plus (ID)	1,731
Author's keywords (DE)	1,294
Authors	
Authors	4,375
Author appearances	5,925
Authors of single-authored documents	36
Authors of multi-authored documents	4,339
Authors collaboration	
Single-authored documents	44
Documents per author	0.144
Authors per document	6.96
Co-Authors per documents	9.42
Collaboration index	7.42

contribute to knowledge, protect intellectual properties, serve as a requirement for gaining promotion, apply for a grant, and confirm the existing facts. The survey research involves 4,375 participating authors with 0.144 articles/author (6.96 authors/article), 9.42 coauthors/articles, and a collaboration index of 7.42. This shows a high rate of collaboration and a large size of the research team involved in cancer research in Nigeria. Although there were 36 single-author documents, 4,339 authors engaged in multi-authored research efforts. The number of authors/articles reflects collaboration; it also reveals the role of each author and diffusion of knowledge from a more experienced researcher to early-career scientists. It may

also reflect the complexity of a given task and the heterogeneous/multidisciplinary composition of the team. Collaboration helps to gain access to equipment/reagents, funding, expertise and more problem-solving skills than a single researcher or institution can offer. There were about 16,358 references within this period. Research articles usually contain a reference section where the work of other researchers used in developing the current work are listed. The high number of references observed from the retrieved publications shows that there is a lot of work that has been done on cancer research within this survey period. Methodology, research background, and discussion adopted in particular research are usually adopted from previous works; the source is usually cited in the article and included in the reference list. This also lends credence to the fact that researchers in this field did not work in isolation, they consulted extensively and built on the work of early pioneers in the field. The reference list helps to provide interrelated articles that can be a great tool in understanding and expanding research activities in a field (27).

Annual publication and citation

Figure 1 reveals the annual publication and annual total citation per year. In 1990, 11 articles were published with a mean total citation per article of 4.818 and mean total citation per year of 0.161. The overall mean per article (average growth rate) was

19.25 ± 4.95 . The number of research articles on cancer-related research started with just 11 articles in 1990 and grew to about 629 articles in 2019. The last ten years have witnessed explosive growth in terms of the number of articles published, it accounted for 63% of the total number of articles in the 30 years. The publication growth pattern from 2014 - 2019 was linear. The highest number of articles was published in 2019 ($n = 62$), while the least was in 1992 ($n = 2$). This suggests that cancer-related research has been of a broad interest in the past 30 years. This may likely be due to increased cancer awareness over the years or possibly due to an increase in the number of cancer cases caused by lifestyle changes, diet, and embracement of technology with it accompanying side effects such as radiation, biological and chemical carcinogens. Owing to the pattern in this present result, it is projected that the number of cancer-related research will further increase in the future. The number of publications for a given year reflects the intensity of research activities in that year. The highest average citation per year was recorded in 2017 ($n = 17.66$), while the least was in 1990 ($n = 0.16$). An average of 23.05 citations per article was obtained during the survey period. The research study was conducted between 1990 - 2019 with an average total citation per year per article per year was 3.417. Citation reveals how relevant a document is, because other authors tend to cite articles with a meaningful impact on their work.

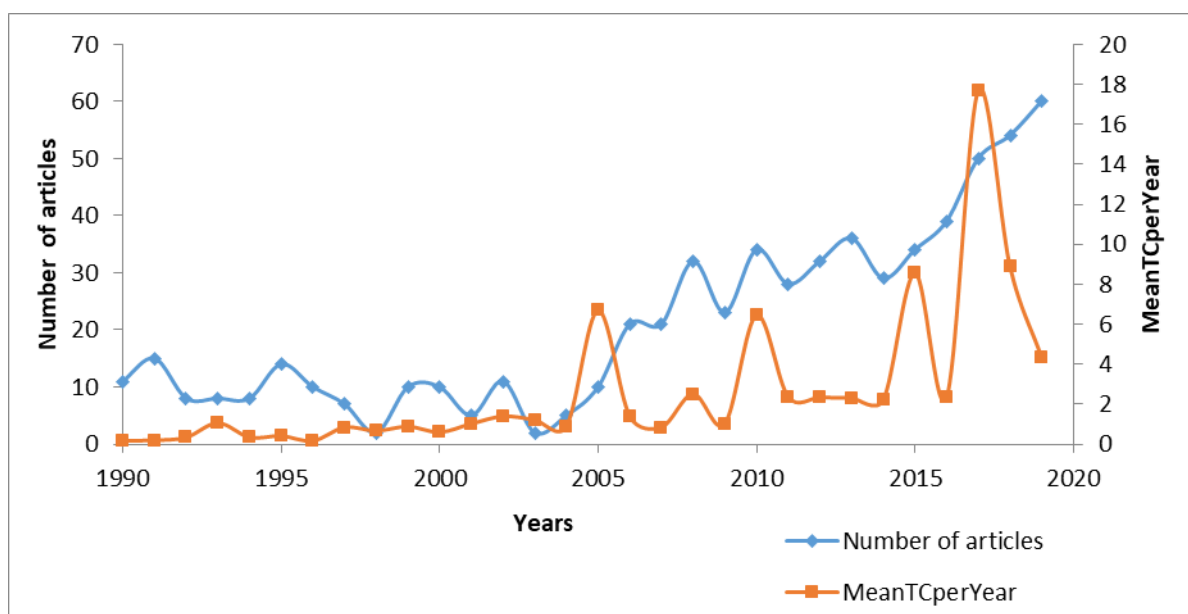


Figure 1. Annual production and mean total citation per year on cancer research in Nigeria from 1990 – 2019

It helps to connect the past to the present state; it also helps to prevent plagiarism and maintain academic integrity by serving as a means of according proper accolades to earlier works and researchers in the field (28). A good citation can help to back up a claim in an article through comparison with the works of others; it can also help to improve the quality of a research paper.

Authors

Figure 2a shows that the most relevant authors are Olapade HI (33 articles); Huo D (28 articles), and Ogundiran TO (21 articles). This shows they are the most prolific authors in terms of cancer research in Nigeria. The top three authors published a total of 82 articles between them. Figure 2b shows

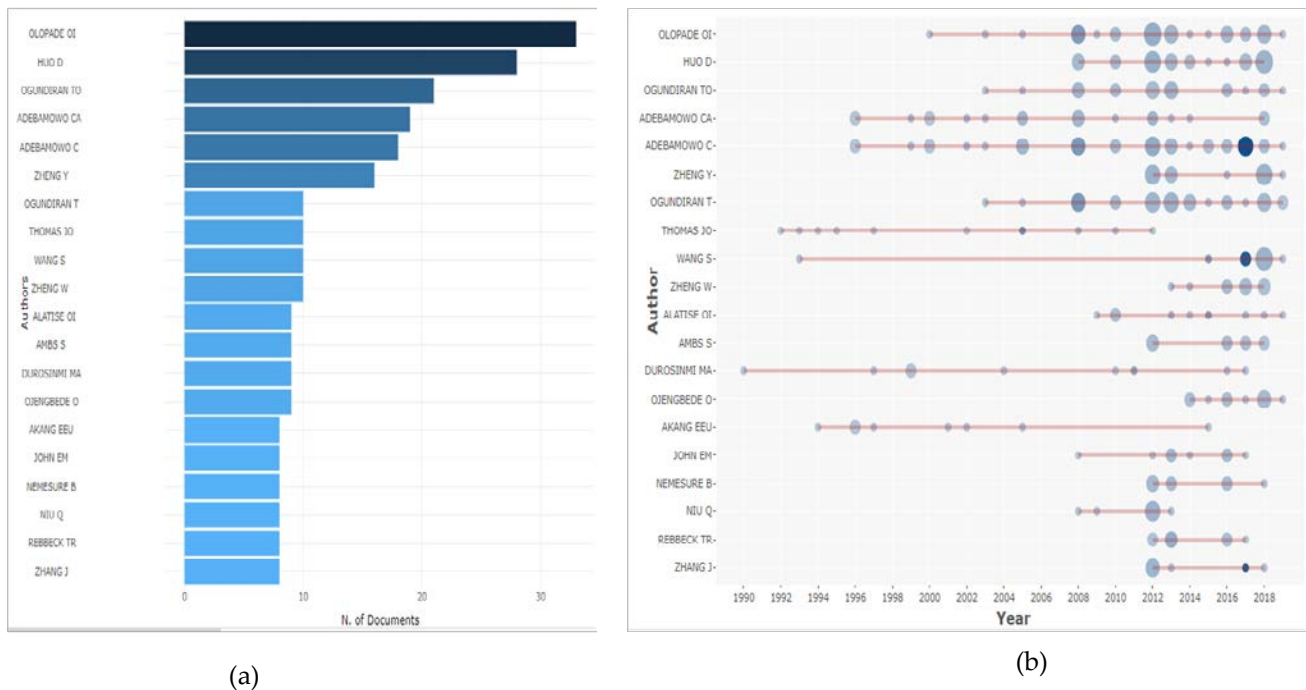


Figure 2. Author's productivity. (a) Most relevant authors (b) Top authors production over time on cancer research in Nigeria from 1990 – 2019

the top authors' productivity in cancer research in Nigeria. Olapade OI, Ogundiran TO, Adebamowo C, and Ogundiran C consistently published articles between 2004 - 2019. Adebamowo, C, Ogundiran C, Thomas JO, Durosinmi and Akang EEU are early producers on cancer research in Nigeria. The presence of bubbles on the line shows production, while the size of the bubble shows the level of production for a given year. Figure 3 shows the collaborative efforts of Nigerian authors with international counterparts on cancer-related studies. Olagunju AT is the Nigerian researcher with the most collaborative network on cancer research. His major collaborators are Moosavi M, Radfar A, Mokdad AH, Rawaf DI, Manafi N, Shirkoohi R, Pereira DM, Moosavi M, Murray CJL, Meles HG, Rabiee N, Khader YS and

Rezapour A. The authors with the most impactful contributions are Olapade, OI (h index = 17, g index = 33, m index = 0.81), Adebamowo, CA (h index = 15, g index = 19, m index = 0.6) and Huo, D (h index = 14, g index = 24, m index = 1.077) (Table 2). Olapade, though based in the United Kingdom, contributed significantly to oncology and breast cancer research in Nigeria (29). Olapade's dominance in the field of cancer research in Nigeria is not only in terms of his number of publications (articles), but also in terms of citations of his work; the volume of his publications and high impact metrics might be due to his access to facilities, funding, quality of his research work, high motivation, early exploit in the field, strong collaboration network and publication of his research findings in journals with high visibility when com-

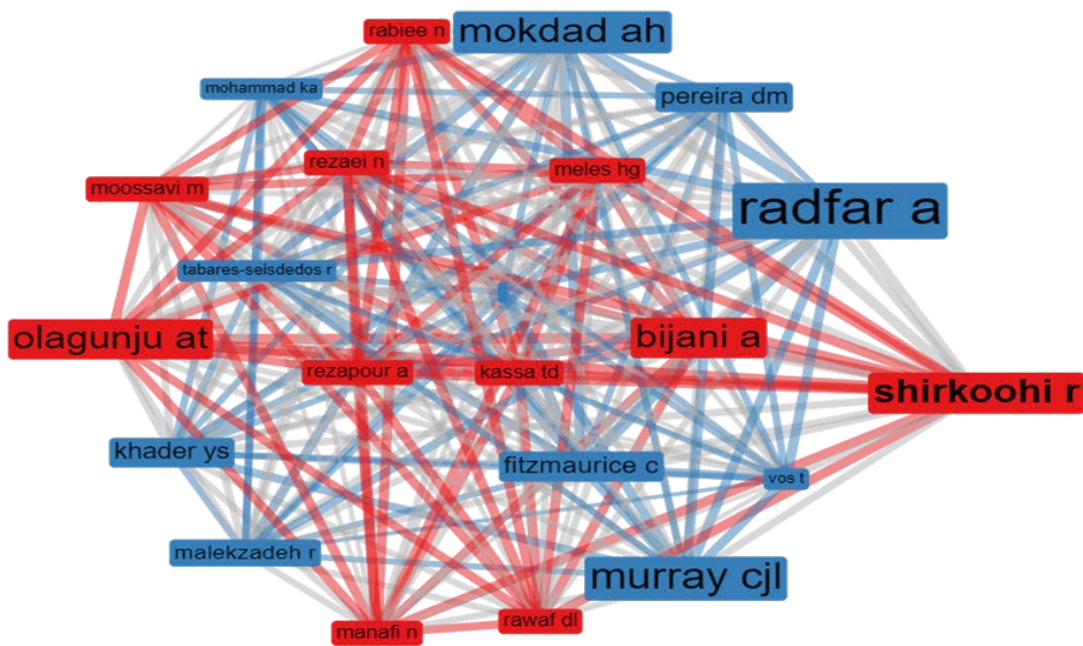


Figure 3. Authors' collaboration network on cancer research in Nigeria from 1990 – 2019

Table 2. Author's impact on cancer research in Nigeria from 1990 – 2019

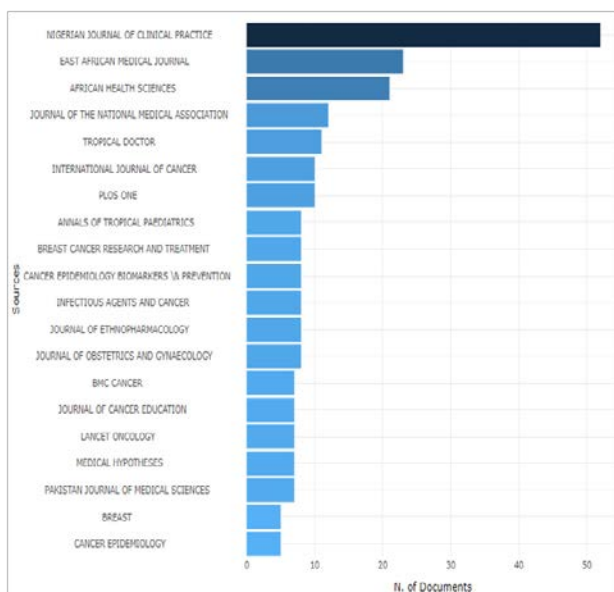
Author	h_index	g_index	m_index	TC	NP	PY_start
OLOPADE OI	17	33	0.81	1102	33	2000
HUO D	14	24	1.07	599	28	2008
OGUNDIRAN TO	14	1	0.77	548	21	2003
ADEBAMOWO CA	15	19	0.60	864	19	1996
ADEBAMOWO C	11	18	0.68	1050	18	2005
ZHENG Y	10	16	1.11	276	16	2012
OGUNDIRAN T	7	10	0.53	497	10	2008
THOMAS JO	5	10	0.17	884	10	1992
WANG S	5	10	0.83	236	10	2015
ZHENG W	6	10	0.75	152	10	2013
ALATISE OI	7	9	0.58	378	9	2009
AMBS S	6	9	0.66	136	9	2012
DUROSINMI MA	5	9	0.16	303	9	1990
OJENGBEDE O	6	9	0.85	88	9	2014
AKANG EEU	6	8	0.22	94	8	1994
JOHN EM	7	8	0.53	164	8	2008
NEMESURE B	7	8	0.77	191	8	2012
NIU Q	7	8	0.53	187	8	2008
REBBECK TR	7	8	0.77	224	8	2012
ZHANG J	7	7	0.77	544	7	2012

pared to his peers that are based in Nigeria. Nigeria’s researchers are usually faced with lack of funding as the government only budget 6.7% of its budget on education compared to 25% that was recommended by UNESCO. More so, the large chunk of the education’s budget goes to recurrent expenditure such as payment of salary with only a little that goes into funding of tertiary education (30). The creation of Tertiary Education Trust Fund (TETFUND) meant to cushion the effect of funding of tertiary education could not help fill the research gap as allocation from TETFUND predominantly goes into execution of capital projects, establishment of more universities and other non-research activities. The little amount set for research grants still remain inaccessible to most researchers as stringent conditions are set to access these funds and only little percentage of Nigeria researchers could access these funds yearly. Furthermore, lack of partnership between the universities/research institutions and industries has not helped to attract funds into the universities. Most multinational companies in Nigeria prefer to out-source their research needs to institutions where the headquarters of such companies are domiciled. Private sectors in Nigeria tend to lack interest in funding research; they prefer to fund realities TV shows and other programs that will bring more

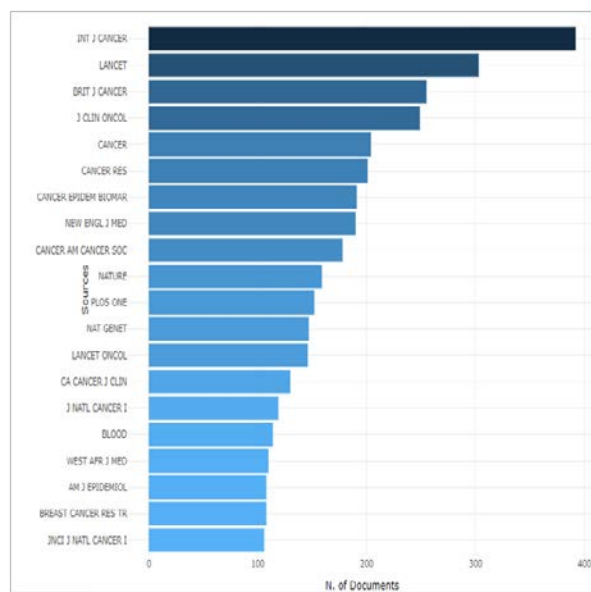
awareness to their brands than on funding scientific research. Lack of access to equipment, fund and reagents is a limiting factor for the research of cancer in Nigeria.

Distribution of sources/journals

The 629 articles on cancer research in Nigeria were published across 276 journals (Table 1). Figure 4a shows the most relevant sources in the area of cancer research in Nigeria. Nigerian Journal of Clinical Practice ranked first with 52 articles, followed by East African Medical Journal (23 articles) and African Health Sciences (21 articles). This shows that most Nigeria researchers working on cancer published their research findings in Nigerian and African Journals with a specialty in Health and medical sciences. The most locally cited sources are International Journal of Cancer (n = 392), Lancet (303), and British Journal of Cancer (n = 255) (Figure 4b). The local citation refers to the number of times that articles in the same collection are cited by other documents in the same collection. The data on most relevant and most local cited sources showed that most of the Nigerian researchers do not publish in international and journals with high impact factors; this can affect their visibility/circulation, citation, con-



(a)



(b)

Figure 4. Sources (a) Most relevant sources (b) Most local cited sources on cancer research in Nigeria from 1990 – 2019

Table 3. Sources impact on cancer research in Nigeria from 1990 – 2019

Source	h_index	g_index	m_index	TC	NP	PY_start
NIGERIAN JOURNAL OF CLINICAL PRACTICE	7	11	0.53	206	52	2008
EAST AFRICAN MEDICAL JOURNAL	5	7	0.17	82	23	1992
AFRICAN HEALTH SCIENCES	8	11	0.61	158	21	2008
JOURNAL OF THE NATIONAL MEDICAL ASSOCIATION	7	12	0.23	200	12	1991
TROPICAL DOCTOR	4	7	0.13	61	11	1991
INTERNATIONAL JOURNAL OF CANCER	8	10	0.28	365	10	1993
PLOS ONE	7	10	0.77	123	10	2012
ANNALS OF TROPICAL PAEDIATRICS	4	7	0.13	52	8	1990
BREAST CANCER RESEARCH AND TREATMENT	8	8	0.50	171	8	2005
CANCER EPIDEMIOLOGY BIOMARKERS \& PREVENTION	4	8	0.36	71	8	2010
INFECTIOUS AGENTS AND CANCER	5	8	0.71	68	8	2014
JOURNAL OF ETHNOPHARMACOLOGY	6	8	0.22	196	8	1994
JOURNAL OF OBSTETRICS AND GYNAECOLOGY	5	8	0.35	69	8	2007
BMC CANCER	6	7	0.40	172	7	2006
JOURNAL OF CANCER EDUCATION	3	7	0.27	49	7	2010
LANCET ONCOLOGY	7	7	0.63	1767	7	2010
MEDICAL HYPOTHESES	3	4	0.10	22	7	1990
PAKISTAN JOURNAL OF MEDICAL SCIENCES	2	2	0.14	10	7	2007
BREAST	4	5	0.15	161	5	1995
CANCER EPIDEMIOLOGY	4	5	0.44	139	5	2012

sideration for funding, exclusion of their research work from a database of international bibliographies and influence of their research on a global scale. International collaboration can help Nigeria researchers to publish their work in journals with broader visibility and high impact factors. The most impactful sources used on cancer research in Nigeria are African Health Science (h index = 8; g index = 11, m index = 0.615), Nigeria Journal of Clinical Practice (h index = 7; g index = 11, m index = 0.538), and International Journal of Cancer (h index = 8; g index = 10, m index = 0.286) (Table 3). It is often held that the most important articles are not always published in the most productive/relevant journals, therefore, dominance of the journal in terms of their impact factors and other metrics are often considered (31). The most impactful journals in this study indicate that these journals are not only highly-rated cancer research publishing houses, but the articles from those journals were useful for Nigeria researchers working on cancer studies (32 - 33). Researchers usually consider impact factors when considering where to publish their work. The high impact factor by a journal implies that collection of articles in that jour-

nals are frequently cited by others over the years. This may occur because such articles are of immense benefit to other researchers in that field (34).

AFFILIATIONS AND COLLABORATIONS

Table 4 shows the most relevant author's affiliations in cancer research in Nigeria. University of Ibadan had the highest number of articles (n = 206), followed by University of Nigeria, Nsukka with 115 articles and Obafemi Awolowo University with 105 articles. It is not surprising to see University of Ibadan as the most productive institution because it is the highest ranked Nigeria University and it is well known for her giant strides in medical science. All the top four universities in terms of productivity in this research are also among the top five rated Nigeria Universities according to the Times Higher Education and other ranking bodies. This further lend credence to the research capabilities and quality of researchers in these universities.

Figure 5 reveals that University of Ibadan and University of Lagos are the Nigerian institutions with the most extensive research collaborations on

cancer research. University of Ibadan’s main collaborators are University of Washington, USA; University of Valencia, Spain; University of Manitoba, Canada and John Hopkins University, USA. Univer-

sity of Lagos main collaborators are University of Washington, USA; University of Tehran Medical Science, Iran, University of Washington, USA; University of Alabama, Birmingham, USA; Duy Tan University, Vietnam and Babol University of Medical Science, Iran. Nigeria’s major collaborators are USA, United Kingdom, Spain, Australia, France, Russia, Germany, China, India, Pakistan, Ghana, and Ethiopia (Figure 6). The extent of collaboration was shown by the thickness and the proximity of the lines connecting them and also by the size of the nodes. A lot of Nigeria institutions are not collaborating with foreign institutions in cancer research; this can have a great impact on research productivity, knowledge/skill transfer, access to research facilities, funding, and economic activities in Nigeria. A high level of intra-national and international collaboration with other institutions against independent studies can help enhance research visibility and citation frequency (35 - 38).

Table 4. Most relevant affiliations on cancer research in Nigeria from 1990 – 2019

Affiliations	Articles
UNIV IBADAN	328
UNIV NIGERIA	115
OBAFEMI AWOLowo UNIV	106
UNIV LAGOS	82
UNIV ILORIN	57
UNIV BENIN	53
AHMADU BELLO UNIV	48
OLABISI ONABANJO UNIV	47
UNIV JOS	38
UNIV PORT HARCOURT	29

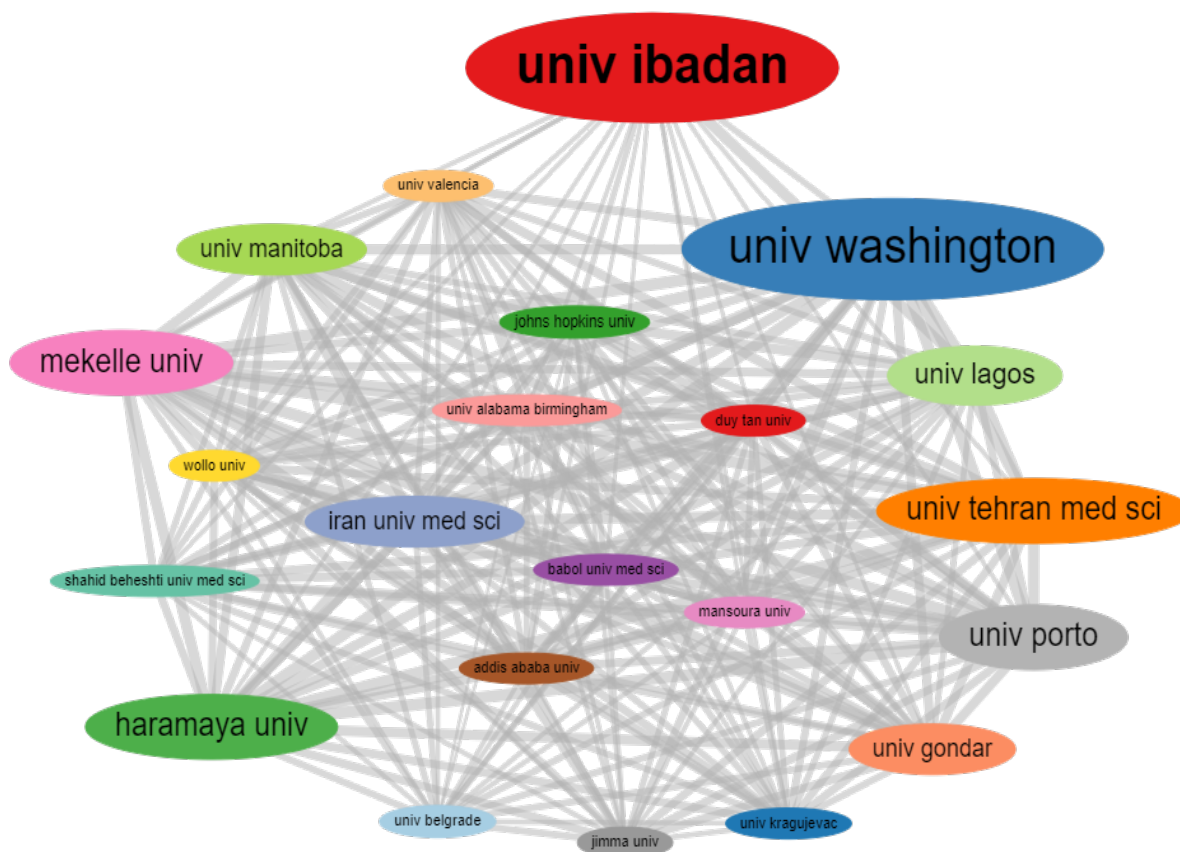


Figure 5. Institutions’ collaboration network on cancer research in Nigeria from 1990 – 2019

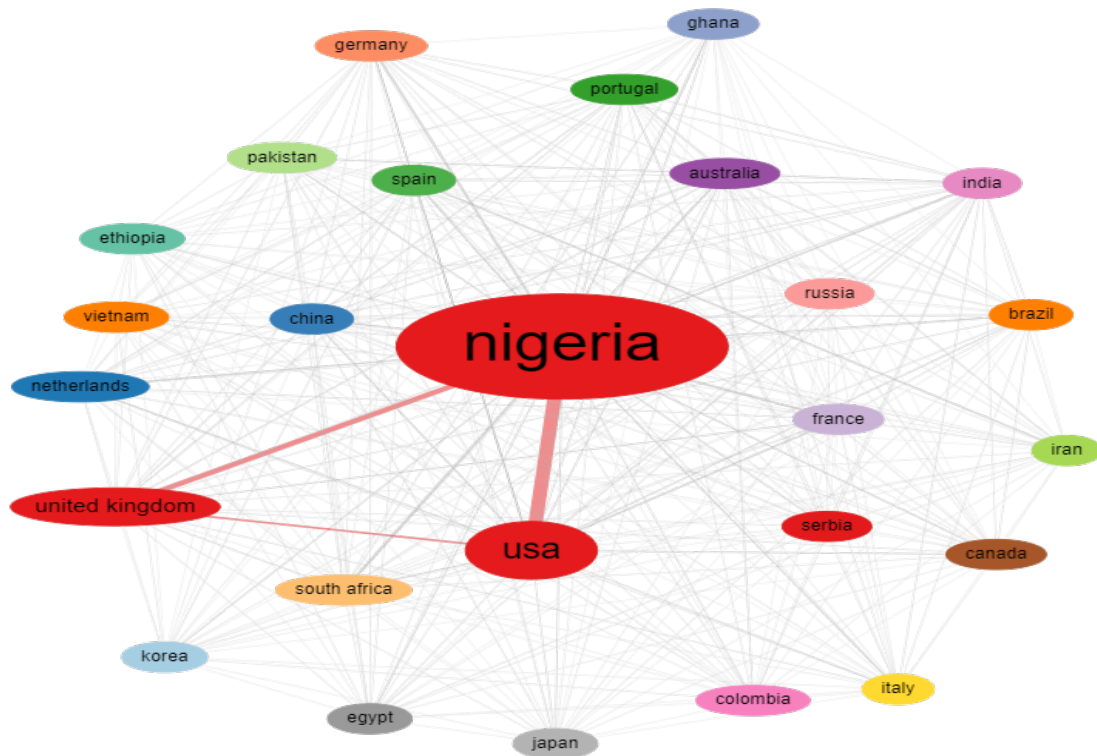


Figure 6. Countries collaborating with Nigeria on cancer research in Nigeria from 1990 – 2019

KEYWORD ANALYSES

There are about 1,294 author’s keywords and 1,731 keywords plus (Table 1). Author’s keywords are words usually written by authors in the abstract section of articles submitted for publication. They represent important words that are essential to the research under investigation. Keywords plus are important words that are frequently used in the entire documents. Table 5 shows the most frequently used author’s keywords and keywords plus. The most frequently used author’s keywords are Nigeria (n = 66), breast cancer (n = 56), cancer (n = 48), cervical cancer (n = 31), prostate cancer (n = 25), chemotherapy (n = 18) and screening (n = 16). It is not surprising seeing Nigeria occurring frequently because the researches considered in this study involve Nigeria. Breast and cervical cancer are the most prevalent forms of cancer especially amongst women, while research on prostate cancer is one of the most prevalent for men (24). Chemotherapy is usually applied to cancer patients by using a chemical drug (s) to destroy the growing cancer cells, reduce metastasis, shrink tumour size, and reduce cancer

symptoms. It can be used alone or in combination with other therapies such as radiation, hormones, or surgery depending on the stage and type of cancer. Treatment can also be dependent on the age of the patient, response to initial treatment, location of the cancer cells, the overall health of the patient, and his or her treatment preference. However, chemotherapy has some of its side effects such as mouth sores, loss of appetite, hair loss, weight loss, pain, anaemia, constipation, etc. This side effect could include damage to nerves, kidney, lungs, heart, and reproductive organs (39 - 41). Screening helps to identify specific types of cancer before signs and symptoms start manifesting. Early screening can help to discover cancer at a more treatable stage thereby enhancing survival by preventing death or reduce death cases associated with cancer. The type of screening depends on the type of cancer; for instance, mammography, clinical self-examination, breast self-examination, and magnetic resonance imaging are used for screening breast cancer, while human papillomavirus (HPV) and pap test are used cervical cancer screening; colonoscopy, sigmoidoscopy, faecal occult blood test, stool DNA tests, and double-contrast bar-

Table 5. Author's keywords

Rank	Author's keywords	Occurrences	Keywords plus	Occurrences
1	Nigeria	66	Women	49
2	Breast cancer	56	Risk	46
3	Cancer	48	Cancer	44
4	Cervical cancer	31	Carcinoma	39
5	Prostate cancer	25	Survival	33
6	Chemotherapy	18	Therapy	27
7	Screening	16	Risk factors	23
8	Africa	15	Expression	22
9	Apoptosis	14	Epidemiology	21
10	Hepatocellular carcinoma	12	Population	21
11	Prognosis	10	Chemotherapy	19
12	Survival	10	Infection	18
13	Cytotoxicity	9	Mortality	18
14	Awareness	8	Prevalence	18
15	Breast	8	Diagnosis	17
16	Carcinoma	8	Prevention	17
17	HIV	8	Cells	16
18	Human papillomavirus	8	Children	16
19	Sub-Saharan Africa	8	Stage	16
20	Hepatitis B virus	7	Trends	15

ium enema are used for screening colorectal cancer; digital rectal examination and prostate-specific antigen is used for screening prostate cancer. However, there are risks associated with screening such as overdiagnosis, false positives, and false reassurance (42 - 44). The most frequent keywords plus in cancer research in Nigeria from 1990 - 2019 are women (n = 49), risk (n = 46), cancer (n = 44), carcinoma (n = 39). Women occur more frequently probably due to the high prevalence of cancer linked to them in Nigeria and the intensity of research involving women related types of cancer. Keywords in this present study may also signify rich search words on the subject matter; they also help to give an idea of the general content and focus of an article (33).

STUDY LIMITATION AND CONCLUSIONS

Limitations

The use of Web of Science Index (Science Citation Index Expanded) [WoSSCIE] limits the anal-

ysis; documents indexed in other databases such as PubMed, Embase, EBSCO host, AJOL, J-Gate and Scopus were not considered. Consequently, some influential articles on cancer research may have been omitted. However, WoSSCIE database is the most used database for medical-related bibliometric analysis. Also, articles not written in English language were not considered; this may have resulted in incomplete coverage of articles published on cancer.

This is not a serious issue as only a few articles were published in other languages.

Conclusions

To the best of our knowledge, this is the first study in Nigeria that used bibliometric analysis to summarize publication trends and development of cancer research for 30 years based on articles retrieved from WoS SCI-Expanded. The study revealed that there was significant output in cancer research

over the years with unprecedented rate obtained in the last five years. Olopade, OI was the most relevant and the most impactful author, while University of Ibadan had the highest number of authors affiliated to it. This study revealed that most of the articles were published in local journals and there was little collaboration with international researchers. Research output on cancer from institutions in Nigeria can be increased if there can be improved funding by the government and private sectors. This research work has provided valuable information in narrowing the knowledge gap in cancer-related researches in Nigeria.

DECLARATIONS

Author contribution statement

Okaiyeto Kunle, Adams Moses Dele and Adeoye Raphael conceptualized the study; Adams Moses Dele and Adeoye Raphael wrote the first draft of the manuscript. Okaiyeto Kunle supervised the study; all the authors proofread and approved read the manuscript for submission.

Competing interest statement

The authors declare no conflict of interest.

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Received: July 31, 2021

Revised: December 23, 2021

Accepted: January 24, 2022

Online first: June 14, 2022

Tri decenije kvantitavne procene istraživanja karcinoma u Nigeriji u periodu od 1990. do 2019. godine

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SAŽETAK

Uvod. Nema dovoljno saznanja o kvalitetu i kvantitetu istraživanja karcinoma u Nigeriji. Ovaj pregledni rad daje izveštaj o literaturi iz oblasti istraživanja karcinoma, indeksiranoj na sajtu Web of Science (WoS), u Nigeriji, u periodu od 1990. do 2019. godine.

Materijal i metode. Podaci korišćeni u ovoj studiji objavljeni su u istraživačkim radovima pronađenim na sajtu Web of Science (WoS)

Rezultati. U ovom periodu, objavljeno je ukupno 629 istraživačkih radova u 276 časopisa. Najviše radova objavljeno je 2019. godine (n = 62), a najmanje 1992. godine (n = 2). Međutim, u poslednjih deset godina beleži se eksplozivni porast, što čini 63% od ukupnog broja objavljenih radova. Najrelevantniji autori su *Olapade HI* (33 rada), *Huo D* (28 radova) i *Ogundiran TO* (21 rad). Najrelevantniji izvori u oblasti istraživanja karcinoma u Nigeriji su *Nigerian Journal of Clinical Practice* (52 rada), *East African Medical Journal* (23 rada) i *African Health Sciences* (21 rad). Najrelevantnije institucije na kojima su autori zaposleni su Univerzitet u Ibadenu (n = 206), Univerzitet u Nigeriji, Nsukka (n = 115), kao i Univerzitet *Obafemi Awolowo* (n = 105).

Zaključak. Rezultati ove studije pokazuju da bi institucije u Nigeriji trebalo intenzivnije da sarađuju sa stranim institucijama i budu partneri sa određenim industrijskim granama kako bi poboljšale kvalitet svojih istraživačkih studija.

Ključne reči: istraživanje karcinoma, Nigerija, bibliometrijski, kvantitavne analize, mreža saradnje